Clean Water Act §319(h) Nonpoint Source Grant Program

Water Quality and Pollutant Loading Assessment in the Angelina River above Sam Rayburn Watershed

TSSWCB Project # 16-13

Quality Assurance Project Plan

Texas State Soil and Water Conservation Board

Revision #3

prepared by

Texas A&M AgriLife Research
Texas Water Resources Institute

Angelina & Neches River Authority

Effective Period: Upon EPA approval through December 31, 2021

Questions concerning this quality assurance project plan should be directed to:

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Section A1: Approval Sheet

Quality Assurance Project Plan (QAPP) for the *Water Quality and Pollutant Loading Assessment in the Angelina River above Sam Rayburn Watershed*

United States Environmental Protection Agency (USEPA), Region VI

Name: Nelly Smith
Title: USEPA Chief State/Tribal Programs Section

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Texas A&M AgriLife Research – Texas Water Resources Institute (TWRI)

Name: Lucas Gregory
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Name: Anna Gitter
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Name: Ed Rhodes
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Angelina & Neches River Authority (ANRA)

Name: Carla Ethridge
Title: ANRA PM

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Name: Kelley Holcomb
Title: Acting ANRA Lab Manager (LM)

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Name: Melissa Garcia
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Name: Jeremiah Poling
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Lower Colorado River Authority (LCRA) Environmental Laboratory Services (ELS)

Name: Dale Jurecka
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Name: Angel Mata
Title: LCRA ELS Quality Assurance Coordinator (QAC)

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Section A2: Table of Contents

Section: Title

List of Acronyms and Abbreviations

ANRA	Angelina & Neches River Authority
AWRL	Ambient Water Reporting Limits
BAEN	Department of Biological and Agricultural Engineering
BMP	best management practice
CAR	corrective action report
CMS	coordinated monitoring schedule
COC	chain of custody
CRP	Clean Rivers Program
CWA	Clean Water Act
DM	Data Manager
DMRG	data management reference guide
DO	dissolved oxygen
DQO	data quality objectives
ELS	Environmental Laboratory Services
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LIMS	laboratory information management system
LM	Laboratory Manager
LCRA	Lower Colorado River Authority
LOD	limit of detection
LOQ	limit of quantitation
NELAP	National Environmental Laboratory Accreditation Program
NWS	National Weather Service
OSSF	onsite sewage facility
PM	Project Manager
PO	Project Officer
QA	quality assurance
QAC	Quality Assurance Coordinator
QAPP	quality assurance project plan
QAO	Quality Assurance Officer
QC	quality control
QM	quality manual
QPR	quarterly progress report
RPD	relative percent difference
SOP	standard operating procedure
SSL	Spatial Sciences Laboratory
SWCD	Soil and Water Conservation District
SWQM	surface water quality monitoring
SWQMIS	Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TCEQ SOP, V1	TCEQ’s Surface Water Quality Monitoring Procedures, Volume 1
TSSWCB	Texas State Soil and Water Conservation Board
TWRI	Texas AgriLife Research, Texas Water Resources Institute
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WPP	watershed protection plan
%R	percent recovery

Section A3: Distribution List

Organizations, and individuals within, which will receive copies of the approved QAPP and any subsequent revisions include:

United States Environmental Protection Agency, Region VI

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Name: Jeremiah Poling
Title: ANRA DM

Lower Colorado River Authority Environmental Laboratory Services

3505 Montopolis
Austin, TX 78744

Name: Dale Jurecka
Title: LCRA ELS PM/LM

Name: Angel Mata
Title: LCRA ELS QAC

Section A4: Project/Task Organization

The following is a list of individuals and organizations participating in the project with their specific roles and responsibilities:

USEPA – United States Environmental Protection Agency, Region VI. Provides project oversight and funding at the federal level.

Anthony Suttice, USEPA Texas Nonpoint Source Project Officer
Responsible for overall performance and direction of the project at the federal level. Ensures that the project assists in achieving the goals of the Clean Water Act (CWA). Reviews and approves the QAPP, project progress, and deliverables.

TSSWCB – Texas State Soil and Water Conservation Board, Temple, Texas. Provides project overview at the State level.

Liza Parker, TSSWCB PM
Responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. Provides the primary point of contact between TSSWCB and TWRI. Tracks and reviews deliverables to ensure that tasks in the work plan are completed as specified. Reviews and approves QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TSSWCB participants. Notifies TSSWCB QAO of any project non-conformances or corrective actions reported or taken by TWRI.

Mitch Conine, TSSWCB QAO
Reviews and approves QAPP and any amendments or revisions. Responsible for verifying that the QAPP is followed by project participants. Monitors implementation of corrective actions. Coordinates or conducts audits of field and laboratory systems and procedures. Determines that the project meets the requirements for planning, quality assessment (QA), quality control (QC), and reporting under the TSSWCB Nonpoint Source Management Program.

TWRI – Texas Water Resources Institute, College Station, Texas. Responsible for general project oversight, coordination and administration, project reporting, collection of a portion of water quality data, data assessment, Load Duration Curve (LDC) development, stakeholder facilitation, WPP development, development of data quality objectives (DQOs) and QAPP development.

Lucas Gregory, TWRI; Project Lead & QAO
Responsible for determining that the QAPP meets the requirements for planning, QA and QC. Conducts audits of field and laboratory systems and procedures. Responsible for maintaining the official, approved QAPP, as well as conducting quality assurance audits in conjunction with TSSWCB personnel. Also responsible for supporting the development and ensuring the timely delivery of project deliverables, ensuring

cooperation between project partners, providing fiscal oversight and completing project reporting.

Anna Gitter, TWRI; PM

The TWRI Project Manager is responsible for ensuring that tasks and other requirements in the contract are executed on time and with the QA/QC requirements in the system as defined by the contract and in the project QAPP; assessing the quality of subcontractor/participant work; and submitting accurate and timely deliverables to the TSSWCB PM.

Ed Rhodes, TWRI; Field Supervisor & Data Manager

Responsible for supervising all aspects of the sampling and measurement of surface waters and other field parameters. Responsible for the collection of water samples and field data measurements in a timely manner that meet the quality objectives specified in Section A7 (Table A7.1), as well as the requirements of Sections B1 through B8. Responsible for field scheduling, staffing, and ensuring that staff is appropriately trained. Reports status, problems, and progress to TWRI PM.

Responsible for acquisition, verification, and transfer of data to the TSSWCB PM. Oversees data management for the project. Performs data quality assurances prior to transfer of data to the Texas Commission on Environmental Quality (TCEQ) in the format specified in the most recent version of the Surface Water Quality Monitoring (SWQM) Data Management Reference Guide (DMRG). Ensures that the data review checklist is completed and data is submitted with appropriate codes. Provides the point of contact for the TSSWCB PM to resolve issues related to the data and assumes responsibility for the correction of any data errors.

ANRA – Angelina Neches River Authority, Lufkin, Texas. Responsible for conducting portion of water quality monitoring and laboratory analysis; data assimilation and data submission to TCEQ's Surface Water Quality Monitoring Information System (SWQMIS) Database; provide assistance for stakeholder relations and public outreach; preparation of task reports and assistance in preparation of the final report.

Carla Ethridge, ANRA PM

Responsible for ensuring that project tasks, deliverables and requirements are met on time and as described. Monitors and assesses the quality of work. Coordinates attendance at conference calls, training, meetings, and related project activities with the TWRI. Responsible for verifying the QAPP is followed and the project is producing data of known and acceptable quality. Ensures adequate training and supervision of all monitoring and data collection activities. Complies with corrective action requirements.

Melissa Garcia, ANRA QAO

Responsible for coordinating development and implementation of the QA program. Responsible for contributing to the development of the QAPP. Responsible for identifying, receiving, and maintaining project quality assurance records. Responsible for coordinating

with the TWRI QAO and TSSWCB QAO to resolve QA- related issues as appropriate. Notifies the TWRI PM of particular circumstances which may adversely affect the quality of data. Responsible for validation and verification of all data collected according to procedures described in the QAPP after each task is performed. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Conducts laboratory inspections. Develops, facilitates, and conducts monitoring systems audits. Responsible for coordinating the scheduling and collection of water samples.

Kelley Holcomb, Acting ANRA LM

Responsible for coordinating the receipt of water samples and performing required analytical analysis on all samples received. Also responsible for assimilating and storing environmental water quality data in a form such that it is prepared for delivery to TCEQ. This includes ensuring that laboratory personnel involved in processing environmental samples have adequate training and thorough knowledge of the QAPP and its requirements specific to the analysis performed.

Jeremiah Poling, ANRA DM

Responsible for the acquisition, verification, and transfer of data to the TCEQ. Oversees data management for the study. Performs data quality assurances prior to transfer of data to TCEQ. Responsible for transferring data to the TCEQ in the Event/Result file format specified in the TCEQ *Surface Water Quality Data Management Reference Guide* (DMRG) (TCEQ 2015). Ensures data are submitted according to work plan specifications. Provides the point of contact for the TCEQ Data Manager to resolve issues related to the data.

LCRA ELS-Lower Colorado River Authority, Austin, Texas. Responsible for analyses performed by LCRA ELS for ANRA in the event that ANRA cannot complete analysis as planned.

Dale Jurecka, LCRA ELS PM/LM

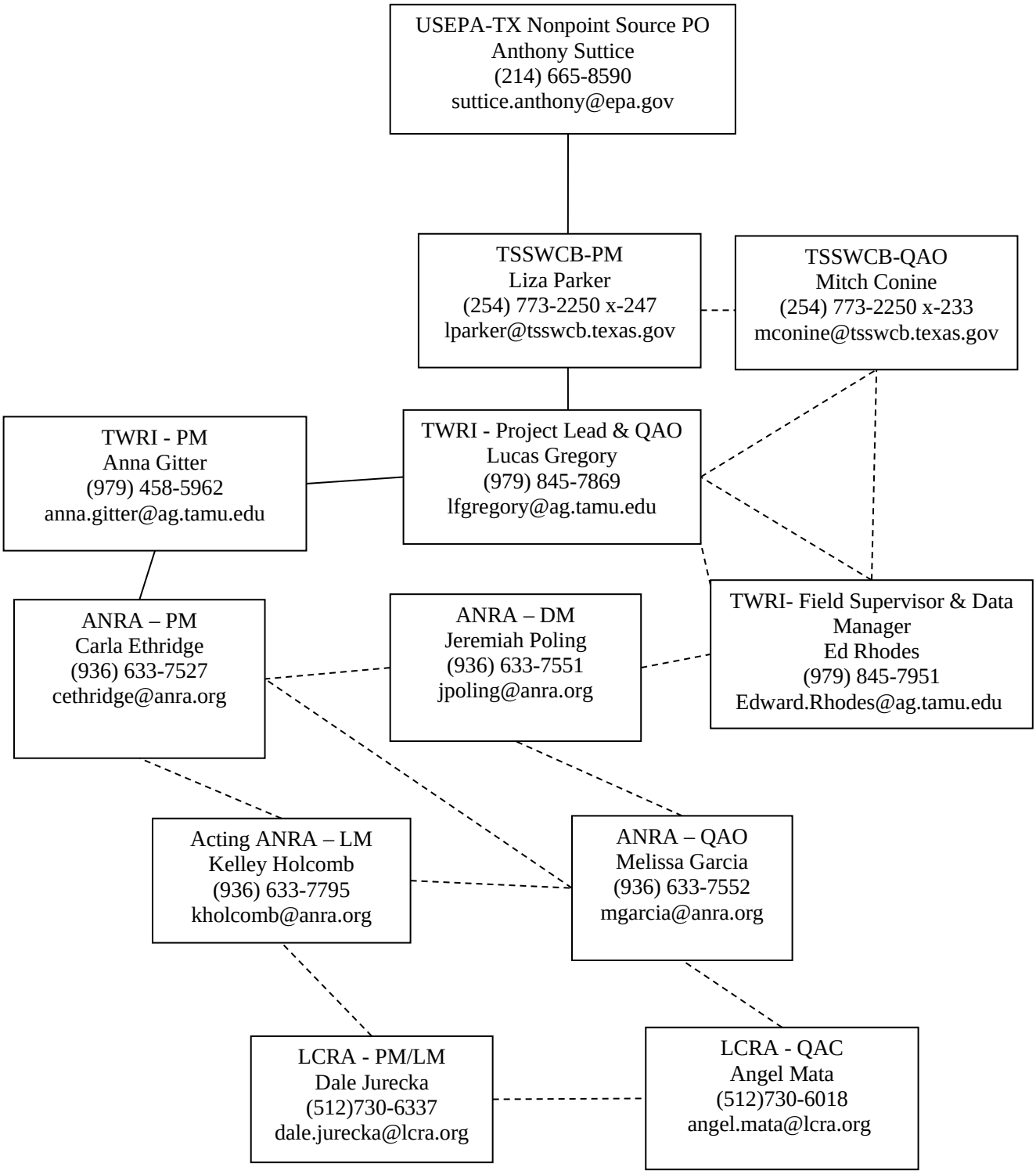
Responsible for overall performance, administration, and reporting of analyses performed by LCRA's Environmental Laboratory Services. Responsible for supervision of laboratory personnel involved in generating analytical data for the project. Ensures that laboratory personnel have adequate training and a thorough knowledge of the QAPP and related SOPs. Responsible for oversight of all laboratory operations ensuring that all QA/QC requirements are met, documentation is complete and adequately maintained, and results are reported accurately. Responsible for analyses performed by LCRA ELS for ANRA. Responsible for project set up in LIMS. Makes ELS data available to the ANRA PM. Notifies ANRA of laboratory analysis issues that may invalidate data. Reviews and verifies all laboratory data for integrity and continuity, reasonableness and conformance to project requirements, and then validates the data against the measurement performance specifications listed in Tables A7.1 and A7.2 of the QAPP.

Angel Mata, LCRA ELS QAC

Responsible for the overall quality control and quality assurance of analyses performed by LCRA's ELS. Monitors the implementation of the QM/QAPP within the laboratory to ensure complete compliance with QA data quality objectives, as defined by the

contract and in the QAPP. Conducts in-house audits to ensure compliance with written SOPs and to identify potential problems. Responsible for supervising and verifying all aspects of the QA/QC in the laboratory.

Figure A.4.1. Project Organization Chart



Section A5: Problem Definition/Background

The Angelina River above Sam Rayburn Reservoir rises in rural Rusk County and flows 104 miles in a southerly direction. The river sub-basin encompasses portions of Angelina, Cherokee, Nacogdoches, Rusk and Smith counties. This covers approximately 1,048,568 acres or 1,638 square miles. Hydrologic unit codes 120200040101-0106; 0201-0207; 0301-0305; 0401-0405; 0501-0506; 0601-0604; 0701-0705 are included in this area. Cities within this area include Arp, Cushing, Gallatin, Henderson, Jacksonville, Mount Enterprise, New Chapel Hill, New Summerfield, Reklaw, Troup, Tyler and Whitehouse. The sub-basin includes a total of eighteen named stream segments: two rivers, thirteen creeks, and three lakes. Routine water quality monitoring demonstrated that four waterbodies in this sub-basin do not meet the state's water quality standard for contact recreation due to elevated *Escherichia coli (E. coli)* concentrations; they are now on the Texas 303(d) List. In addition to the listed impairments, concerns for depressed dissolved oxygen, elevated nitrate, ammonia, and total phosphorus also exist in these waterbodies. Once listed as impaired, the U.S. Environmental Protection Agency, through the Federal Clean Water Act, requires remedial action to address water quality impairments. However, establishing a clear understanding of the water quality issues and drivers of these problems prior to remedial efforts is important for future success. The state conducted recreational use attainability analyses (RUAAs) on Segments 0611A, C, and D in 2014 and found that the current primary contact recreation standard is appropriate for Segments 0611A and D. Secondary contact recreation 1 is more appropriate for Segment 0611C (https://www.tceq.texas.gov/waterquality/standards/ruaas/ruaasneches). If approved by EPA, this change would result in this segment being removed from the 303 (d) List in the future.

According to the Angelina & Neches River Authority (ANRA) Clean Rivers Program (CRP) Coordinator and the FY 2016 Coordinated Monitoring Schedule available online (https://cms.lcra.org/schedule.aspx?basin=6&FY=2016), ANRA and TCEQ Regional Office personnel currently monitor 17 stations within this sub-basin. Of these, six are on the Angelina or East Fork of the Angelina River, seven are on tributaries, and four are in lakes. This monitoring approach provides a good spatially representative data set; however, this quarterly monitoring regime proves limited, as it does not capture temporal variability in flow and pollutant loading conditions. A more extensive monitoring regime is necessary to better define water quality in these segments and aid efforts to identify potential source impacts to these waterbodies. Aggregating and analyzing existing data regarding potential pollutant loadings is also needed to develop an appropriate restoration strategy.

Evidence suggests multiple potential contributors to the overall pollutant load in these waterbodies; however, a concerted effort to aggregate available information and assess it collectively has not been completed. Diverse land use in the sub-basin suggests that common point and nonpoint sources of bacteria and nutrients exist in this watershed. However, many potential pollution sources in the sub-basin have yet to be quantified. On-site sewage facilities are one source whose distribution remains largely unknown. If failing, they may contribute significant pollutant loading. Feral animals, livestock, pets, and wildlife are also present in the

watershed and represent a source of pollutant loading that is not currently well understood. Gaining an understanding of water quality drivers and transferring it to stakeholders is necessary so that they may select a restoration strategy that is appropriate for this area or smaller watersheds within this larger sub-basin. Stakeholder desire to address local water quality issues is also unclear. Most stakeholders are unaware that water quality impairments exist in these waterbodies and they are not actively engaged in restoration efforts to correct impairments. Therefore, education program delivery to local stakeholders to increase their knowledge and understanding of water quality issues and potential mitigation strategies is needed. Programming such as the Texas Watershed Steward or other similar programs can provide the needed education and fill this critical information gap. Additionally, these efforts will empower local stakeholders to better care for their water resources, and will also promote future water quality efforts in these and other nearby watersheds. Providing focused information will set a firm foundation for watershed based planning efforts to restore water quality now and in the future.

Section A6: Project Goals and Task Description

This project will investigate current water quality in the watershed through an integrated assessment of existing watershed and water quality data, collection and additional intensive water quality data analysis and local watershed stakeholder engagement. It will identify and establish a baseline pollutant source understanding and quantify existing pollutant loads and define load reductions needed to achieve applicable water quality standards.

Data aggregation and assessment will begin following approval of the project's QAPP and will focus on compiling existing watershed data that allows pollutant sources to be identified and their extent of potential influence to be quantified. Data gathered will include previously collected water quality data, streamflow records, wildlife densities and livestock estimates. If available, data regarding the number of septic systems and the extent of wastewater and stormwater infrastructure will be collected. If unavailable, this information will be estimated utilizing approaches similar to other watersheds. Collectively, information will be assessed to provide a general description of watershed pollutant contributors. Geographic information systems (GIS) will be utilized significantly where appropriate to aid in identifying watershed areas where potential causes and sources of pollutant contributors exist. This platform will allow visualization of pollutant loadings in relation to potential source locations across the watershed.

Supplemental water quality data will be collected to provide improved temporal scale to the existing CRP monitoring regime and refined spatial scale through monitoring non-CRP sites. Monitoring will not commence until the QAPP is approved. Nine existing monitoring sites will be selected for additional monitoring. Selections will be made by ANRA and TWRI in consultation with TSSWCB and other watershed stakeholders such that data is provided at the most critical and useful sites. Planned quarterly CRP monitoring will continue at all sites and supplemental monitoring will be coordinated such that the selected sites will be monitored on a monthly basis for one year. This approach will fill data gaps resulting from the traditional quarterly CRP monitoring regime. Collecting additional water quality and flow data will improve estimates for loading reductions needed to achieve applicable water quality standards.

Additional monitoring beyond the nine originally monitored sites (completed February 2019) will be conducted in Mud and West Mud Creeks. Four sites, two on each creek, will be monitored for an additional 20 months to increase data resolution for future watershed planning and assessment purposes. Three of the sites are existing CRP sites and the fourth was monitored during the initial monitoring efforts of this project. This regime will provide additional data regarding bacteria source loading to impaired segments of these waterbodies.

Data analysis will be conducted to improve knowledge regarding existing instream water quality conditions and hydrological influences on overall pollutant loading. Load duration curves (LDCs) are widely accepted for depicting existing pollutant loading in relation to flow regime and enable current pollutant loads and needed pollutant loading reduction estimates to be made. LDCs will be developed at each sampling station in the watershed with sufficient

paired water quality and stream flow data (≥20 points) and will demonstrate the general drivers of pollution. Other water quality data assessments will also be conducted using proven statistical methods to determine the presence of other trends or correlations in water quality and/or watershed characteristics.

Pollutant source identification and loading estimates will be completed through this project. To assess potential pollutant loading in the watershed, source categories will be identified through discussions with local stakeholders and population estimates for each source will be estimated. Commonly used methods to estimate sources will be used including estimating populations and potential pollutant loadings for feral animals, livestock, pets, on-site sewage facilities, wastewater treatment and other wildlife as appropriate. The spatially explicit load enrichment calculation tool (SELECT) will be used to depict potential *E. coli* loads from evaluated sources. Collectively, this approach will produce Element A and a portion of Element B of the EPA's 9 key elements of successful WPPs.

Cultivating local support to improve water quality is a primary goal for this effort. General education delivery will initiate efforts in the watershed to raise awareness about local water quality issues and will provide general education regarding causes, sources, impacts of and potential solutions to water quality impairments. Information will likely come from the Texas Watershed Steward program and may include other general educational programs. More focused engagement will follow with discussions on local water quality impairments, their causes and sources, and options to address noted impairments. Stakeholder engagement in this project will culminate with discussion regarding the most appropriate path forward to address impairments in the sub-basin.

Using information gleaned through this project, TWRI will work with stakeholders in the future to develop a WPP that satisfies USEPA's 9 key elements of watershed based plans. In short, the developed WPP will clearly define pollutant sources and estimated loadings and will establish management recommendations and estimate their pollutant loading reductions. Additionally, the plan will also describe technical and financial assistance needs, an education plan, a project schedule with interim measurable milestones, indicators to measure progress and a long-term monitoring plan. This project will provide a basis of knowledge to the project team and an avenue for increasing water quality awareness among local stakeholders that will allow for more rapid WPP development through a future project(s).

The purpose of this QAPP is to clearly delineate the QA policy, management structure, and procedures, which will be used to implement the QA requirements necessary to acquire existing data, develop LDCs, conduct water quality monitoring and complete SELECT modeling under tasks 4 and 5. Table A6.1 provides specific subtask milestones for this project.

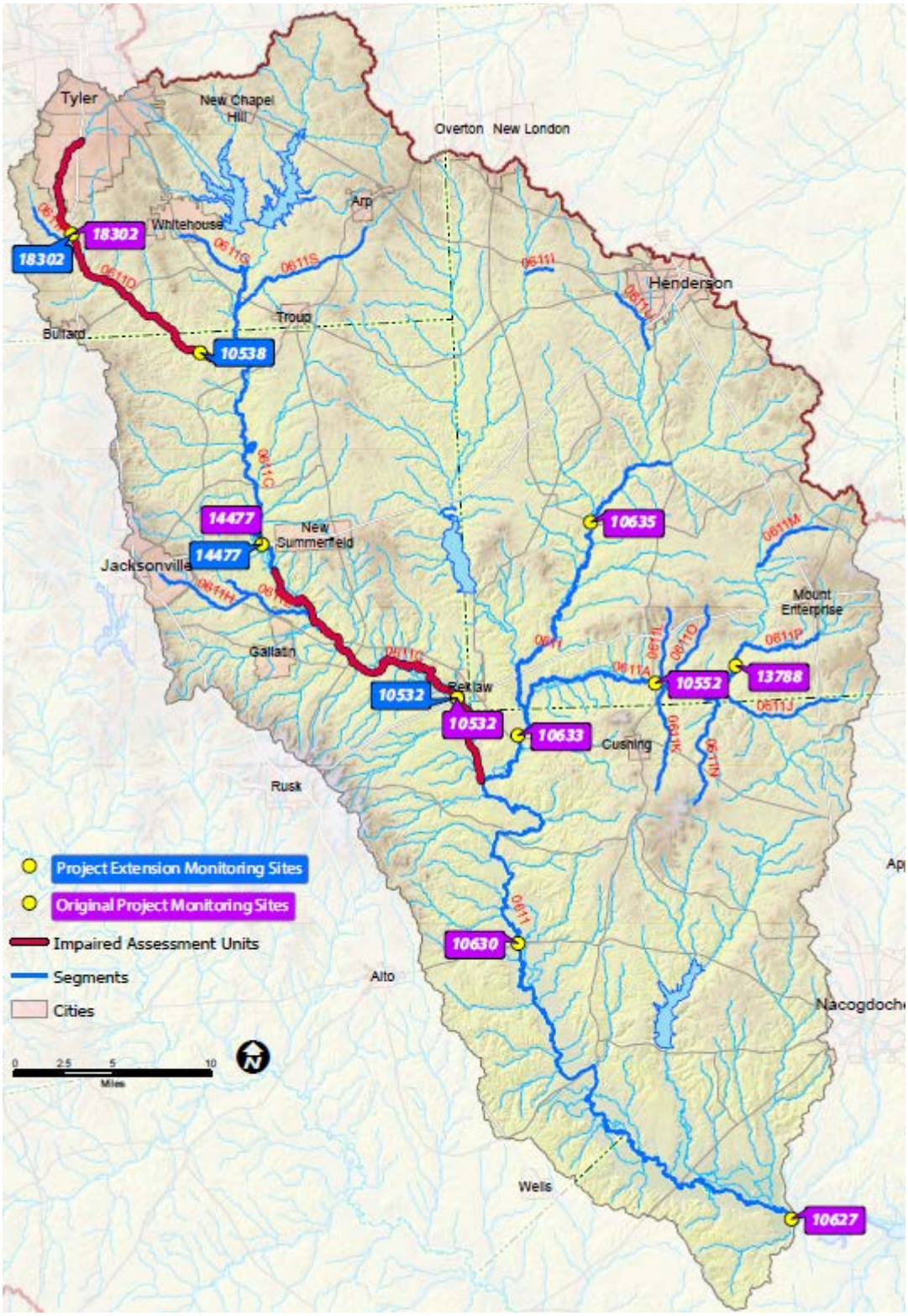


Figure A6.1. The Upper Angelina River Watershed and current monitoring stations (Source: ANRA CRP)

Table A6.1. Project Plan Milestones

Task	Project Milestones	Agency	Start Month	End Month
4.1	TWRI will gather existing data and information pertaining to water quality impairments and issues in the watershed. Generally, this will consist of existing water quality data, streamflow data, animal and human population data, and geospatial data regarding the watershed's physical characteristics, uses and features.	TWRI	4	56
4.2	TWRI, with assistance from ANRA will perform GIS analysis throughout the project area and estimate pollutant loadings from sources contributing to water quality impairments and concerns. SELECT will also be used to demonstrate pollutant source loading potential. This will be completed by analyzing existing data and information to the extent possible, and characterizing water quality conditions, watershed conditions, and sources of pollution contributing to water quality impairments and issues.	TWRI/ ANRA	6	56
4.3	Using load duration curves, existing and needed instream pollutant loads will be estimated using data acquired in Subtask 4.1 and produced through Task 5. Load duration curves will be developed at all stations with at least 20 data points containing both pollutant concentrations and stream flow rate.	BAEN	18	56
4.4	Using existing data that has been analyzed, TWRI with consultation from ANRA will identify additional data needs to further evaluate water quality drivers in the watershed.	TWRI/ ANRA	20	56
5.1	ANRA and TWRI will confer with watershed stakeholders to select 9 monitoring sites in the watershed to perform intensive water quality monitoring. Sites selected will supplement existing CRP monitoring in the watershed and will include monitoring at some CRP sites in off months. This approach will provide an enhanced data set at these sites and will be useful for assessment purposes.	TWRI/ ANRA	1	4
5.2	Four additional sites will be selected along West Mud Creek and Mud Creek to conduct targeted supplemental monitoring. Sites selected will supplement existing CRP monitoring in the watershed and will include monitoring at some CRP sites in off months. This approach will provide an enhanced data set at selected sites and will be useful for future planning purposes.	TWRI/ ANRA	30	34
5.3	ANRA and TWRI will conduct routine, monthly, ambient water quality monitoring consistent with ANRA's current CRP monitoring regime. Sampling will include routine field parameters (water temperature, pH, DO, specific conductance, instantaneous stream flow, days since last significant rainfall, flow severity, present weather, transparency and total water depth). Water samples returned to the lab will be analyzed for conventional parameters, to include Ammonia-N, Nitrate-N, Nitrite-N, Sulfate, Chloride, Total Phosphorus, Total Suspended Solids, and *E. coli* bacteria. Water samples will be delivered to the ANRA Environmental Laboratory within the appropriate holding time for analysis.	TWRI/ ANRA	6	53
5.4	ANRA will transfer completed lab analysis data to TCEQ for inclusion in SWQMIS on a quarterly basis.	ANRA	12	55

TWRI and ANRA will be responsible for the collection and transport of all water quality samples to the ANRA Lab within appropriate sample holding times and in accordance with this QAPP. Sampling will be conducted routinely at the sampling sites designated in Table A6.2.

ANRA will receive water samples and analyze them for *E. coli* enumeration, nutrients, and suspended solids analysis.

Table A6.2. Angelina River above Sam Rayburn Sampling Site Locations

TCEQ Station ID	Site Description	Latitude	Longitude	Start Date (Upon QAPP approval)	End Date	Mode of Sampling	Sample Matrix	Monitoring Freq.	Agency Responsible for Sampling
10627	Angelina River at US 59	31.457113	-94.726472	1/2018	12/2018	Grab	Water	12	TWRI
13788	East Fork Angelina River at Rusk CR 3218	31.870552	-94.752069	1/2018	12/2018	Grab	Water	12	TWRI
10552	East Fork Angelina River at FM 225	31.860399	-94.823008	1/2018	12/2018	Grab	Water	12	TWRI
18302	West Mud Creek at US 69	32.213684	-95.315002	1/2018	12/2018	Grab	Water	12	TWRI
10630	Angelina River at SH 21	31.671589	-94.952714	1/2018	12/2018	Grab	Water	8*	ANRA
10633	Angelina River 340 Meters Upstream of SH 204	31.82628	-94.944756	1/2018	12/2018	Grab	Water	8*	ANRA
10635	Angelina River at FM 1798	31.98234	-94.872686	1/2018	12/2018	Grab	Water	8*	ANRA
14477	Mud Creek at US 79	31.976871	-95.160575	1/2018	12/2018	Grab	Water	8*	ANRA
10532	Mud Creek at US 84	31.856232	-94.996108	1/2018	12/2018	Grab	Water	8*	ANRA
Supplemental Mud and West Mud Creek Sites									
14477	Mud Creek at US 79	31.976871	-95.160575	1/2020	10/2021	Grab	Water	14*	ANRA
10532	Mud Creek at US 84	31.856232	-94.996108	1/2020	10/2021	Grab	Water	14*	ANRA
18302	West Mud Creek at US 69	32.213684	-95.315002	1/2020	10/2021	Grab	Water	20	ANRA
10538	West Mud Creek at FM 3052	32.121361	-95.207080	1/2020	10/2021	Grab	Water	20	ANRA

*These sites are existing CRP monitoring sites that are sampled quarterly. Sampling conducted under this project will be completed in months not sampled under the CRP program.

Model Descriptions

Load Duration Curves

This is a simple and an effective first-step methodology to obtain data-based TMDLs (Cleland, 2003; Stiles, 2001). A duration curve is a graph that illustrates the percentage of time during which a given parameter's value is equaled or exceeded. For example, a flow duration curve (FDC) (Figure A6.2) uses the hydrograph of the observed stream flows to calculate and depict the percentage of time the flows are equaled or exceeded.

A LDC (Figure A6.3) is related to the flow duration curve (FDC) and shows the relationship between contaminant loadings and stream flow conditions at the monitoring site. In this manner, it assists in determining patterns in pollution loading (point sources, nonpoint sources, erosion, etc.) depending on the streamflow conditions. Based on the observed patterns, specific restoration plans can be implemented that target a particular kind of pollutant source. For example, if the pollutant loads exceed the allowable loads (see Figure A6.3) for low stream flow regimes, then the point sources such as wastewater treatment plants and direct deposition sources (wildlife, livestock) should be targeted for the restoration plans. Another main advantage of the LDC method is that it can also be used to evaluate the current impairment as some percent of samples which exceed the standard, and therefore it allows for the rapid development of TMDLs (Stiles, 2001). Figures A6.2 and A6.3 are examples of a FDC and LDC from a project that focused on the Plum Creek watershed.

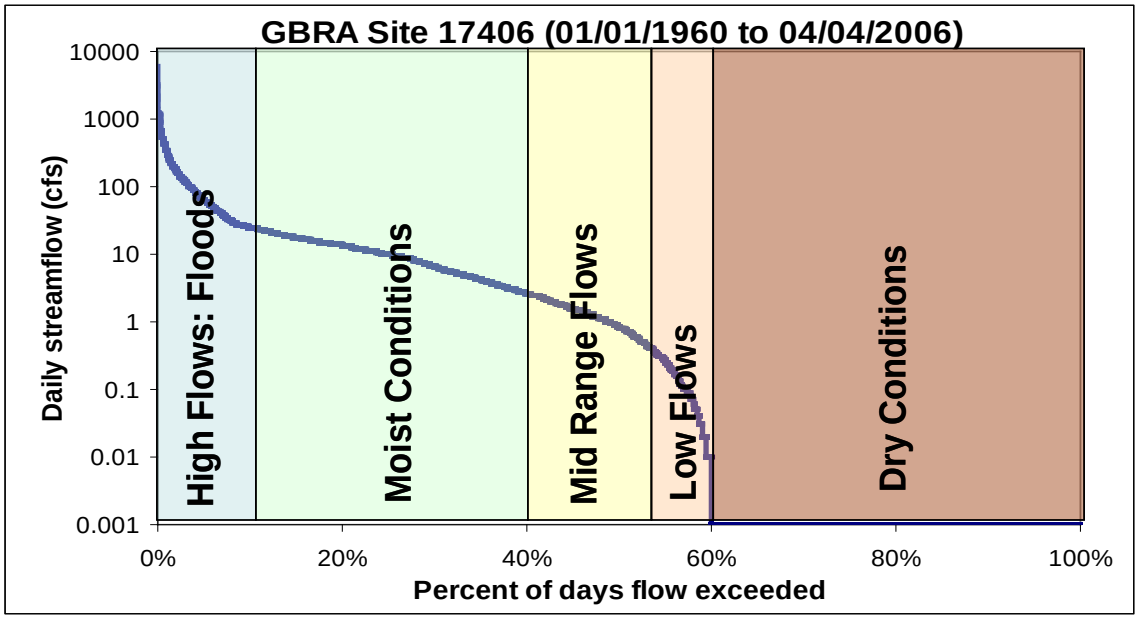


Figure A6.2. FDC for streamflow conditions at GBRA monitoring station 17406 on Plum Creek, near Uhland, TX. The flow data at 17406 was obtained from the nearest USGS gage station 8172400, after adjusting for subwatershed aerial contribution during runoff events.

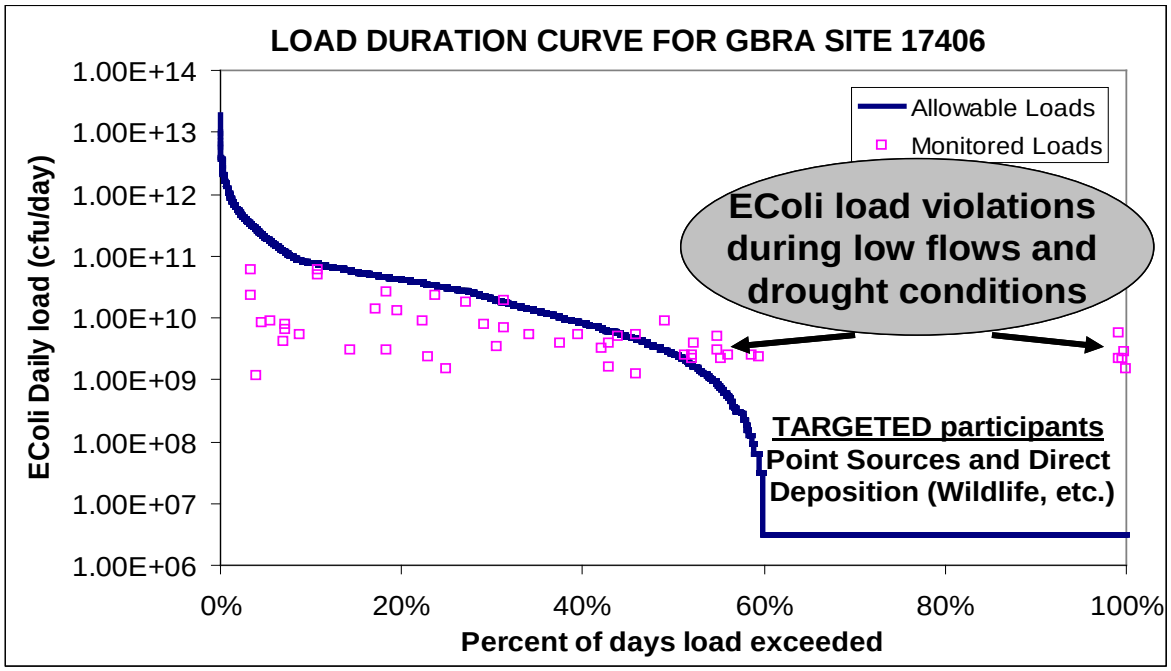


Figure A6.3. LDC for *E. coli* at GBRA monitoring station 17406 on Plum Creek, near Uhland, TX. The flow data at 17406 was obtained from the nearest USGS gage station 8172400, after adjusting for subwatershed aerial contribution during runoff events.

Spatially Explicit Load Enrichment Calculation Tool (SELECT)

The Center for Total Maximum Daily Load (TMDL) and Watershed Studies at Virginia Tech has been involved in TMDL development for bacteria impairments. The Center personnel developed a systematic process for source characterization that includes the following steps:

- inventorying bacterial sources (including livestock, wildlife, humans, and pets);
- distributing estimated loads to the land as a function of land use and source type; and
- generating bacterial load input parameters for watershed-scale simulation models.

This process provides a consistent approach that is necessary to develop comprehensive bacteria TMDLs. The Center personnel developed a software tool, the Bacteria Source Load Calculator (BSLC), to assist with the bacterial source characterization process and to automate the creation of input files for water quality modeling (Zeckoski, et al., 2005). But BSLC does not spatially reference the sources. A spatially-explicit tool, SELECT was developed by the Spatial Sciences Laboratory (SSL) and BAEN Department at Texas A&M University to calculate contaminant-loads resulting from various sources within a watershed. SELECT spatially references the sources, calculates and allocates potential pathogen loading to a stream from various sources within a watershed. All loads will be spatially referenced. In order to allocate the *E. coli* load throughout the Angelina River above Sam Rayburn watershed, estimations of the source contributions will be made. This in turn allows the sources and locations to be ranked according to their potential contribution for each sub-watershed. The populations of agricultural animals, wildlife, and domestic pets will be calculated and distributed throughout each watershed according to appropriate land use. Septic system contribution will also be estimated based on criteria including distance to a stream, soil type, failure rate, and age of system. Once the watershed profile is developed for each potential source, the information can be aggregated to the sub-watershed level to identify the top contributing areas in the watershed.

Section A7: Quality Objectives and Criteria for Data Quality

Personnel at TWRI and ANRA will conduct water quality monitoring and a phased modeling effort to develop pollutant source and loading information and estimates of needed bacteria reductions. The objectives of the water quality modeling for this project are as follows:

The objectives for this project are as follows:

1) Develop and obtain approval for a QAPP
2) Collect environmental and water quality data to support the development of a WPP
3) Spatially characterize and rank sources of bacteria and within the watershed using an updated version of SELECT, a spatially-explicit GIS methodology. Divide the area into sub-watersheds and identify, quantify and rank pollutant loads from various sources, i.e. agriculture, urban/human, wildlife, and other sources in the study area.
4) Develop LDCs to analyze the temporal trends in the observed water quantity and quality data for the watershed. The LDCs will be developed using currently existing water quality and flow data available from the TCEQ SWQMIS Database and data generated through this project. Evaluate the violations and the required load-reductions of bacteria and nitrates for different flow-rate regimes (low, medium, and high flow) using LDC and interpolated model.

Surface Water Quality Monitoring (SWQM) – The goal of this section is to ensure that data collected meets the data quality objectives (DQOs) of the project. The objective of this project is to identify the level and specific sources of bacteria entering the Angelina River above Sam Rayburn. Achievement of these objectives will support decisions for implementation of appropriate best management practices (BMPs) in order to reduce fecal bacteria levels in the Angelina River above Sam Rayburn Watershed to comply with existing water quality standards.

Following are actions that will be undertaken by this project to assess bacterial pollution within the Angelina River above Sam Rayburn Watershed:

- Monitor water quality as related to bacterial and nutrient loading
- Model bacteria loading using LDCs and SELECT

The measurement performance criteria to support the project objectives are specified in Table A7-1.

Consistent with the most recent version of the TCEQ *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods* (TCEQ SOP, V1) (TCEQ 2012), routine grab samples will be collected on a monthly basis to supplement the quarterly Clean Rivers Program monitoring. During routine sampling measurements of DO, conductivity, pH, stream flow, and water temperature will be obtained *in situ*. These data will be logged on field data sheets, incorporated into a computer-based database maintained by TWRI.

Water samples collected will be transported to the ANRA for nutrient analysis, bacteria enumeration and data logging. TWRI/ANRA will deliver water samples to the ANRA laboratory within designated holding times for respective analysis; ANRA will use designated methods outlined in Tables A7.1, A7.2 and B2.1. Appropriate DQOs and QA/QC requirements for this analysis are also reported in Tables A7.1 and B2.1.

Ambient Water Reporting Limits (AWRLs)
The AWRL establishes the reporting specification at or below which data for a parameter must be reported to be compared with freshwater screening criteria. The AWRLs specified in Appendix A, Table A7.1 are the program-defined reporting specifications for each analyte and yield data acceptable for the TCEQ's water quality assessment. A full listing of AWRLs can be found at http://www.tceq.state.tx.us/assets/public/waterquality/crp/QA/awrlmaster.pdf.

The limit of quantitation (LOQ) is the minimum level, concentration, or quantity of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence by the laboratory analyzing the sample. Analytical results shall be reported down to the laboratory's LOQ (i.e., the laboratory's LOQ for a given parameter is its reporting limit).

The following requirements must be met in order to report results to TCEQ for inclusion in SWQMIS:

- The laboratory's LOQ for each analyte must be at or below the AWRL as a matter of routine practice
- The laboratory must demonstrate its ability to quantitate at its LOQ for each analyte by running an LOQ check sample for each analytical batch of CRP samples analyzed.
- Control limits for LOQ check samples are found in Appendix A.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria are provided in Section B5.

Precision
Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. It is a measure of agreement among replicate measurements of the same property, under prescribed similar conditions, and is an indication of random error.

Laboratory precision is assessed by comparing replicate analyses of Laboratory Control Samples (LCS) in the sample matrix (e.g. deionized water, sand, commercially available tissue), Matrix Spike/Matrix Spike Duplicate (MS/MSD), or sample/duplicate (DUP) pairs, as applicable. Precision results are compared against measurement performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for precision are defined in Tables A7.1 and A7.2.

Bias
Bias is a statistical measurement of correctness and includes multiple components of systematic error. A measurement is considered unbiased when the value reported does not differ from the true value. Bias is determined through the analysis of LCS and LOQ Check Samples prepared with verified and known amounts of all target analytes in the sample matrix (e.g. deionized water, sand, commercially available tissue) and by calculating percent recovery. Results are compared against measurement performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for bias are specified in Table A7.1.

Representativeness
Site selection, the appropriate sampling regime, the sampling of all pertinent media according to TCEQ SOP, V1, and use of only approved analytical methods will assure that the measurement data represents the conditions at the site. Routine data collected under CRP for water quality assessment are considered to be spatially and temporally representative of routine water quality conditions. Water Quality data are collected on a routine frequency and are separated by approximately even time intervals. At a minimum, samples are collected over at least two seasons (to include inter-seasonal variation) and over two years (to include inter-year variation) and include some data collected during an index period (March 15- October 15). For this project, monthly sampling will be conducted to supplement the quarterly monitoring conducted for CRP through ANRA's CRP QAPP. Although data may be collected during varying regimes of weather and flow, the data sets will not be biased toward unusual conditions of flow, runoff, or season. The goal for meeting total representation of the water body will be tempered by the potential funding for complete representativeness.

Comparability
Confidence in the comparability of routine data sets for this project and for water quality assessments is based on the commitment of project staff to use only approved sampling and analysis methods and QA/QC protocols in accordance with quality system requirements and as described in this QAPP and in TCEQ SOP, V1. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for rounding figures, and by reporting data in a standard format as specified in the Data Management Plan Section B10.

Completeness
The completeness of the data is basically a relationship of how much of the data are available for use compared to the total potential data. Ideally, 100% of the data should be available. However, the possibility of unavailable data due to accidents, insufficient sample volume, broken or lost samples, etc. is to be expected. Therefore, it will be a general goal of the project(s) that 90% data completion is achieved.

Limit of Quantitation

AWRLs (Tables A7.1 & A7.2) are used in this project as the *limit of quantitation specification*, so data collected under this QAPP can be compared against the Texas Surface

Water Quality Standards. Laboratory *limits of quantitation* (Tables A7.1 & A7.2) must be at or below the AWRL for each applicable parameter.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria are provided in Section B5

Analytical Quantitation
To demonstrate the ability to recover at the limit of quantitation, the laboratory will analyze an LOQ check standard for each batch of samples run.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria are provided in Section B5

LDC – this approach has been utilized in several TMDL projects as an initial screening-tool to evaluate the actual temporal load trends in streams (Cleland, 2003; Stiles, 2001). In cases of violations, it is necessary to determine the required load-reduction in that region near the monitoring station. Load-reductions should be calculated for all flow-regimes of the stream. In order to do this continuous monitoring data will be simulated using the actual monitoring data by regression methods. Uncertainty of the model will be estimated via residual error analysis. The straight line passing through residual error plot should have a slope of zero.

SELECT – this approach is being updated by BAEN. It is similar to BSCL (Zeckoski, et al. 2005) in TMDL development. High quality spatial data (most recently available land use and land cover data, soil survey geographic (SSURGO) soils data, National Hydrography Dataset (NHD), etc) will be processed and utilized in SELECT approach. Distributions for input parameters for SELECT will be created based on literature values and expert knowledge.

Table A7.1. Measurement Performance Specifications for Conventional Parameters in Water

Parameter	Units	Matrix	Method	Parameter Code	TCEQ AWRL	LOQ	LOQ Check Sample %Rec	Precision (RPD)	Bias %Rec of LCS	Lab	% Completeness
RESIDUE, TOTAL NONFILTERABLE (MG/L)	mg/L	Water	SM 2540D	00530	5	2.5 1.0	NA	NA	80-120	ANRA LCRA ELS*	90
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	mg/L	Water	SM 4500-NH3 D EPA 350.1	00610	0.1	0.1 0.02	70-130	20	80-120	ANRA LCRA ELS*	90
NITRITE PLUS NITRATE, TOTAL ONE LAB DETERMINED VALUE (MG/L AS N)	mg/L	Water	SM 4500-NO3 H	00630	0.05	0.02	70-130	20	80-120	LCRA ELS*	90
NITRITE NITROGEN, TOTAL (MG/L)	mg/L	Water	EPA 300.0	00615	0.05	0.05	70-130	20	80-120	ANRA	90
NITRATE NITROGEN, TOTAL (MG/L)	mg/L	Water	EPA 300.0	00620	0.05	0.05	70-130	20	80-120	ANRA	90
PHOSPHORUS, TOTAL, WET METHOD (MG/L)	mg/L	Water	EPA 365.4	00665	0.06	0.02	70-130	20	80-120	ANRA LCRA ELS*	90
CHLORIDE (MG/L)	mg/L	Water	EPA 300.0	00940	5	5	70-130	20	80-120	ANRA LCRA ELS*	90
SULFATE (MG/L)	mg/L	Water	EPA 300.0	00945	5	5	70-130	20	80-120	ANRA LCRA ELS*	90

References:
United States Environmental Protection Agency (USEPA) Methods for Chemical Analysis of Water and Wastes, Manual #EPA-600/4-79-020
U.S. Code of Federal Regulations (CFR). Title 40: Protection of Environment, Part 136
American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), Standard Methods for the Examination of Water and Wastewater, 23rd Edition, 2017.
TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods, 2012 (RG-415).
TCEQ SOP, V2 - TCEQ Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Assemblage and Habitat Data, 2014 (RG-416).
*LCRA ELS will serve as alternate for the sample analysis of conventional parameters in the event that analysis cannot be conducted at the ANRA Environmental Laboratory.

Table A7.2. Measurement Performance Specifications for Bacteriological Parameters in Water

Parameter	Units	Matrix	Method	Parameter Code	TCEQ AWRL	LOQ	LOQ Check Sample %Rec	Log Difference of Duplicates	Bias %Rec. of LCS	Lab	% Completeness
E. *COLI*, COLILERT, IDEXX METHOD, MPN/100ML	MPN/100mL	Water	SM 9223B**	31699	1	1	NA	0.50*	NA	ANRA	90
E.COLI, COLILERT, IDEXX, HOLDING TIME	hours	Water	NA	31704	NA	NA	NA	NA	NA	ANRA	90

* This value is not expressed as a relative percent difference. It represents the maximum allowable difference between the logarithm of the result of a sample and the logarithm of the duplicate result. See Section B5.
** *E. coli* samples analyzed by these methods should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 6 hours, the holding time may be extended and samples must be processed as soon as possible and within 30 hours.

References:
United States Environmental Protection Agency (USEPA) Methods for Chemical Analysis of Water and Wastes, Manual #EPA-600/4-79-020
American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), Standard Methods for the Examination of Water and Wastewater, 23rd Edition, 2017.
TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods, 2012 (RG-415).

Table A7.3. Measurement Performance Specifications for Field Parameters

Parameter	Units	Matrix	Method	Parameter Code	AWRL	LOQ	LOQ Check Sample %Rec	Precision (RPD)	Bias %Rec of LCS	% Completeness
PH (STANDARD UNITS)	s.u.	water	EPA 150.1 and TCEQ SOP	00400	NA	NA	NA	NA	NA	90
OXYGEN, DISSOLVED	mg/L	water	SM4500 O-G and TCEQ SOP	00300	NA	NA	NA	NA	NA	90
SPECIFIC CONDUCTANCE, FIELD (US/CM @ 25C)	uS/cm	water	EPA 120.1 and TCEQ SOP	00094	NA	NA	NA	NA	NA	90
TEMPERATURE	°C	water	SM2500B and TCEQ SOP	00010	NA	NA	NA	NA	NA	90
FLOW STREAM, INSTANTANEOUS (CUBIC FEET PER SEC)	cfs	water	TCEQ SOP V1 or USGS 2005-5183	00061	NA	NA	NA	NA	NA	90
FLOW SEVERITY: 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry	NU	water	TCEQ SOP V1	01351	NA	NA	NA	NA	NA	90
STREAM FLOW ESTIMATE (CFS)	cfs	water	TCEQ SOP V1	74069	NA	NA	NA	NA	NA	90
FLOW MTH 1=GAGE 2=ELEC 3=MECH 4=WEIR/FLU 5=DOPPLER	NU	other	TCEQ SOP V1	89835	NA	NA	NA	NA	NA	90
SECCHI DEPTH	meters	water	TCEQ SOP V1	00078	NA	NA	NA	NA	NA	90
DAYS SINCE LAST SIGNIFICANT RAINFALL	days	NA	TCEQ SOP V1	72053	NA	NA	NA	NA	NA	90
DEPTH OF BOTTOM OF WATER BODY AT SAMPLE SITE	meters	water	TCEQ SOP V2	82903	NA	NA	NA	NA	NA	90

References:

United States Environmental Protection Agency (USEPA) Methods for Chemical Analysis of Water and Wastes, Manual #EPA-600/4-79-020
American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998. (Note: The 21st edition may be cited if it becomes available.)
TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods, 2012 (RG-415).
TCEQ SOP, V2 - TCEQ Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Assemblage and Habitat Data, 2014 (RG-416).

Section A8: Special Training Requirements/Certification

Surface Water Quality Monitoring
Work conducted for this project is covered under and documented in this QAPP. Personnel conducting work associated with this project are deemed qualified to perform their work through educational credentials, specific job/task training, required demonstrations of competency, and internal and external assessments. Laboratories are NELAP-accredited as required. Records of educational credentials, training, demonstrations of competency, assessments, and corrective actions are retained by project management and are available for review.

Staff responsible for operating the field-use multi-parameter sondes and flow loggers will undergo training event by a qualified trainer (the equipment manufacturer, TCEQ SWQM personnel, an experienced field sampler, or the QA Officer). Training may also occur at set statewide training events, such as the annual SWQM Workshop.

Field personnel will receive training in proper sampling and field analysis. Before actual sampling or field analysis occurs, they will demonstrate to the QA officer (in the field), their ability to properly operate the field-use multi-parameter sondes and retrieve the samples. The QA officer will sign off each field staff in their field logbooks. Field personnel training is documented and retained in the personnel file, and will be available during a monitoring systems audit.

LDC and SELECT Analyses
All personnel involved in model calibration, validation, and development will have the appropriate education and training required to adequately perform their duties. No special certifications are required.

Section A9: Documentation and Records

SWQM- Hard copies of general maintenance records, all field data sheets, chain of custody (COC) forms, laboratory data entry sheets, calibration logs, and corrective action reports (CARs) will be archived for at least five years. In addition, ANRA will archive electronic forms of all project data for at least five years. All electronic data are backed up on an external networked server. A blank CAR form is presented in Appendix A, a blank COC form is presented in Appendix C, and blank field data reporting forms are presented in Appendix B.

Laboratory Documentation

Test/data reports from the laboratory must document the test results clearly and accurately. Routine data reports should be consistent with the *TNI Volume 1, Module 2, Section 5.10* (2009) and include the information necessary for the interpretation and validation of data. The requirements for reporting data and the procedures are provided.

Reports of results of analytical tests performed by the laboratory contain the following elements:

- Title of report
- Name and address of the laboratory
- Name and address of the client
- A clear identification of the sample(s) analyzed (unique identifiers)
- Identification of method used
- Identification of samples that did not meet QA requirements (by use of data qualifiers)
- Sample results
- Units of measurement
- Sample matrix
- Station information
- Date and time of collection
- LOQ and limit of detection (LOD) (formerly referred to as the reporting limit and the method detection limit, respectively), and qualification of results outside the working range (if applicable)
- Certification of NELAP compliance
- Clearly identified subcontract laboratory results (as applicable)
- A name and title of the person accepting responsibility for the report
- Project-specific QC results

Upon completion of all analyses, the ANRA Environmental Laboratory generates a Report Cover Page, a Laboratory Analysis Report, and a Quality Control Data Report. The chain of custody documentation, field data sheets, and subcontract laboratory reports (if applicable) are attached to form the final report. The ANRA LM reviews the report and submits it to the ANRA Quality Manager for additional review. Upon final review by the ANRA Quality Manager, the report is submitted to the ANRA Information Resources Manager for electronic submittal to SWQMIS.

Electronic Data

Data will be submitted to the TCEQ by ANRA in the event/result format specified in the most current version of the TCEQ DMRG for upload to SWQMIS. The DMRG can be found at https://www.tceq.texas.gov/waterquality/data-management/dmrg_index.html. The Data Review Checklist and Summary as contained in Appendix D of this document will be submitted with the data.

All reported Events will have a unique TagID (see DMRG). TagIDs used in this project will be seven-character alphanumeric codes with the structure of the two-letter Tag prefix followed by a five-digit number: for example – TX01234, TX01235, etc.

Submitting Entity, Collecting Entity, and Monitoring Type codes will reflect the project organization and monitoring type in accordance with the DMRG. The proper coding of Monitoring Type is essential to accurately capture any bias toward certain environmental condition (for example, high flow events).

Table A9.1. SWQMIS Data Entry Codes

Sample Description	Tag Prefix	Submitting Entity	Collecting Entity	Monitoring Type
Routine Monitoring, Load Contributions	TX	TX	AN	RTLF
Routine Monitoring, Load Contributions	TX	TX	WR	RTLF

LDC and SELECT Analyses- All records, including modeler's notebooks and electronic files, will be archived by TWRI for LDCs and BAEN for SELECT for at least five years. These records will document model testing, calibration, and evaluation and will include documentation of written rationale for selection of models, record of code verification (hand-calculation checks, comparison to other models), source of historical data, and source of new theory, calibration and sensitivity analyses results, and documentation of adjustments to parameter values due to calibration. Electronic data on the project computers and the network server are backed up daily to the network drive and weekly to an external hard drive and the PI's computer. In the event of a catastrophic systems failure, the tapes can be used to restore the data in less than one day's time. Data generated on the day of the failure may be lost, but can be reproduced from raw data in most cases.

Digital files of land cover data for each watershed will be produced in shapefile or ArcGIS grid format and stored on digital media. Multi-color hard copy maps of land cover can be produced at various geographic scales from these digital files.

Combined Project Documentation

Quarterly progress reports disseminated to the individuals listed in section A3 will note activities conducted in connection with the water quality modeling project, items or areas identified as potential problems, and any variations or supplements to the QAPP. Final reports on the SELECT modeling analysis and the LDC analysis will be developed as chapters to the WPP. Outcomes will be submitted to the established stakeholder group and utilized in future WPP development.

CARs will be utilized when necessary (Appendix A). CARs will be maintained in an accessible location for reference at TWRI and will be disseminated to the individuals listed in section A3. CARs resulting in any changes or variations from the QAPP will be made known to pertinent project personnel and documented in updates or amendments to the QAPP.

All electronic data are backed up routinely. A blank CAR is presented in Appendix A and a blank COC form is presented in Appendix C.

The TSSWCB may elect to take possession of records at the conclusion of the specified retention period.

Table A9.2. Project Documents and Records

Document/Record	Location	Retention	Form
QAPP, amendments, and appendices	TWRI/ANRA	5 years	Electronic
QAPP distribution documentation	TWRI/ANRA	5 years	Paper/Electronic
Corrective Action Reports (CARs)	TWRI/ANRA/LCRA	5 years	Paper/Electronic
Training Records	TWRI/ANRA	5 years	Paper/Electronic
Field notebooks or field data sheets	TWRI/ANRA	5 years	Paper/Electronic
Field equipment calibration/maintenance	TWRI/ANRA	5 years	Paper/Electronic
Chain of custody records	TWRI/ANRA/LCRA	5 years	Paper/Electronic
Laboratory QA manuals	ANRA/LCRA	5 years	Paper/Electronic
Laboratory SOPs	ANRA/LCRA	5 years	Paper/Electronic
Laboratory procedures	ANRA Lab	5 years	Paper/Electronic
Instrument raw data files	ANRA Lab	5 years	Paper/Electronic
Instrument readings/printouts	ANRA/LCRA	5 years	Paper/Electronic
Laboratory data reports/results	ANRA/LCRA	5 years	Paper/Electronic
Laboratory equipment maintenance logs	ANRA/LCRA	5 years	Paper/Electronic
Laboratory calibration records	ANRA/LCRA	5 years	Paper/Electronic
Modeler Notebooks	BAEN	5 years	Paper
Model Input Data Files	BAEN	5 years	Electronic
Model Calibration Documentation	BAEN	5 years	Electronic
Model Validation Documentation	BAEN	5 years	Electronic
Model Output	BAEN	5 years	Electronic
Progress Reports/Final Reports	TWRI/TSSWCB	3 years	Electronic

Data Transfer between Entities

Data transfer between entities occurs via electronic means. Specific format of the data transferred depends on the specific data and includes ArcMap, MS Office, and PDF formats.

QAPP Revision and Amendments

Until the work described is completed, this QAPP shall be revised as necessary and reissued annually on the anniversary date, or revised and reissued within 120 days of significant changes, whichever is sooner. The last approved versions of QAPPs shall remain in effect until revised versions have been fully approved; the revision must be submitted to the TSSWCB for approval before the last approved version has expired. If the entire QAPP is current, valid, and accurately reflects the project goals and the organization's policy, the annual re-issuance may be done by a certification that the plan is current. This can be accomplished by submitting a cover letter stating the status of the QAPP and a copy of new, signed approval pages for the QAPP.

Amendments to the QAPP may be necessary to reflect changes in project organization, tasks, schedules, objectives and methods; address deficiencies and non-conformances; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Requests or amendments are directed from the TWRI Project Lead to the TSSWCB PM in writing. The changes are effective immediately upon approval by the TSSWCB PM and QAO, or their designees, and the USEPA Project Officer. Amendments to the QAPP and the reasons for the changes will be documented, and copies of the approved QAPP Expedited Amendment form will be distributed to all individuals on the QAPP distribution list by the TWRI QAO. Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process.

Section B1: Sampling Process Design (Experimental Design)

SWQM- The sampling conducted for this project is intended to assess water quality in the Angelina River above Sam Rayburn watershed. Sampling will be conducted on a monthly basis at supplemental stations (Table A6.2) within watershed for all constituents listed in this QAPP as directed by TCEQ SOP, V1. *E. coli* bacteria and nutrients are the primary parameters of concern. Sampling types, frequencies and locations are described in Table A6.2. Physical parameters that will be measured *in situ* during routine sampling and include flow, specific conductance, DO, pH, and water temperature; other noted items will include the flow severity, days since last significant rainfall and present weather conditions. Water quality samples collected as part of the routine sampling schedule will be analyzed for bacteria and nutrients as outlined in Table A7.1 and 7.2.

In order to obtain representative results, ambient water sampling will occur on a routine schedule over the course of 12 months, capturing dry and runoff-influenced events at their natural frequency. There will be no prejudice against rainfall or high flow events, except that the safety of the sampling crew will not be compromised in case of lightning or flooding; this is left up to the discretion of the sampling crew. In the instance that a sampling site is inaccessible, no sample will be taken and will be documented in the field notebook and the event will be made up at a later date when safe conditions return. If, near the end of the study, the TSSWCB PM/QAO agrees that the sampling has not achieved good representativeness of typical conditions, the final sampling event(s) may be extended.

Site Descriptions
Monitoring will be conducted at stations that have been historically monitored by ANRA & TCEQ. The four supplemental stations are as follows:

Station 14477, Mud Creek at US 79, is located 9.8 km East of Jacksonville and 5.9 km West of New Summerfield. This monitoring station is located on Segment 0611C. ANRA will be responsible for monitoring this station.

Station 10532, Mud Creek at US 84, is located 0.87 km Southwest of Reklaw. This monitoring station is located on Segment 0611C. ANRA will be responsible for monitoring this station.

Station 18302, West Mud Creek at US 69, is located South of Tyler. This monitoring station is located on Segment 0611D. TWRI will be responsible for monitoring this station.

Station 10538, West Mud Creek at FM 3052, is located approximately 7.24 km Southwest of the City of Troup and East of Bullard. This monitoring station is located on Segment 0611D. ANRA will be responsible for monitoring this station.

The monitoring stations are included in Table A6.2. The monitoring stations for this project will be added to the Coordinated Monitoring Schedule (CMS) located at cms.lcra.org. A

detailed site location map is located in Section A6.

***LDC and SELECT Analyses*-** Not relevant.

Section B2: Sampling Method Requirements / Data Collection Method

SWQM

Field Sampling Procedures

Field sampling for the procedures listed in this QAPP will be conducted according to procedures documented in the latest version of the TCEQ SOP, V1. Additional aspects outlined in Section B below reflect specific requirements for sampling. Sampling will be done so that it is consistent with sampling conducted under the guise of the Clean Rivers Program. Field sampling activities are documented on field data reporting forms as presented in Appendix B.

All sample information will be logged into a field log. The following will be recorded for all water sampling:

- station ID
- location
- sampling time
- date
- water depth
- flow rate
- sample collector's name/signature

Detailed observational data are recorded including water appearance, weather, biological activity, stream uses, unusual odors, specific sample information, days since last significant rainfall, estimated hours since rainfall began (if applicable), and flow severity.

Typically, water samples will be collected directly from the stream (midway in the stream channel) into approved sample containers.

Certificates from sample container manufacturers are maintained by the ANRA Environmental Laboratory.

All sample containers will be labeled with the following information:

- collection date
- collection time
- sample location
- and sampler's initials

Care will be exercised to avoid the surface microlayer of water, which may be enriched with bacteria and not representative of the water column. In cases where, for safety reasons, it is inadvisable to enter the stream bed, and boat access is not practical, staff will use a clean bucket and rope from a bridge to collect the samples from the stream. If a bucket is used, care will be taken to avoid contaminating the sample. Specifically, technicians must exert care to ensure that the bucket and rope do not come into contact with the bridge. The bucket must be thoroughly rinsed between stations. Buckets are also to be sanitized between sampling stations with a bleach- or isopropyl alcohol-soaked wipe. The first bucketful of water collected from a bridge is used to rinse the bucket. Rinse water is not returned to the stream, but is instead disposed of away from the sampling site to ensure that the collected sample will not be affected by the bleach or alcohol residual. Samples are collected from subsequent buckets of water. This type of sampling will be noted in the field records.

Water temperature, pH, specific conductivity, specific conductance, and DO will be measured and recorded *in situ* with a multiprobe whenever samples are collected. Flow is measured with an electronic flow meter as described in the TCEQ SOP, V1 or in USGS Quality Assurance Plan for Discharge Measurements Using Acoustic Doppler Current Profilers (USGS 2005-5183). All field measurements will be conducted in accordance with the methods listed in Table B.4-1. All samples will be transported in an iced container to the laboratory for analysis.

Table B2.1. Storage, Preservation and Handling Requirements

Parameter	Matrix	Container	Preservation	Sample Volume (mL)	Holding Time
TSS	Water	Plastic	<6°C (but not frozen)	1000	7 days
Ammonia-N	Water	Plastic	pH<2 with H_2SO_4, <6°C (but not frozen)	500	28 days
Nitrate+Nitrite-N	Water	Plastic	pH<2 with H_2SO_4, <6°C (but not frozen)	500	28 days
Nitrate-N	Water	Plastic	<6°C (but not frozen)	500	48 hours
Nitrite-N					48 hours
Chloride					28 days
Sulfate					28 days
Phosphorus, Total	Water	Plastic	pH<2 with H_2SO_4, <6°C (but not frozen)	500	28 days
*E. coli**	Water	SPS	<6°C (but not frozen), sodium thiosulfate	250	8 hours

**E. coli* samples should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 8 hours, the holding time may be extended and samples must be processed as soon as possible and within 30 hours.

Sample Containers

The sample container types used for sampling are as follows:

The preferred bacteriological sample containers are sterile polyethylene (SPS) 120mL and 290mL bottles with sodium thiosulfate. The bottles contain sufficient sodium thiosulfate to remove 10mg/L or 15mg/L of total chlorine, respectively. Sample containers used for conventional parameters are purchased pre-cleaned and are disposable. Sample containers are either High Density Polyethylene (HDPE) or Low Density Polyethylene (LDPE). Certificates from sample container manufacturers are maintained by the ANRA Environmental Laboratory.

Processes to Prevent Contamination

The most recent version of the TCEQ SOP, V1 outlines the necessary steps to prevent contamination of samples. These include: direct collection into sample containers, when possible. Field QC samples as discussed in Section B5 are collected to verify that contamination has not occurred.

Failures in Sampling Methods Requirements and/or Deviations from Sample Design and Corrective Action

Examples of failures in sampling methods and/or deviations from sample design requirements include but are not limited to such things as sample container problems, sample site

considerations, etc. Failures or deviations from the QAPP are documented on the field data reporting form and reported to the TWRI and/or ANRA CRP Coordinator. The project managers in consultation will determine if the deviation from the QAPP compromises the validity of the resulting data. The project managers, in consultation with the TWRI, ANRA, and TSSWCB PM and QAO, will decide to accept or reject data associated with the sampling event, based on best professional judgment. The resolution of the situation will be reported to the TSSWCB in the quarterly progress report (QPR).

***LDC and SELECT Analyses*-** Not relevant.

Section B3: Sample Handling and Custody Requirements

SWQM

Chain-of-Custody (COC)

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of sampling and continuing through transport, sample receipt, preparation, and analysis. The COC form is used to document sample handling during transfer from the field to the laboratory and inter-laboratory. The sample number, location, date, changes in possession and other pertinent data will be recorded in indelible ink on the COC. The sample collector will sign the COC and transport it with the sample to the laboratory. At the laboratory, samples are inventoried against the accompanying COC. Any discrepancies will be noted at that time and the COC will be signed for acceptance of custody. Sample information will be entered into ANRA's Laboratory Information Management System (LIMS) upon receipt of the samples. The LIMS will generate a unique sample identification number for the sample, which will be affixed to each container. A copy of a blank COC form used on this project is included as Appendix C.

Sample Labeling

Samples will be labeled on the container with an indelible, waterproof marker. Label information will include site identification, date, sampler's initials, and time of sampling. The COC form will accompany all sets of sample containers.

Sample Handling

Field data sheets (Appendix B) are supplied to all field personnel prior to initiation of collection procedures. The field data sheets have spaces dedicated to recording of all pertinent field observations and water quality parameters. The field staff has the prime responsibility to insure that all pertinent information is recorded correctly and in the proper units.

All samples brought to the ANRA Environmental Laboratory are examined for proper documentation, holding times, sample temperature, and preservation by the ANRA Sample Custodian. The Sample Custodian accepts delivery by signing the final portion of the official COC submitted with the samples. The accepted samples are immediately logged into the laboratory LIMS and assigned a unique laboratory sample ID number. It is the responsibility of the sample custodian to log-in collected water samples in the proper format, and to record the unique laboratory sample ID number on the sample container. The sample container is placed in the proper laboratory refrigerator by the sample custodian.

LCRA ELS will serve as the primary lab for Nitrate Plus Nitrite analysis, and as a backup for all other parameters in the A7.1 table in the event that the primary lab is unable to perform the required analysis. Samples that will be sent to LCRA ELS for analysis will first be received by ANRA. ANRA staff will accept, log-in, and label the samples. The samples are packed on ice in a cooler to maintain a temperature between freezing and 6°C. The cooler is sealed containing the samples and appropriate COC forms, then a pickup is scheduled with FedEx, UPS, or other appropriate shipping service/courier. The sealed cooler is relinquished to LCRA ELS, the sample custodian verifies the condition of the samples and logs them into the LIMS.

Proper sample custody is a joint effort of the field sampling staff, the sample transporter, and the laboratory staff. The main documentation of proper sample custody for all events up to the arrival of the sample at the laboratory is the COC form which is provided in Appendix C. If any of the information blanks or signature locations on the COC form are not completely filled out, there is a gap in the documentation of sample custody. In such an event, the laboratory sample custodian will question whether the sample should be accepted. All data acceptance questions are referred to the Laboratory Manager and Quality Manager.

The following procedures outline sample handling from collection to receipt of analytical results:

1. After a sample is transferred into the proper sample container, the container is tightly capped as quickly as possible to prevent the loss of volatile components and to exclude possible oxidation. Where appropriate, samples are preserved and/or split in the field. All samples are placed on ice immediately following field measurements and transported to the laboratory as soon as possible.

2. The container is labeled with the proper laboratory sample identification number (a unique designation) on a label securely affixed to the container. A marker with waterproof ink is used when labeling the sample container and filling out the appropriate COC form.

3. The COC form is filled out completely and accurately.

4. Samples requiring subcontractor lab analysis are delivered to the laboratory for analysis as soon as possible via ground shipment. These samples are accompanied by the appropriate laboratory's COC form. The COC is relinquished by the ANRA Laboratory and is delivered to the laboratory personnel authorized to receive samples. The date and time the sample was shipped by the ANRA Laboratory must be filled out, along with the ANRA Sample Custodian relinquishment signature before the subcontract laboratory accepts the sample(s). Copies of complete COC forms are returned along with the analysis report.

5. A copy of the COC forms is retained for ANRA records. Copies of COC forms are kept along with the laboratory analysis reports and associated field sheet(s).

Sample Tracking

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of sampling and continuing through transport, sample receipt, preparation, and analysis.

A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The COC form is used to document sample handling during transfer

from the field to the laboratory and among contractors. The following information concerning the sample is recorded on the COC form (See Appendix C):

- Date and time of collection
- Site identification
- Sample matrix
- Number of containers
- Preservative used
- Was the sample filtered?
- Analyses required
- Name of collector
- Custody transfer signatures and dates and time of transfer
- Bill of lading (*if applicable*)

Sample Tracking Procedure Deficiencies and Corrective Action
All failures associated with COC procedures are to be immediately reported to the TSSWCB PM. Failures include such items as delays in transfer, resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc. The ANRA CRP Coordinator and the TSSWCB PM/QAO will determine if the procedural violation may have compromised the validity of the resulting data. Any failure that potentially compromises data validity will invalidate data, and the sampling event should be repeated. The resolution of the situation will be reported to the TSSWCB in the QPR. Copies of the CARs will be maintained by the ANRA Quality Manager, TWRI PM, and TSSWCB PM.

***LDC and SELECT Analyses*-** Not relevant.

Section B4: Analytical Methods

SWQM- The analytical methods are listed in Tables A7.1, A7.2, and A7.3 of Section A7. Laboratories must be accredited in accordance with NELAP requirements for the matrix, method, parameter combinations listed in Tables A7.1, A7.2, and A7.3 of this QAPP. Procedures for laboratory analysis will be in accordance with the most recently published or online edition of *Standard Methods for the Examination of Water and Wastewater*, the latest version of the TCEQ SOP, V1 or other reliable procedures acceptable to TCEQ.

Laboratories that produce analytical data under this QAPP must be NELAP accredited. Copies of laboratory quality manuals (QMs) and SOPs are available for review by the TCEQ.

Standards Traceability
All standards used in the field and laboratory are traceable to certified reference materials. Standards and reagent preparation is fully documented and maintained in a standards log book. Each documentation includes information concerning the standard or reagent identification, starting materials, including concentration, amount used and lot number; date prepared, expiration date and preparer's initials/signature. The bottle is labeled in a way that will trace the standard or reagent back to preparation. Standards or reagents used are documented each day samples are prepared or analyzed.

Analytical Method Deficiencies and Corrective Actions
Deficiencies in field and laboratory measurement systems involve, but are not limited to such things as instrument malfunctions, failures in calibration, blank contamination, quality control samples outside QAPP defined limits, etc. In many cases, the field technician or lab analyst will be able to correct the problem. If the problem is resolvable by the field technician or lab analyst, then they will document the problem on the field data sheet or laboratory record and complete the analysis. If the problem is not resolvable, then it is conveyed to the applicable LM, who will make the determination and notify the ANRA Quality Manager. If the analytical system failure may compromise the sample results, the resulting data will not be reported to the TCEQ SWQMIS database. The nature and disposition of the problem is reported on the data report. The TWRI PM/QAO will include this information in the CAR and submit it with the QPR, which is sent to the TSSWCB PM.

The definition of and process for handling deficiencies, non-conformances, and corrective action are defined in Section C1.

The TCEQ has determined that analyses associated with the qualifier codes (e.g. "holding time exceedance", "sample received unpreserved", "estimated value", etc.) may have unacceptable measurement uncertainty associated with them. This will immediately disqualify analyses from submittal to SWQMIS. Therefore, data with these types of problems should not be reported to the TCEQ. Additionally, any data collected or analyzed by means other than those stated in the QAPP must have an appropriate data qualifier assigned which can be found in the most recent version of the SWQM DMRG.

Failures in Measurement Systems and Corrective Actions
Failures in field and laboratory measurement systems involve, but are not limited to such things as instrument malfunctions, failures in calibration, blank contamination, QC samples outside QAPP defined limits, etc. In many cases, the field technician or lab analyst will be able to correct the problem. If the problem is resolvable by the field technician or lab analyst, then they will document the problem on the field data sheet or laboratory record and complete the analysis. If the problem is not resolvable, then it is conveyed to the ANRA LM or ANRA Quality Manager, who will make the determination in coordination with the TWRI PM/QAO. If the analytical system failure may compromise the sample results, the resulting data will not be reported to the TSSWCB as part of this project. The nature and disposition of the problem is reported on the data report. The TWRI PM/QAO will include this information in the CAR and submit with the QPR which is sent to the TSSWCB PM.

***LDC and SELECT Analyses*-** Not relevant.

Section B5: Quality Control Requirements

SWQM
Sampling Quality Control Requirements and Acceptability Criteria

Samples are collected in accordance with the TCEQ SOP, V1. These procedures were revised in 2014 to eliminate the requirement for a Field Split.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Batch
A batch is defined as environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same NELAP-defined matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 25 hours. An **analytical batch** is composed of prepared environmental samples (extract, digestate. or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

Method Specific QC requirements
QC samples, other than those specified later this section (e.g., sample duplicates, surrogates, internal standards, continuing calibration samples, interference check samples, positive control, negative control, and media blank), are run as specified in the methods. The requirements for these samples, their acceptance criteria or instructions for establishing criteria, and corrective actions are method-specific.

Detailed laboratory QC requirements and corrective action procedures are contained within the individual laboratory QMs. The minimum requirements that all participants abide by are stated below.

Limit of Quantitation (LOQ)
The laboratory will analyze a calibration standard (if applicable) at the LOQ listed in Table A7.1 on each day calibrations are performed. In addition, an LOQ check sample will be analyzed with each analytical batch. Calibrations including the standard at the LOQ will meet the calibration requirements of the analytical method or corrective action will be implemented.

LOQ Check Sample
An LOQ check sample consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system at the lower limits of analysis. The LOQ check sample is spiked into the sample matrix at a level less than or near the LOQ listed in Table A7.1 for each analyte for each analytical batch of samples run. If it is

determined that samples have exceeded the high range of the calibration curve, samples should be diluted or run on another curve.

The LOQ check sample is carried through the complete preparation and analytical process. LOQ Check Samples are run at a rate of one per analytical batch.

The percent recovery of the LOQ check sample is calculated using the following equation in which %R is percent recovery, S_R is the sample result, and S_A is the reference concentration for the check sample:

$$\%R = {}^{S_R}/_{S_A} \times 100$$

Measurement performance specifications are used to determine the acceptability of LOQ Check Standard analyses as specified in Table A7.1.

Laboratory Control Sample (LCS)
An LCS consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system. The LCS is spiked into the sample matrix at a level less than or near the mid-point of the calibration for each analyte. In cases of test methods with very long lists of analytes, LCSs are prepared with all the target analytes and not just a representative number, except in cases of organic analytes with multipeak responses.

The LCS is carried through the complete preparation and analytical process. LCSs are run at a rate of one per preparation batch.

Results of LCSs are calculated by percent recovery (%R), which is defined as 100 times the measured concentration, divided by the true concentration of the spiked sample.

The following formula is used to calculate percent recovery, where %R is percent recovery; S_R is the measured result; and S_A is the true result:

$$\%R = {}^{S_R}/_{S_A} \times 100$$

Measurement performance specifications are used to determine the acceptability of LCS analyses as specified in Table A7.1.

Laboratory Duplicates
A laboratory duplicate is prepared by taking aliquots of a sample from the same container under laboratory conditions and processed and analyzed independently. A laboratory control sample duplicate (LCSD) is prepared in the laboratory by splitting aliquots of an LCS. Both samples are carried through the entire preparation and analytical process. LCSDs are used to assess precision and are performed at a rate of one per preparation batch.

For most parameters except bacteria, precision is evaluated using the relative percent difference (RPD) between duplicate LCS results as defined by 100 times the difference (range) of each duplicate set, divided by the average value (mean) of the set. For duplicate results, X_1 and X_2, the RPD is calculated from the following equation:

$$RPD = \frac{|X_1 - X_2|}{\left(\frac{X_1+X_2}{2}\right)} \times 100$$

For bacteriological parameters, precision is evaluated using the results from laboratory duplicates. Bacteriological duplicates are collected on a 10% frequency (or once per sampling run, whichever is more frequent). These duplicates will be collected in sufficient volume (200 mL or more) for analysis of the sample and its laboratory duplicate from the same container.

The base-10 logarithms of the result from the original sample and the result from its duplicate will be calculated. The absolute value of the difference between the two logarithms will be calculated, and that difference will be compared to the precision criterion in Table A7.2.

If the difference in logarithms is greater than the precision criterion, the data are not acceptable for use under this project and will not be reported to TCEQ. Results from all samples associated with that failed duplicate (usually a maximum of 10 samples) will be considered to have excessive analytical variability and will be qualified as not meeting project QC requirements.

The precision criterion in Table A7.2 for bacteriological duplicates applies only to samples with concentrations > 10 MPN/100mL. Field splits will not be collected for bacteriological analyses.

Matrix Spike (MS)
Matrix spikes are prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.

Matrix spikes indicate the effect of the sample on the precision and accuracy of the results generated using the selected method. The frequency of matrix spikes is specified by the analytical method, or a minimum of one per preparation batch, whichever is greater. To the extent possible, matrix spikes prepared and analyzed over the course of the project should be performed on samples from different sites.

The components to be spiked shall be as specified by the mandated analytical method. The results from matrix spikes are primarily designed to assess the validity of analytical results in a given matrix, and are expressed as percent recovery (%R).

The percent recovery of the matrix spike is calculated using the following equation, where %R is percent recovery, S_{SR} is the concentration measured in the matrix spike, S_R is the concentration in the unspiked sample, and S_A is the concentration of analyte that was added:

$$\%R = \frac{S_{SR} - S_R}{S_A} \times 100$$

Matrix spike recoveries are compared to the same acceptance criteria established for the associated LCS recoveries, rather than the matrix spike recoveries published in the mandated test method. The EPA 1993 methods (i.e. ammonia-nitrogen, ion chromatography, TKN) that establish matrix spike recovery acceptance criteria are based on recoveries from drinking water that has very low interferences and variability and do not represent the matrices sampled in the CRP (ambient surface water). If the matrix spike results are outside laboratory-established criteria, there will be a review of all other associated quality control data in that batch. If all of quality control data in the associated batch passes, it will be the decision of the ANRA Quality Manager or ANRA CRP Coordinator/TWRI PM to report the data for the analyte that failed in the parent sample to TCEQ or to determine that the result from the parent sample associated with that failed matrix spike is considered to have excessive analytical variability and does not meet project QC requirements. Depending on the similarities in composition of the samples in the batch, ANRA may consider excluding all of the results in the batch related to the analyte that failed recovery.

Method Blank

A method blank is a sample of matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as the samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. The method blanks are performed at a rate of once per preparation batch. The method blank is used to document contamination from the analytical process. The analysis of method blanks should yield values less than the LOQ. For very high-level analyses, the blank value should be less than 5% of the lowest value of the batch, or corrective action will be implemented. Samples associated with a contaminated blank shall be evaluated as to the best corrective action for the samples (e.g. reprocessing or data qualifying codes). In all cases the corrective action must be documented.

The method blank shall be analyzed at a minimum of once per preparation batch. In those instances for which no separate preparation method is used (example: volatiles in water) the batch shall be defined as environmental samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples.

Quality Control or Acceptability Requirement Deficiencies and Corrective Actions

Sampling QC excursions are evaluated by the ANRA CRP Coordinator, in consultation with the ANRA Quality Manager. In that differences in sample results are used to assess the entire sampling process, including environmental variability, the arbitrary rejection of results based on pre-determined limits is not practical. Therefore, the professional judgment of the ANRA CRP Coordinator and Quality Manager will be relied upon in evaluating results. Rejecting sample results based on wide variability is a possibility.

Laboratory measurement quality control failures are evaluated by the laboratory staff. The disposition of such failures and the nature and disposition of the problem is reported to the ANRA Quality Manager. The ANRA Quality Manager will discuss the failure with the ANRA CRP Coordinator. If applicable, the ANRA CRP Coordinator will include this information in the CAR and submit with the Progress Report, which is sent to the TSSWCB PM.

Additionally, in accordance with TNI Standard (Volume 1, Module 2, Section 4.5, Subcontracting of Environmental Tests) when a laboratory that is a signatory of this QAPP finds it necessary and/or advantageous to subcontract analyses, the laboratory that is the signatory on this QAPP must ensure that the subcontracting laboratory is NELAP-accredited (when required) and understands and follows the QA/QC requirements included in this QAPP. This includes that the sub-contracting laboratory utilize the same reporting limits as the signatory laboratory and performs all required quality control analysis outlined in this QAPP. The signatory laboratory is also responsible for quality assurance of the data prior to delivering it to ANRA, including review of all applicable QC samples related to project data. As stated in section 4.5.5 of TNI Standard, the laboratory performing the subcontracted work shall be indicated in the final report and the signatory laboratory shall make a copy of the subcontractor's report available to the client (ANRA) when requested.

The definition of and process for handling deficiencies, non-conformances, and corrective action are defined in Section C1.

Failures in Quality Control and Corrective Action
Notations of blank contamination will be noted in QPRs and the final report. Corrective action will involve identification of the possible cause (where possible) of the contamination failure. Any failure that has potential to compromise data validity will invalidate data, and the sampling event should be repeated. The resolution of the situation will be discussed with pertinent project PMs and QAOs. The TWRI PM and QAO will include this information in the CAR and submit with the Progress Report which is sent to the TSSWCB PM.

LDC and SELECT Analyses- Not relevant.

Section B6: Equipment Testing, Inspection, & Maintenance Requirements

SWQM
All sampling equipment testing and maintenance requirements are detailed in the most recent version of the TCEQ SOP, V1. Sampling equipment is inspected and tested upon receipt and is assured appropriate for use. Equipment records are kept on all field equipment and a supply of critical spare parts is maintained.

All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory QM(s).

LDC and SELECT Analyses- Not relevant.

Section B7: Instrument Calibration and Frequency

SWQM- In-stream field equipment calibration requirements are contained in the most recent version of the TCEQ SOP, V1 or manufacturers manuals. Equipment will be tested, maintained, inspected, and calibrated according to these procedures. Post calibration error limits and the disposition resulting from error are adhered to. Data not meeting post-error limit requirements invalidates associated data collected subsequent to the pre-calibration and are not submitted to the TCEQ.

Detailed laboratory calibrations are contained within the laboratory QM(s), SOPs, and manufacturers manuals as appropriate and will be tested, maintained, inspected, and calibrated according to these procedures.

LDC and SELECT Analyses- Not relevant.

Section B8: Inspection/Acceptance Requirements for Supplies and Consumables

SWQM- New batches of supplies are tested before use to verify that they function properly and are not contaminated. The laboratory QM provides additional details on acceptance requirements for laboratory supplies and consumables.

LDC and SELECT Analyses- Not relevant.

Section B9: Data Acquisition Requirements (Non-direct Measurements)

SWQM- Water quality data available in TCEQ's SWQMIS and ANRA's CRP Database will be used as historical references for instream water quality and conditions. US Geologic Survey (USGS) flow data available in the watershed may also be useful for evaluating instream conditions. These data will support the development of trend analysis during the waterbody assessment. This is the only water quality data collected outside this project that will be utilized.

Table B9.1. Monitoring Data Sources

Data Type	Monitoring Project/Program	Collecting Entity	Dates of Collection	QA Information	Data Use(s)
Monitoring Data	ANRA Clean Rivers Program	ANRA	9/1/1990 - Current at stations historically monitored by ANRA in Table A6.2	ANRA-CRP QAPP; SWQMIS database	summary statistics, trend analysis
Monitoring Data	TCEQ SWQM Program	TCEQ	9/1/1990 - Current at stations historically monitored by TCEQ in Table A6.2	TCEQ SWQM QAPP; SWQMIS database	summary statistics, trend analysis
Flow Data	United States Geological Survey (USGS) flow data	USGS	For the period of record collected by the USGS at stations in Table A6.2	USGS QAPP; USGA database	Flow measurements
Precipitation Data	National Weather Service (NWS)	NWS	Most up-to-date precipitation data will be downloaded from the NWS website	NWS Website	Days since last precipitation

Any non-direct measurements will comply with all requirements under this QAPP. Sampling conducted by the TCEQ, the USGS and Texas Clean Rivers Program partners is not covered under this QAPP and will not be reported to the TSSWCB PM by the TWRI. However, data collected by the above organizations that meet the data quality objectives of this project will be useful in satisfying the data and informational needs of the project. The collection and qualification of the TCEQ and USGS data are addressed in the TCEQ Surface Water Quality Monitoring QAPP. The collection and qualification of the Texas CRP data are addressed in the Texas Clean Rivers Program QAPPs. Historic water quality data collected through TCEQ's CRP program and under its approved QAPP will be utilized in this project. Parameters utilized will include instantaneous stream flow, temperature, pH, specific conductivity, DO, nitrate, nitrite, nitrate+nitrite (alternative for nitrate, nitrite), ammonia, sulfate, total phosphorus, chloride, total suspended solids, and *E. coli* as available. Potential sources where data will be acquired from are included in Table B9.1. No limitations will be placed on these data as they have been vetted by the TCEQ SWQM Data Management and Assessment Team and were collected under a TCEQ approved QAPP.

Only data collected directly under this QAPP will be submitted to the TCEQ for storage in SWQMIS. This project will not submit any acquired or non-direct measurement data to SWQMIS

that has been or is going to be collected under another QAPP. All data collected under this QAPP and any acquired or non-direct measurements will comply with all requirements/guidance of the project.

LDC and SELECT Analyses- Water quality data collected by TCEQ & ANRA, specifically *E. coli*, nitrates, and flow will be used to conduct the SELECT (*E. coli* only) and LDC (*E. coli* and nitrates) analyses. ANRA is a partner in the Clean Rivers Program for the state of Texas. As such, they collect data on a regular basis for routine water quality assessment as part of the state's mandate for Clean Water Act (CWA) §305(b) – Water Quality Inventory Report. These data also are used by Texas for consideration of water bodies to be added to their list of impaired water body segments, as described in CWA §303(d). Additional data obtained from the TCEQ SWQMIS database will also be utilized.

All data used in the modeling procedures for this project are collected in accordance with approved quality assurance measures under the state's Clean Rivers Program, TCEQ, Texas Water Development Board, USDA, National Weather Service, or U.S. Geologic Survey (USGS).

GIS Inventory

Geospatial data available from various local, regional, state, and federal organizations may be used for cartographic purposes. Maps developed for reports will be for illustrative purposes. Geospatial data utilized in maps of the study area may include land use, precipitation, soil type, ecoregion, TCEQ monitoring location, TCEQ permitted outfall, gage location, city/county/state boundary, stream hydrology, reservoir, drought, road, watershed, municipal separate storm sewer system, urbanized area, basin, railroad, recreational area, area landmark, aerial photography, and park information. The above data come from the following reliable sources: USGS, TNRIS, TCEQ, TXDOT, TSSWCB, TWDB, and US Census Bureau. Geospatial data from these sources are accepted for use in this project maps based on the reputability of these data sources and the fact that there are no known comparable sources for these data. Geospatial data will be cited in reports.

Other data that are compiled and published by other entities may also be used in preparing project reports. This may include long-term precipitation, census, ecoregion, land use and land cover, historic water quality and stream flow data. Sources of these data are the USGS, National Weather Service, US Census Bureau, USDA NRCS, TCEQ, and TPWD. Data collected by these entities are assumed to have been verified and validated according to the requirements of the respective programs. Data compilations created for this project will be visually screened for errors. Data will be cited in reports.

Table B9.2 lists the type of measurement, data, units, source, QA documentation use and data range of each acquired data set where applicable.

Because most historical data is of known and acceptable quality and were collected and analyzed in a manner comparable and consistent with needs for this project, no limitations will be placed on their use, except where known deviations have occurred.

Table B9.2. Non-Direct Data Types and Data Sources for the Waterbodies in the Angelina River above Sam Rayburn watershed

Type of Measurement or Analysis	Type of Data (time series, rate, constant, statistic, taxa, etc.)	Units	Source (weblink when available)	Quality Assurance Documentation	Use	Date Range
Streamflow	Time series, daily streamflow	Average daily (cfs)	USGS http://waterdata.usgs.gov/tx/nwis/sw	Data noted as "Approved" (quality-assured data) or "Provisional" (of unverified accuracy and subject to revision). More recent "provisional" data may be used in the project after thorough review. "Approved" data have successfully undergone USGS quality assurance.	FDCs	All data available
E. coli, specific conductance, nitrate, phosphorous, DO, instantaneous flow	Concentration at various points in time	CFU or MPN/100mLfor bacteria; µmhos/cm for spec. cond; ppm for nutrients; mg/L for DO, cfs for flow	TCEQ SWQMIS http://www.tceq.texas.gov/waterquality/data-management/wdma_forms.html	Data requested will include only data that met quality assurance/quality control (QA/QC) requirements as outlined under the SWQM Data Management Reference Guide.	LDCs	most recent 7 years; or 10 years if insufficient data exists
TCEQ Surface Water Quality Monitoring Stations	Spatial data, location of active and historical SWQM stations	Shapefile - Points	TCEQ GIS Site Layers Download Page http://www.tceq.texas.gov/gis/sites.html	Data Management Reference Guide (DMRG) for Surface Water Quality Monitoring http://www.tceq.texas.gov/waterquality/data-management/dmrg_index.html	Map development and FDCs/LDCs	N/A
TCEQ Segments	Spatial data, official TCEQ Segments	Shapefile - Polylines	TCEQ GIS Hydrology Layers http://www.tceq.texas.gov/gis/hydro.html	TCEQ 2010 Stream Segments Metadata http://www.tceq.texas.gov/assets/public/gis/metadata/stream_segments.pdf	Map development	N/A
County Boundaries	Spatial data, StratMap Boundaries	Shapefile - Polygons	TNRIS Data Search & Download http://www.tnris.org/	Metadata available with download	Map development	N/A
Watershed topography	Spatial GIS data, Digital Elevation Models (DEMs)	Raster- 10 meter resolution	National Elevation Dataset from USGS National Map Viewer http://nationalmap.gov/viewer.html	Digital Elevation Model Technologies and Applications: The DEM Users Manual 2nd Edition	Delineation of watershed and subwatershed boundaries for maps	N/A

Type of Measurement or Analysis	Type of Data (time series, rate, constant, statistic, taxa, etc.)	Units	Source (weblink when available)	Quality Assurance Documentation	Use	Date Range
Land Use/Land Cover	National Land Cover Dataset – GIS raster dataset	Raster – 30 m resolution	National Land Cover Database 2016 (NLCD2016) from MRLC Consortium Viewer https://www.mrlc.gov/viewer/	Jin, S., Yang, L., Danielson, P., Homer, C., Fry, J., and Xian, G. 2013. A comprehensive change detection method for updating the National Land Cover Database to circa 2011. *Remote Sensing of Environment*, 132: 159 – 175.	Map development	Based on Landsat imagery between 2013 and 2016
Soil Map Unit Boundaries and Properties	Spatial GIS data, Soils	Shapefile - polygons	NRCS SSURGO databases via Web Soil Survey http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm or Geospatial Data Gateway http://datagateway.nrcs.usda.gov/	SSURGO/STATSGO2 Structural Metadata and Documentation http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053631	Map development	various
Sanitary Sewer Overflows (SSOs)	Individual events	Location and amount (gallons)	TCEQ Regions 12 & 14 Excel database provided upon request by regional staff	Data entry based on reported occurrences, Level of QA unknown	Quantify reported SSOs	2000-2013
Municipal & Industrial WWTF Discharge Monitoring Reports	Self-reporting monthly discharge and concentration data	concentration bacteria (MPN/100mL or colonies/100mL), flow (MGD)	USEPA Enforcement & Compliance History Online (ECHO) website http://echo.epa.gov/echo/ or directly from permitted facilities	Reporting data based on permit requirements	Source analysis; FDCs/LDCs	2000 - present for presently active permits
General permits involving regulation of stormwater	Regulated entities	N/A	TCEQ Information Resources Division Central Registry http://www2.tceq.texas.gov/wq_dpa/index.cfm	None accessible; TCEQ databases	Determination of regulated stormwater for TMDL development	2000 - present
Water Rights Diversion Points	Spatial GIS and Tabular Data	N/A	TCEQ http://www.tceq.state.tx.us/gis/sites.html	None accessible; TCEQ databases	Understanding uses of surface water in the watershed	2013
Urbanized Areas	Spatial GIS	Shapefile - polygons	U.S. Census Bureau TIGER/Line® Shapefiles http://www.census.gov/cgi-bin/geo/shapefiles2010/main and information from municipalities	Urban-Rural Classification Program http://www.census.gov/geo/reference/urban-rural.html	Map development; define regulated stormwater	2010

Type of Measurement or Analysis	Type of Data (time series, rate, constant, statistic, taxa, etc.)	Units	Source (weblink when available)	Quality Assurance Documentation	Use	Date Range
Population	Spatial GIS and tabular data	2010 Census blocks, Shapefile – polygons	US Census Bureau, 2010 TIGER/Line® Shapefiles download interface http://www.census.gov/cgi-bin/geo/shapefiles2010/main; Tabular data from US Census Bureau, American Fact Finder http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml	Metadata available with download	Map and source development	2010
Building locations	Spatial GIS, point data	Shapefile - points	Brazos Valley and Heart of Texas Councils of Government 911 address shapefiles	Programmatic	Map and source development, OSSF estimations	N/A
Hydrography	Vector GIS data	Geodatabase – points, polylines, polygons	National Hydrography Dataset (NHD)Pre-staged Subregions http://nhd.usgs.gov/data.html	NHD Program Documentation http://nhd.usgs.gov/program_documentation.html	Map development	N/A
Livestock population estimates	County-level livestock density	County level individual animals	USDA Census of Agriculture https://www.nass.usda.gov/Publications/AgCensus/2017/index.php	Regulations Guiding NASS http://www.agcensus.usda.gov/About_the_Census/Regulations_Guiding_NASS/index.php	Map and source development	2007-2017 (when available)
Deer	Spatial wildlife density	Density (animal per unit area)	Texas Parks & Wildlife Department surveys and/or information from biologists	Jester & Dillard (undated)	Source development	N/A
Cats and dogs	Spatial, pet density	number per household	AVMA 2002 U.S. Pet Ownership data and stakeholder input	[AVMA] American Veterinary Medical Association. 2002. U.S. Pet Ownership and Demographics Source Book.Schaumberg (Illinois): Center for Information Management, American Veterinary Medical Association.	Source development	N/A

Type of Measurement or Analysis	Type of Data (time series, rate, constant, statistic, taxa, etc.)	Units	Source (weblink when available)	Quality Assurance Documentation	Use	Date Range
Feral hogs	Spatial feral animal density	Feral hog density (animals per unit area)	TWRI, Wagner, K.L. and Moench, E. 2009. https://oaktrust.library.tamu.edu/bitstream/handle/1969.1/93181/TR-347%20Copano%20Task%202%20Report%20031109.pdf?sequence=1&isAllowed=y. *Education Program for Improved Water Quality in Copano Bay. Task Two Report*. College Station, TX: Texas Water Resources Institute. TR-347. literature values and stakeholder input TPWD, literature values and stakeholder input	Mellish et al. 2013.	Source development	N/A
Water and sewer service areas	Spatial GIS data	Shapefile - polygons	TCEQ GIS Regulatory/ Administrative Boundaries, Water & Sewer Certificates of Convenience and Necessity Service Areas,http://www.tceq.texas.gov/gis/boundary.html	Sewer CCN Service Areas Metadata, http://www.tceq.texas.gov/assets/public/gis/metadata/ccn_sewer.pdf	Map and source development	Present
Population projections	Tabular data, organized by Region, includes Census 2010 data and population projections for 2020 - 2070	Water User Group (WUG)	TWDB Water Planning, 2017 State Water Plan Projections Data, DRAFT http://www.twdb.state.tx.us/waterplanning/data/projections/2017/demandproj.asp	Projection Methodology – Draft Population and Municipal Water Demands, http://www.twdb.state.tx.us/waterplanning/data/projections/2017/doc/draft/methodology.pdf	Map and source development, LDC	2010 -2070
Air temperature and precipitation	Daily time series and monthly and annual normal values	Air Temperature (ºC or ºF), Precipitation (mm or inches)	National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) http://www.ncdc.noaa.gov/cdo-web/	NOAA Information Quality Guidelines, http://www.cio.noaa.gov/services_programs/info_quality.html	Summarize past and current weather conditions for reports	1972 - 2012
Average annual air temperature and precipitation	Spatial GIS data	Raster – 800 m resolution	PRISM Climate Group, Oregon State University, 30-arcsec NORMALS http://www.prism.oregonstate.edu/	PRISM Climate Group, Documentation FGDC Metadata http://www.prism.oregonstate.edu/docs/index.phtml	Map development	1981 -2010

Section B10: Data Management

SWQM- It is imperative that data and associated applications be maintained and managed in a manner consistent with the development and use of the data; in this case, data will be maintained so that they are consistent with CRP requirements. For scientifically valid results, the data, program applications, and reports must be handled in an orderly and consistent manner. Documented quality assurance and quality control checks/procedures are applied to all received data sets, individual data points and data manipulation programs.

Data will be incorporated into the ANRA database and subject to varying levels of review. The QA/QC checks evaluate each data set as a whole, and the validity of individual data points. Each data set to be processed into the database is evaluated for any problems that might impose a limitation on the use of the data. This check is performed prior to processing/importing to the database. The following information is considered:

a. Credibility of data source
b. Acceptable QA/QC procedures
c. Intended use of the data
d. Frequency of data collection/impact of missed sampling events
e. Sample size
f. Sample collection and preservation methods
g. Field and laboratory test procedures
h. General documentation

Upon passing the evaluation of a data set's limitations, the data are incorporated into the ANRA Database. Initially data are entered, either manually or electronically, into a set of working directory files that are consistent with the ANRA Database file structures. In the event that a deviation is found in the data set, the corresponding data points will be coded with a “D” in the remarks section of the Results Table. The remark “D” code refers to the SWQMIS data qualifiers, which means ‘did not pass all QC criteria. Any deviation found in the data set will be conveyed to the TWRI PM by ANRA. Disqualified data will be removed from the dataset and will not be submitted to the TSSWCB for inclusion in SWQMIS. The reason for the data removal will be listed on the data summary.

Electronic data input procedures vary according to the source and format of the data. Manual data input will be made to appropriately structured MS Access tables. Standardized procedures are followed to ensure proper data entry. Laboratory data will be queried directly from the Laboratory’s LIMS and imported into the ANRA CRP Database.

After the data/data sets have been input/converted into an appropriate working directory database, the individual data points will be evaluated by the ANRA PM and ANRA QAO to determine their reasonableness. Data values that are considered outliers will be discarded or coded prior to entry into the records directory. The criteria for determination of outliers will be based on individual data sets being processed for entry into the TCEQ’s SWQMIS database. Once the data set is complete, any individual points falling outside the most recent Max/Min

range as defined by the TCEQ SWQM Parameters Table will be considered outliers. If an outlier does occur, then it will be noted in the remark section of the database and verified against the original data report, and if necessary, verified by the laboratory. After verification, outliers will either be assigned the appropriate remark code or documented as verified with a 1 in the verify_flg section of the results table.

After the ANRA QAO performs the final QA checks, data is then loaded into the SWQMIS Test Environment by ANRA before submitting it to the TCEQ. TCEQ will then send the validator report to the TSSWCB in order to cross-check it with the QAPP. Lastly, TSSWCB will then approve or disapprove the final upload of the data and inform the TCEQ of their decision.

Only data collected under this project and its QAPP will be transferred. The tag series transferred is documented on the Data Summary (QAPP Appendix D) that is submitted to the TCEQ upon the completion of the data transfer. All QA data sets associated with the data transfer will be submitted in the form of a QA Table. The files are transferred as pipe delimited text file format as described in the most recent version of the SWQM DMRG to TCEQ's SWQMIS and on to the TSSWCB PM. After data have been transferred, reviewed, and loaded into the TCEQ SWQMIS Database, a link will provided to the TCEQ's Surface Water Quality Web Reporting Tool at:
https://www80.tceq.texas.gov/SwqmisPublic/public/default.htm.

Data Dictionary - Terminology and field descriptions are included in the most recent version of the *SWQM Data Management Reference Guide*. For the purposes of verifying which entity codes are included in this QAPP, the following will be used when submitting data under this QAPP:

Tag Prefix:	TX - Texas State Soil and Water Conservation Board
Submitting Entity:	TX - Texas State Soil and Water Conservation Board
Collecting Entity:	WR- Texas Water Resources Institute AN- Angelina Neches River Authority

Data Errors and Loss
To prevent loss of data and minimize errors, all data generated under this QAPP are verified against the appropriate quality assurance checks as defined in the QAPP, including but not limited to chain of custody procedures, field sampling documentation, laboratory analysis results, and quality control data.

Automated and manual Data Reviews are performed prior to data transmittal to TCEQ. Examples of checks that are used to review for data errors and data loss include:

- Parameter codes are contained in the QAPP

- Sites are in the QAPP Coordinated Monitoring Schedule
- Transcription or input errors
- Relationships among analytes
- Count of reported analytes (ex: # pH = # DO = # Temperature)
- Significant figures
- Values are at or above the LOQs
- Values are below the highest standard of the calibration curve, and appropriate dilutions (if necessary) have been used
- Check for outliers
- Verified outliers are flagged
- Use of correct reporting units
- Flows should have a flow method associated with the data
- If flow severity = 1, then flow = 0
- If flow severity = 6, then no value is reported for flow
- Depth of surface sample is reported
- Post-calibration error limits for multiprobe instrumentation (Table 8.3 in SWQM PM)

Results and Events files are automatically generated from the ANRA Database. These files contain the correct number of fields for inclusion in SWQMIS.

Data exceeding holding times, improperly preserved samples, and estimated concentrations have unacceptable measurement uncertainty associated with them. This uncertainty will immediately disqualify analyses for submittal to SWQMIS. Therefore, data with these types of issues are not reported to the TCEQ and will be noted in the Data Summary Report.

All data is uploaded to the SWQMIS User Acceptance Test environment, and a validator report is generated. The validator report is reviewed and any issues are corrected prior to the data being transmitted to the SWQMIS Production environment.

Record Keeping and Data Storage
A three ring binder will be used as a data set log to track all hard copy data sets associated with the ANRA Database. Data sets will be scanned for electronic storage.

Complete original electronic data sets are backed up on a daily basis Monday through Friday of each work week, with data stored at an off-site location to prevent loss due to a disaster such as fire or flood. The original hard copies of field data sheets and laboratory reports are stored in binders at the ANRA offices until the data sheets and forms can be electronically scanned. Paper copies of the field sheets and reports may be disposed of once a permanent electronic record is created and saved to the ANRA server.

Archives/Data Retention
Complete original data sets are archived electronically and retained on-site by ANRA for a retention period specified in section A9. Electronic data is typically stored permanently on ANRA's server.

Data Verification/Validation
The control mechanisms for detecting and correcting errors and for preventing loss of data during data reduction, data reporting, and data entry are contained in Sections D1, D2, and D3.

Forms and Checklists
See Appendix D for the Data Review Checklist and Summary.
See Appendix B for the Field Data Reporting Form.
See Appendix C for the Chain-of-Custody Form

Data Handling
ANRA's server provides security by limiting access to restricted users. The ANRA LIMS is also protected by user-level login and user-specific menus which can be used to restrict access to certain functions in the system.

The Laboratory's LIMS program has user-level access control. From the LIMS, analytical results are exported to ANRA's Database, which is a MS Access-based database. Several data checks have been implemented into the ANRA Database to identify values which do not meet criteria for inclusion into SWQMIS. The ANRA Database sequentially assigns Tag IDs to samples entered into the system. The database is capable of automatically generating Results and Events files which are compliant with the specifications listed in the **DMRG.**

Hardware and Software Requirements
Hardware configurations are sufficient to run Microsoft Access under the Windows operating system. Information Resources staff are responsible for assuring hardware configurations meet the requirements for running current and future data management/database software as well as providing technical support. Software development and database administration are also the responsibility of the information resources department. Information Resources develops applications based on user requests and assures full system compatibility prior to implementation.

Hardware – The ANRA water quality database is stored on a Windows-based server. The ANRA Laboratory's LIMS (LabLite) is run from a Windows Server-based system.

Software – Laboratory data is stored in LabLite LIMS, a SQL-based database program.

Staff uses MS Office software (Word, Excel, Access, PowerPoint, and Outlook). For GIS, ANRA uses ESRI ArcView.

Information Resource Management Requirements
Data will be managed in accordance with the DMRG, and applicable ANRA information resource management policies.

Data analyzed by the ANRA Laboratory is stored in Lablite LIMS, a commercially available SQL-based relational database. The ANRA Database, created in-house and based on MS

Access, has been modified to import data directly from Lablite LIMS, automating the process and eliminating the manual reentry of the data, reducing the chance of transcription errors. Additional validity checks have also been included in the ANRA Database. Imported data is linked to parameter code tables in the ANRA Database, ensuring that results are reported under the correct parameter code. Additional functions, such as a graphing module, have been added to the database for data review purposes. Results and Events files are automatically generated by the database in the proper format for submittal to SWQMIS.

Data in both Lablite and the ANRA Database are stored on a password-protected server, and access is granted only to authorized individuals. Data backups are performed nightly, with copies of backups stored off-site.

Data Validation

Following review of laboratory data, any data that is not representative of environmental conditions, because it was generated through poor field or laboratory practices, will not be submitted to the TSSWCB. This determination will be made by the ANRA PM, ANRA QAO, TWRI PM/QAO, TSSWCB QAO, and other personnel having direct experience with the data collection effort. This coordination is essential for the identification of valid data and the proper evaluation of that data. The validation will include the checks specified in Table D2.1.

Data Dissemination

At the conclusion of the project, the TWRI Project Leader will provide a copy of the complete project electronic spreadsheet via recordable media to the TSSWCB PM, along with the final report. The TSSWCB may elect to take possession of all project records. However, summaries of the data will be presented in the final project report.

Section C1: Assessments and Response Actions

The following table presents types of assessments and response actions for data collection and analysis activities applicable to the QAPP and all facets of the project.

Table C1.1. Assessments and Response Actions

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	TWRI, ANRA, BAEN	Monitor project status and records to ensure requirements are being fulfilled. Monitoring & review performance & data quality	Report to TSSWCB in QPR.
Laboratory Inspections	TBD by TSSWCB	TSSWCB	Analytical and QC procedures in the laboratory	45 days to respond to TSSWCB with corrective actions
Technical systems audit	As needed	TSSWCB	Assess compliance with QAPP; review facility and data management as they relate to the project	45 days to respond to TSSWCB with corrective actions
Monitoring Systems Audit	Once per life of project	TSSWCB	Assess compliance with QAPP; review field sampling and data management as they relate to the project	45 days to respond to TSSWCB with corrective actions

In-house review of data quality and staff performance to assure that work is being performed according to standards will be conducted by all entities. If review show that the work is not being performed according to standards, immediate corrective action will be implemented. CARs will be submitted to TSSWCB and documented in the project QPRs.

The TSSWCB QAO (or designee) may conduct an audit of the field or technical systems activities for this project as needed. Each entity will have the responsibility for initiating and implementing response actions associated with findings identified during the on-site audit. Once the response actions have been implemented, the TSSWCB QAO (or designee) may perform a follow-up audit to verify and document that the response actions were implemented effectively. Records of audit findings and corrective actions are maintained by the TSSWCB PM and TWRI QAO. Corrective action documentation will be submitted to the TSSWCB PM with the progress report. If audit findings and corrective actions cannot be resolved, then the authority and responsibility for terminating work is specified in agreements or contracts between participating organizations.

Corrective Action Process for Deficiencies

Deficiencies are any deviation from the QAPP, TCEQ SOP, V1, DMRG, or lab QMs or SOPs. Deficiencies may invalidate resulting data and may require corrective action. Corrective action may include for samples to be discarded and re-collected. Deficiencies are documented in

logbooks, field data sheets, etc. by field or laboratory staff. It is the responsibility of each respective entity's Project Leader or PM, in consultation with the TWRI QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the TSSWCB PM both verbally and in writing in the project progress reports and by completion of a CAR. All deficiencies identified by each entity will trigger a corrective action plan.

Corrective Action

Corrective Action Reports (CARs) should:

- Identify the problem, nonconformity, or undesirable situation
- Identify immediate remedial actions if possible
- Identify the underlying cause(s) of the problem
- Identify whether the problem is likely to recur, or occur in other areas
- Evaluate the need for Corrective Action
- Use problem-solving techniques to verify causes, determine solution, and develop an action plan
- Identify personnel responsible for action
- Establish timelines and provide a schedule
- Document the corrective action

The status of CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TSSWCB immediately.

The Project Lead or PM or each respective entity is responsible for implementing and tracking corrective actions. Records of audit findings and corrective actions are maintained by the Project Lead or PM of each respective entity. Audit reports and corrective action documentation will be submitted to the TSSWCB with the Progress Report.

LDCs and SELECT

In addition to those listed above, the following assessment and response actions will be applied to LDCs and SELECT activities. As described in Section B9 (Non-direct Measurements), modeling staff will evaluate data to be used LDC and SELECT assessments according to criteria discussed in Section A7 (Quality Objectives and Criteria for Model Inputs/Outputs Data) and will follow-up with the various data sources on any concerns that may arise.

Corrective action is required to ensure that conditions adverse to quality data are identified promptly and corrected as soon as possible. Corrective actions include identification of root causes of problems and successful correction of identified problem and will be documented utilizing CARs. CARs (Appendix A) will be filled out to document the problems and the remedial action taken. Copies of CARs will be included in QPRs and will discuss any problems encountered and solutions made. These CARs are the responsibility of the QAO and the PM and will be disseminated to individuals listed in section A3.

Section C2: Reports to Management

Quarterly progress reports developed by the PM and Project Co-Leaders will note activities conducted in connection with the project, items or areas identified as potential problems, and any variations or supplements to the QAPP. CAR forms will be utilized when necessary (Appendix A). CARs will be maintained in an accessible location for reference by all project personnel and at TWRI and disseminated to individuals listed in section A3. CARs that result in any changes or variations from the QAPP will be made known to pertinent project personnel and documented in an update or amendment to the QAPP.

If the procedures and guidelines established in this QAPP are not successful, corrective action is required to ensure that conditions adverse to quality data are identified promptly and corrected as soon as possible. Corrective actions include identification of root causes of problems and successful correction of identified problem. CARs will be filled out to document the problems and the remedial action taken. Copies of CARs will be included with the project's quarterly reports. These reports will discuss any problems encountered and solutions made. These reports are the responsibility of the QAO and the PM and will be disseminated to individuals listed in section A3.

The final report for this project will be a technical report detailing the Water Quality and Pollutant Loading Assessment in the Angelina River above Sam Rayburn Watershed and will include information detailing the results and findings of SELECT modeling, LDCs and SWQM work conducted under this QAPP. Items in this report will include a very brief description of methodologies utilized and implications of these findings.

Section D1: Data Review, Validation and Verification

For the purposes of this document, data verification is a systematic process for evaluating performance and compliance of a set of data to ascertain its completeness, correctness, and consistency using the methods and criteria defined in the QAPP. Validation means those processes taken independently of the data-generation processes to evaluate the technical usability of the verified data with respect to the planned objectives or intention of the project. Additionally, validation can provide a level of overall confidence in the reporting of the data based on the methods used.

All data obtained from field and laboratory measurements will be reviewed and verified for conformance to project requirements, and then validated against the data quality objectives which are listed in Section A7. Only those data which are supported by appropriate quality control data and meet the measurement performance specification defined for this project will be considered acceptable and submitted to the TCEQ for entry into SWQMIS.

The procedures for verification and validation of data are described in Section D2, below. The ANRA LM and ANRA QAO are responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and bias, and reviewed for integrity. The ANRA DM will be responsible for ensuring that all data are properly reviewed and verified, and submitted in the required format to be loaded into SWQMIS. The ANRA QAO is responsible for validating a minimum of 10% of the data produced in each task. Finally, the ANRA QAO is responsible for validating that all data to be reported meet the objectives of the project and are suitable for reporting to TCEQ.

Section D2: Validation Methods

SWQM

Field and laboratory data will be reviewed, verified and validated to ensure conformance with project specifications and adherence to end use as described in Section A7 of this document.

Data review, verification, and validation will be performed using self-assessments and peer and management review as appropriate to the project task. The data review tasks to be performed by field and laboratory staffs are listed in the first column of Table D2.1. Potential errors are identified by examination of documentation and by manual or computer-assisted examination of corollary or unreasonable data. If a question arises or an error is identified, the manager of the task responsible for generating the data is contacted to resolve the issue. Issues which can be corrected are corrected and documented. If an issue cannot be corrected, the task manager consults with the higher level project management to establish the appropriate course of action, or the data associated with the issue are rejected and not reported to the TSSWCB for submission to TCEQ for storage in SWQMIS. Field and laboratory reviews, verifications, and validations are documented.

Table D2.1. Data Review Tasks

Data to be Verified	Field	Lab	Data Manager
Sample documentation complete; samples labeled, sites identified	Y	Y	
Field QC samples collected for all analytes as prescribed in the TCEQ *SWQM Procedures Manual*	Y		
Standards and reagents traceable	Y	Y	
Chain of custody complete/acceptable	Y	Y	
NELAP Accreditation is current		Y	
Sample preservation and handling acceptable	Y	Y	
Holding times not exceeded	Y	Y	
Collection, preparation, and analysis consistent with SOPs and QAPP	Y	Y	Y
Field documentation (e.g., biological, stream habitat) complete	Y		Y
Instrument calibration data complete	Y	Y	Y
Bacteriological records complete	Y	Y	
QC samples analyzed at required frequency	Y	Y	Y
QC results meet performance and program specifications	Y	Y	Y
Analytical sensitivity (LOQ/AWRL) consistent with QAPP	Y	Y	Y
Results, calculations, transcriptions checked	Y	Y	Y
Laboratory bench-level review performed		Y	
All laboratory samples analyzed for all scheduled parameters	Y	Y	Y
Corollary data agree	Y	Y	Y
Nonconforming activities documented	Y	Y	Y
Outliers confirmed and documented; reasonableness check performed		Y	Y
Time based on 24-hour clock			Y
Absence of transcription error confirmed	Y	Y	Y
Absence of electronic errors confirmed	Y	Y	Y
Sampling and analytical data gaps checked	Y	Y	Y
Field instrument pre and post calibration results within limits			Y
10% of data manually reviewed	Y	Y	Y

After the field and laboratory data are reviewed, another level of review is performed once the data are combined into a data set. This review step as specified in Table D2.1 is performed by the ANRA DM and QAO. Data review, verification, and validation tasks to be performed on the data set include, but are not limited to, the confirmation of laboratory and field data review, evaluation of field QC results, additional evaluation of anomalies and outliers, analysis of sampling and analytical gaps, and confirmation that all parameters and sampling sites are included in the QAPP.

The Data Review Checklist (See Appendix D) covers three main types of review: data format and structure, data quality review, and documentation review. The Data Review Checklist is transferred with the water quality data submitted to the TSSWCB to ensure that the review process is being performed.

Another element of the data validation process is consideration of any findings identified during the monitoring systems audit conducted by the TSSWCB QAO. Any issues requiring corrective action must be addressed, and the potential impact of these issues on previously collected data will be assessed. After the data are reviewed and documented, the ANRA PM validates that the data meet the data quality objectives of the project and are suitable for reporting to TSSWCB and subsequently TCEQ.

If any requirements or specifications of the QAPP are not met, based on any part of the data review, the responsible party should document the nonconforming activities and submit the information to the ANRA DM with the data. This information is communicated to the TSSWCB by the ANRA in the Data Summary (See Appendix D).

LDCs and SELECT

There is no validation and calibration for LDCs and SELECT as they are developed using data processors.

Water quality and streamflow data collected by the TCEQ, the USGS, and Texas CRP partners have been verified and validated according to the requirements of the respective programs prior to their use in this project. Data compilations created for this project will be visually screened for errors by TWRI Staff. To verify the correctness of FDCs/LDCs, the TWRI Staff will ensure that the methods for the development of FDCs/LDCs (USEPA 2008) are followed and will verify that data formatting and inputting were done correctly and that outputs were produced error free.

GIS Inventory

Data for this portion of the project (e.g., land use, urban areas, population projections, digital elevation models, stream layers, and population projections) as provided in Table B9.1 have been collected and made publicly accessible by authoritative sources such as the USGS, USDA, USEPA, and U.S. Census Bureau. Data from these sources will be considered as verified and validated by the various agencies providing the data. However, data compilations created for

this project will be visually screened for errors. Any errors detected by project staff will be reported to the ANRA or TWRI PM and, if necessary, to the TSSWCB PM for resolution. Issues which can be readily corrected, e.g., removal of outlier data, will be documented and the data either removed or corrected prior to further analysis.

Section D3: Reconciliation with User Requirements

SWQM

Data produced in this project, and data collected by other organizations will be analyzed and used in the development water quality restoration plans. Data that do not meet requirements described in this QAPP will not be submitted to SWQMIS nor will it be considered appropriate for any of the uses noted above.

Data collected from this project will be analyzed by TWRI and ANRA to document the current state of water quality in the Angelina River above Sam Rayburn. Data will be used to augment the existing geometric means that will be compared to the water quality standard.

Data produced in this project will be analyzed and reconciled with project data quality requirements. Data meeting project requirements may be used by the TCEQ for the *Texas Water Quality Integrated Report* in accordance with the most recent approved version of the TCEQ's *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data*, and for TMDL development, water quality standards development, and permit decisions as appropriate. Data that do not meet data quality objectives outlined in this document will not be submitted to SWQMIS.

LDC

The LDC framework utilized for this project will be used to determine maximum allowed bacteria (*E. coli*) loadings within the water bodies evaluated in the Angelina River above Sam Rayburn Basin. This approach will utilize historical flow data and the primary contact recreation criterion for waters to determine this pollutant load allocation. Exceedances of the allowable load for each waterbody will be determined using the procedures outlined in USEPA (2008) by the BAEN Staff and will provide the basis for future load reductions needed.

The LDC results will be described in detail in the final report and used for educational purposes as appropriate and will aid in making informed decisions about future action to address pollutant loading issues across the watershed. The limitations of LDCs produced will also be described in the report and conveyed to audiences when discussed.

SELECT

The SELECT modeling framework developed for this project will be used to evaluate bacteria loading in the Angelina River above Sam Rayburn watershed. It will provide information pertaining to watershed characteristics and to the prediction of possible pollution, the sources of this pollution and will provide critical information to assist in identifying management practices to prevent pollution loading in area streams. This, in turn, will be useful for the assessing water quality and pollutant loading within the Angelina River above Sam Rayburn Basin.

GIS Inventory

GIS inventory and maps developed for this project will be used for informational purposes only and will not be used exclusively to make any management decisions. Instead, these maps will aid the user by allowing them to visualize watershed features and influences within the watershed that could contribute to the overall bacteria loading being experienced. The limitations of maps produced will be described in the project final report and conveyed to audiences when discussed. Potential limitations may include accuracy and precision of the land use data, planning documents, and societal information used.

References

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Appendix A: Corrective Action Report

SOP-QA-001
CAR #:_____

Date:_____ Area/Location:_____

Reported by:_____ Activity:_____

State the nature of the problem, nonconformance or out-of-control situation:
_____
_____
_____
_____

Possible causes:
_____
_____
_____

Recommended Corrective Actions:
_____
_____
_____

CAR routed to:_____
Received by:_____

Corrective Actions taken:
_____
_____
_____
_____

Has problem been corrected?: YES NO

Immediate Supervisor:_____

Program Manager:_____

TWRI Quality Assurance Officer:_____

TSSWCB Quality Assurance Officer:_____

Appendix B: Field Data Reporting Form

SURFACE WATER QUALITY MONITORING PROGRAM FIELD DATA SHEET

ANGELINA & NECHES RIVER AUTHORITY • P.O. BOX 387 / 210 LUFKIN AVE. • LUFKIN, TEXAS 75902-0387 • (936) 632-7795

Station ID:_____ Station Description:_____

Collector(s) Name/Signature:_____

Date Collected:_____ Time Collected:_____ Sample Depth (meters):_____

Field Tests and Measurements:			Sample Identification:			
	Water Temperature °C	00010	TAG ID		Sample ID	
	Specific Conductance (µS/cm)	00094	Parameters Collected:			
	pH (standard units)	00400	X	E. Coli	X	T. Phosphorus
	Dissolved Oxygen (mg/L)	00300	X	TSS	X	Chlorophyll-a
	Secchi Depth (meters)	00078	X	Ammonia-N	X	Pheophytin-a
	Total Water Depth (meters)	82903	X	Nitrate-N	X	Chloride
	Instantaneous Stream Flow (cfs)	00061	X	Nitrite-N	X	Sulfate

Field Observations:			
	01351 - Flow Severity (1-no flow, 2- low, 3-normal, 4-flood, 5-high, 6-dry)		
	89835 - Flow measurement method (1-gage, 2-electric, 3-mechanical, 4-weir/flume, 5-doppler)		
	72053 - Days since last significant rainfall		
	89966 - Present Weather (1-clear, 2-partly cloudy, 3-cloudy, 4-rain, 5-other)		
	89979 - Evidence of Primary Contact Recreation (1 = Observed, 0 = Not Observed)		
	89978 - Primary Contact, Observed Activity (Number of people observed. Reported as 0-10 or >10)		
	If sampling from a Reservoir		
		00052 - Reservoir Stage (Feet Above Mean Sea Level) (collected from TWDB website)	
		00053 - Reservoir Percent Full (collected from TWDB website)	
		00051 - Reservoir Access Not Possible, Level Too Low (Enter "1" If true)	
	If sampling from an perennial pool (isolated pool)		
		89864 - Maximum pool width in meters	
		89865 - Maximum pool depth in meters	
		89869 - Pool length in meters	
		89870 - Percentage the pool covers within a 500 meter reach	
	74069 - Stream Flow Estimate (cfs)		(W × D × L × C ÷ T = Flow Estimate)
		Stream Width (W)	(feet)
		Average Depth of Stream (D)	(feet)
		Distance Object Travels (L)	(feet)
		Correction Factor (C)	(0.9 for smooth or muddy bottom) (0.8 for rough or rocky bottom)
		Time for Object to Travel Distance (T)	(seconds)
	Comments/Observations:		

FORM: CRP Field Data Sheet Rev 3 11/09/2015 JBS

Appendix C: Chain of Custody Records

ANRA
Angelina & Neches River Authority
2901 N. John Redditt Dr.
Lufkin, TX 75904
Phone: 936-632-7795
Website: www.anra.org

CHAIN-OF-CUSTODY RECORD

SECTION A – CLIENT & SAMPLER INFORMATION		SECTION B – SAMPLE RECEIPT INFORMATION (LAB USE ONLY)			
Client Name		Temperature, °C:	Observed:	/ Corrected:	Receipt #:
Project Name		Thermometer ID / Correction Factor:	THERM-	/ CF:	Client Notification:
Phone #		Preservative & pH paper Standard ID #s:			Comments:
Sampler Name		Subcontract Lab / PO #:	Sub Lab:	PO #:	

SECTION C – SAMPLE CONTAINERS AND PRESERVATION		SECTION D – INSTRUCTIONS/KEYS	
Container Letter		Label each individual sample container with a letter (A, B, C, etc.). If multiple analyses come from the same container, assign them the same letter, or write them in the same column.	Matrix Codes: DW = Drinking Water, NP = Non-Potable Water, S = Soil, SL = Sludge
Container Type		Container Type Codes: A = Amber, AG = Amber Glass, G = Glass, P = Plastic, S = Sterile, V = Vial	
Preservative		Preservative Codes: 1 = None, 2 = Sulfuric Acid (H_2SO_4), 3 = Sodium Thiosulfate ($Na_2S_2O_3$), 4 = Nitric Acid (HNO_3), 5 = Sodium Hydroxide (NaOH), 6 = Hydrochloric Acid (HCl)	Sample Type Codes: C = Composite, G = Grab, SP = Special (DW matrix only)

SECTION E – SAMPLE INFORMATION AND ANALYSES REQUESTED												SECTION F – FIELD ANALYSES/INFORMATION				SECTION G – SAMPLE ID	
												Enter the applicable parameters in the fields below.				LAB USE ONLY	
Item #	Sample Description	Analyses							Matrix (see Section D)	Sample Type (see Section D)	Collection Date	Collection Time					pH of preserved containers (e.g. A <2)	Work Order #: / Sample ID #s
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

SECTION H – COMPOSITE DATA (if Composite marked above)				SECTION I – TRANSFER OF SAMPLE CUSTODY						
	Date	Time	Totalizer	Relinquished by (Signature)	Date	Time	Transported on ice	Received by (Signature)	Date	Time
Start							☐ Yes ☐ No			
End							☐ Yes ☐ No			
Total Flow (MGD)							☐ Yes ☐ No			

Form ID: LAB-027
Revision #: 3
Effective: 6/9/2020
Approved: MDG

NOTE: Section I – Transfer of Sample Custody must reflect all transfers from sample collection to receipt at the ANRA Environmental Laboratory.
NOTE: Chain-of-Custody must be completed by the customer (or corrected, if needed, at the time of sample drop-off) before ANRA staff will accept samples and sign the COC as received.

Clear Form

Environmental Laboratory Services
The Solution Lab

LCRA Environmental Laboratory Services
Request for Analysis Chain-of-Custody Record

LCRA - Environmental Lab
3505 Montopolis Dr.
Austin, TX 78744

Phone: (512) 356-6022 or 1-800-776-5272
Fax: (512) 356-6021
https://els.lcra.org

Lab ID#:
Client PO:

Project:		Client:	ANGELINA NECHES RIVER
Collector:		Contact:	Melissa Garcia
Event#:		Phone:	936-632-7795

Report To: lab@anra.org
2901 N. John Redditt Dr.
Lufkin, TX 75904

Invoice To: sharris@anra.org ANRA
2901 N. John Redditt
Dr. Lufkin, TX 75904

LAB USE ONLY	Sample ID *	Collected *		Matrix*	Container(s) Type/Preservative/Number *										Requested Analysis *											
		Date*	Time * HH:MM	AQ = Aqueous S = Solid T = Tissue DW =Drinking Water	COMPOSITE Y/N	FILTERED Y/N																				
1																										
2																										
3																										
4																										
5																										
6																										
7																										

Transfers	Relinquished By	Date/Time	Received By	Date/Time	Cooler Temp:				Client Special Instructions:
					#	T#	Obs.	Corr.	
1									
2					1				
3					2				Lab Use Only:

Note: Relinquishing sample(s) and signing the COC, client agrees to accept and is bound by the ELS Standard Terms and Conditions. All fields with an asterisk (*) are required to be completed.

Appendix D: Data Review Checklist and Data Summary Sheet

Data Review Checklist

Title of associated QAPP: _____

√, X, or N/A

Data Format and Structure

A. Are there any duplicate *Tag ID* numbers? _____
B. Are the *Tag prefixes* correct? _____
C. Are all *Tag ID* numbers 7 characters? _____
D. Are TCEQ station location (SLOC) numbers assigned? _____
E. Are sampling *Dates* in the correct format, MM/DD/YYYY? _____
F. Is the sampling *Time* based on the 24-hour clock (e.g. 13:04)? _____
G. Is the *Comment* field filled in where appropriate (e.g. unusual occurrence, sampling problems, unrepresentative of ambient water quality) and any punctuation deleted?

_____

H. *Source Code 1, 2* and *Program Code* are valid and used correctly? _____
I. Is the sampling date in the *Results* file the same as the one in the *Events* file? _____
J. Values represented by a valid parameter (*STORET*) code with the correct units and leading zeros? _____
K. Are there any duplicate parameter codes for the same *Tag Id*? _____
L. Are there any invalid symbols in the Greater Than/Less Than (*GT/LT*) field? _____
M. Are there any tag numbers in the *Results* file that are not in the *Events* file? _____
N. Have confirmed outliers been identified? (with a "1" in the Verify_flg field) _____
O. Have grab data (bacteria, for example) taken during 24-hr events been reported separately as RT samples? _____
P. Is the file in the correct format (ASCII pipe-delimited text)? _____

Data Quality Review

A. Are all the values reported at or below the AWRL? _____
B. Have the outliers been verified? _____
C. Checks on correctness of analysis or data reasonableness performed?
e.g.: Is ortho-phosphorus less than total phosphorus?
Are dissolved metal concentrations less than or equal to total metals? _____
D. Have at least 10% of the data in the data set been reviewed against the field and laboratory data sheets? _____
E. Are all parameter codes in the data set listed in the QAPP? _____
F. Are all stations in the data set listed in the QAPP? _____

Documentation Review

A. Are blank results acceptable as specified in the QAPP? _____
B. Were control charts used to determine the acceptability of field duplicates? _____
C. Was documentation of any unusual occurrences that may affect water quality included in the Event file Comments field? _____
D. Were there any failures in sampling methods and/or deviations from sample design requirements that resulted in unreportable data? If yes, explain on next page. _____
E. Were there any failures in field and laboratory measurement systems that were not resolvable and resulted in unreportable data? If yes, explain on next page. _____

√ = Yes **X = No** **N/A** = Not applicable

Describe any data reporting inconsistencies with AWRL specifications. Explain failures in sampling methods and field and laboratory measurement systems that resulted in data that could not be reported to the TCEQ. (attach another page if necessary):

_____

_____

_____

_____

_____

Date Submitted to TCEQ: _____
Tag ID Series: _____
Date Range: _____
Data Source: _____
Comments (attach README.TXT file if applicable):

_____

_____

_____

_____

Planning Agency's Data Manager Signature: _____

Date: _____

DATA SUMMARY

Data Set Information

Data Source: _____.

Date Submitted: _____.

Tag_id Range: _____.

Date Range: _____.

Comments:

Please explain in the space below any data discrepancies discovered during data review including:

- Inconsistencies with AWRL specifications or LOQs
- Failures in sampling methods and/or laboratory procedures that resulted in data that could not be reported to the TCEQ (indicate items for which the Corrective Action Process has been initiated).
- Include completed Corrective Action Plans with the applicable Progress Report.

_____

_____

_____

_____

_____

_____

_____

_____

☐ I certify that all data in this data set meets the requirements specified in Texas Water Code Chapter 5, Subchapter R (TWC §5.801 et seq) and Title 30 Texas Administrative Code Chapter 25, Subchapters A & B.

☐ This data set has been reviewed using the Data Review Checklist.

Planning Agency Data Manager: _____.

Date: _____.