# Assessment of Contact Recreation Use Impairments and Watershed Planning for Five Tributaries of the Little Brazos River (LBR Tributaries Bacteria Assessment) TSSWCB Project 08-54

# Quality Assurance Project Plan

**Revision No. 2**

**Prepared by**
**Brazos River Authority**
**Waco, Texas**

**Funding Source:**
**Texas State Soil and Water Conservation Board**

**Effective Period: November 2008 to May 2010**

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

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# A2 Table of Contents

## A3 Distribution List

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

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Name: Ahmed Kadry, Ph.D.
Title: BRA Laboratory Manager

Name: Jack Davis
Title: BRA Field Operations Manager

## List of Acronyms

| | |
|---|---|
| AWRL | Ambient Water Reporting Limit |
| BMP | Best Management Practice |
| BRA | Brazos River Authority |
| CAR | Corrective Action Report |
| COC | Chain of Custody |
| CRP | Texas Clean Rivers Program |
| CWA | federal Clean Water Act |
| DOC | Demonstration of Capability |
| DMRG | TCEQ Data Management Reference Guide |
| DQO | Data Quality Objective |
| EPA | United States Environmental Protection Agency |
| ESL | BRA Environmental Services Laboratory |
| GIS | Geographic Information System |
| LCS | Laboratory Control Sample (formerly Laboratory Control Standard) |
| LCSD | Laboratory Control Sample Duplicate (formerly Laboratory Control Standard Duplicate) |
| LIMS | Laboratory Information Management System |
| LOD | Limit of Detection |
| LOQ | Limit of Quantitation (formerly reporting limit) |
| NELAC | National Environmental Laboratory Accreditation Conference |
| NPDES | National Pollutant Discharge Elimination System |
| NPS | Nonpoint Source |
| PO | Project Officer |
| QA/QC | Quality Assurance/Quality Control |
| QM | Quality Manual |
| QAO | Quality Assurance Officer |
| QAPP | Quality Assurance Project Plan |
| QMP | Quality Management Plan |
| RPD | Relative Percent Difference |
| SLOC | Station Location Request Form |
| SOP | Standard Operating Procedure |
| SWQM | Surface Water Quality Monitoring |

| | |
|---|---|
| SWQMIS | TCEQ Surface Water Quality Monitoring Information System |
| TCEQ | Texas Commission on Environmental Quality |
| TMDL | Total Maximum Daily Load |
| TSSWCB | Texas State Soil and Water Conservation Board |
| TSWQS | Texas Surface Water Quality Standards |
| WWTF | Wastewater Treatment Facility |

## A4 Project/Task Organization

**Texas State Soil and Water Conservation Board**

**Loren Henley**
**TSSWCB Project Manager**
Maintains a thorough knowledge of work activities, commitments, deliverables, and time frames associated with project. Develops lines of communication and working relationships between BRA and TSSWCB. Tracks deliverables to ensure that tasks are completed as specified in the contract. Responsible for ensuring that the project deliverables are submitted on time and are of acceptable quality and quantity to achieve project objectives. Participates in the development, approval, implementation, and maintenance of the QAPP. Assists the TSSWCB QAO in technical review of the QAPP. Responsible for verifying that the QAPP is followed by the BRA. Notifies the TSSWCB QAO of particular circumstances that may adversely affect the quality of data derived from the collection and analysis of samples. Enforces corrective action.

**Donna Long**
**TSSWCB Quality Assurance Officer**
Reviews and approves QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TSSWCB participants. Responsible for verifying that the QAPP is followed by project participants. Determines that the project meets the requirements for planning, quality assurance (QA), quality control (QC), and reporting under the CWA §319(h) NPS Grant Program. Monitors implementation of corrective actions. Coordinates or conducts audits of field and laboratory systems and procedures.

**Brazos River Authority**

**Jay Bragg**
**BRA Project Manager**
Responsible for ensuring tasks and other requirements in the contract are executed on time and are of acceptable quality. Monitors and assesses the quality of work. Coordinates attendance at conference calls, training, meetings, and related project activities with the TSSWCB. 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.

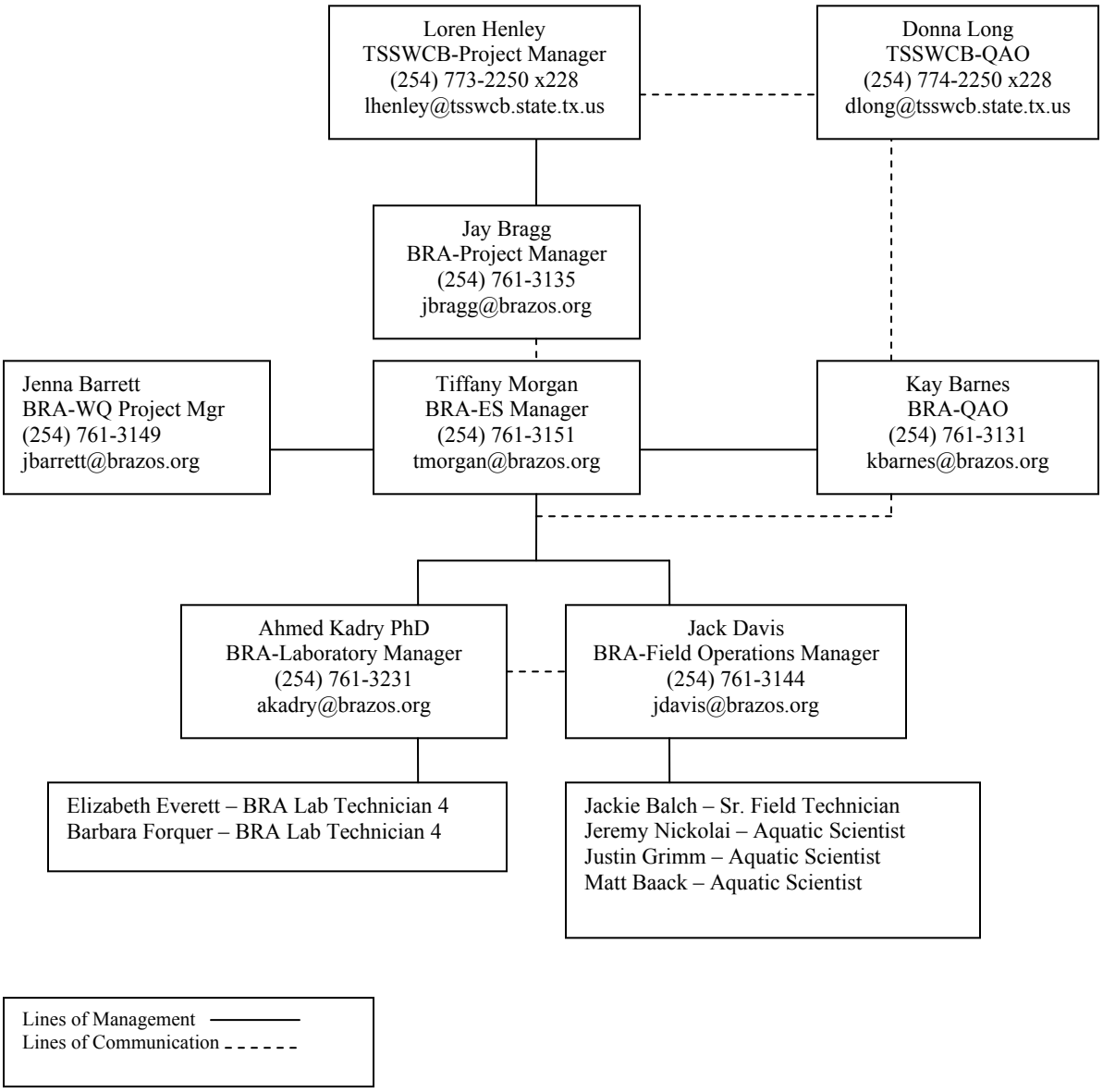
**Tiffany Morgan**
**BRA Environmental Services Manager**
Reports to the Technical Services Manager and oversees field data collections, environmental laboratory operations, and data management activities. The majority of these activities are directly related to a regional project. The Environmental Services Manager provides technical guidance and assistance to regional environmental projects, including initiating, planning, facilitating, and executing of projects. The Environmental Services Manager is solely responsible for the implementation of quality management (planning, assurance, and control) for field, laboratory, and data management operations.

**Kay Barnes**
**BRA QAO and Project Data Manager**
Responsible for coordinating development and implementation of the QA program. Responsible for writing and maintaining the QAPP. Responsible for maintaining records of QAPP distribution, including appendices and amendments. Monitors the implementation of the QAM and the QAPP within the laboratory to ensure complete compliance with QA objectives as defined by the contract and in the QAPP. Conducts internal audits to identify potential problems and ensure compliance with written SOPs. Responsible for supervising and verifying all aspects of the QA/QC in the laboratory. Responsible for maintaining written records of sub-tier commitment to requirements specified in this QAPP. Responsible for identifying, receiving, and maintaining project QA records. Responsible for coordinating with the TSSWCB QAO to resolve QA- related issues. Notifies the BRA Project Manager and TSSWCB Project Manager of particular circumstances which may adversely affect the quality of data. Responsible for validation and verification of all data collected according to Section D2 procedures and acquired data procedures 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. Performs validation and verification of data before the report is sent to the TSSWCB. Insures that all QA reviews are conducted in a timely manner from real-time review at the bench during analysis to final pass-off of data to the QAO. Responsible for the acquisition, verification, and transfer of data to the TSSWCB. Oversees data management for the study. Performs data QA prior to transfer of data to TSSWCB. Responsible for transferring data to the TSSWCB in the acceptable format. Ensures data are submitted according to workplan specifications. Provides the point of contact for the TSSWCB Data Manager to resolve issues related to the data.

**Ahmed Kadry, PhD**
**BRA Laboratory Manager**
Responsible for supervision of laboratory personnel involved in generating analytical data for this project. Responsible for ensuring that laboratory personnel involved in generating analytical data have adequate training and a thorough knowledge of the QAPP and all SOPs specific to the analyses or task performed and/or supervised. Responsible for oversight of all operations, ensuring that all QA/QC requirements are met, and documentation related to the analysis is completely and accurately reported. Enforces corrective action, as required. Develops and facilitates monitoring systems audits.

**Jack Davis**
**BRA Field Operations Manager**
Responsible for supervising all aspects of the sampling and measurement of surface waters and other parameters in the field. Responsible for the acquisition of water samples and field data measurements in a timely manner that meet the quality objectives specified in Section A7 (Table A.1), as well as the requirements of Sections B1 through B8. Responsible for field scheduling, staffing, and ensuring that staff are appropriately trained as specified in Sections A6 and A8.

## Figure A4.1 Organization Chart – Lines of Communication



## A5 Problem Definition/Background

The central watershed of the Brazos River consists of one classified waterbody, the Brazos River above Navasota River (Segment 1242), and a number of unclassified waterbodies on tributary systems. This segment extends from the Lake Brazos Dam in Waco 183 miles downstream to its confluence with the Navasota River southeast of College Station and its watershed encompasses approximately 2,705 square miles. Land use in the watershed is generally agricultural with two urban areas (Waco and Bryan/College Station) and a few large industrial facilities and quarries.

In 2002 a water quality data analysis determined that eight unclassified waterbodies within the central watershed had bacteria concentrations exceeding state water quality standards for contact recreation. As a result these waterbodies were placed on the Texas §303(d) List of Impaired Waters. Three additional unclassified segments were added to the 2006 §303(d) List bringing the total number of water quality impairments (bacteria) on segment 1242 to eleven.

Five of the waterbodies impaired for bacteria are located within very close proximity of each other in Robertson County and share similar land use and water quality characteristics. They are all tributaries to the Little Brazos River (Segment 1242E). The five waterbodies in this project's study area are Campbells Creek (Segment 1242I), Mud Creek (Segment 1242K), Pin Oak Creek (Segment 1242L), Spring Creek (Segment 1242M), and Walnut Creek (Segment 1242O). The study area encompasses 327 square miles, almost entirely within Robertson County. The land use in the area is primarily agricultural (range and pastureland with mixed areas of cultivated cropland) with several small communities.

The 2006 §303(d) List identifies all five segments in the study area as Category 5c, meaning that the waterbody does not meet applicable water quality standards for one or more designated uses by one or more pollutants and that additional data and information will be collected before a TMDL is scheduled.

TCEQ and TSSWCB established a joint technical Task Force on Bacteria TMDLs in September 2006 charged with making recommendations on cost-effective and time-efficient bacteria TMDL development methodologies. The Task Force recommended the use of a three-tier approach that is designed to be scientifically credible and accountable to watershed stakeholders. The tiers move through increasingly aggressive levels of data collection and analysis in order to achieve stakeholder consensus on needed load reductions and strategies to achieve those reductions. In June 2007 the TCEQ and TSSWCB adopted the principles and general process recommended by the Task Force and directed agency staff to incorporate the principles of the recommendations into an updated joint-agency TMDL guidance document.

Major revisions to the Texas Surface Water Quality Standards are being drafted by TCEQ, including modifications to contact recreation use and bacteria criteria. As part of this process, TCEQ has developed procedures for conducting recreational Use Attainability Analyses (UAAs). In order for a new category of recreational use or a different bacteria water quality standard to be applied to a waterbody, a RUAA will need to be conducted. TCEQ and TSSWCB have collaborated on developing a list of priority waterbodies for collecting information needed for RUAAs. Segments in this project's study area are on that list.

In accordance with the *Memorandum of Agreement Between the TCEQ and the TSSWCB Regarding TMDLs, Implementation Plans, and Watershed Protection Plans*, the TSSWCB has agreed to take the lead role in addressing the bacteria impairments for the five segments in the study area. Through this and associated projects, the TSSWCB and BRA will work with local stakeholders to progress through the data collection and analysis components of the first two tiers of the Task Force recommended three-tier approach.

The objective of this project is to provide sufficient water quality data to characterize bacteria loadings across the various flow regimes at a number of locations throughout the study area.

## A6 Project/Task Description

BRA will conduct routine ambient monitoring at 10 sites once every two weeks, collecting field (water temperature, pH, dissolved oxygen, dissolved oxygen saturation, specific conductance), flow, and bacteria (*E. coli*) parameter groups. The sampling period extends over 19 months and includes 410 sample events.

BRA will conduct effluent monitoring at three WWTFs once every two weeks, collecting field (water temperature, pH, dissolved oxygen, dissolved oxygen saturation, specific conductance), flow, and bacteria (*E. coli*) parameter groups. The sampling period extends over 19 months and includes 123 sample events.

BRA will conduct biased-flow monitoring under high flow (storm event influenced) conditions at the 10 streams sites and 3 WWTF sites during at least 12 storm events, collecting field (water temperature, dissolved oxygen, dissolved oxygen saturation, specific conductance), flow, and bacteria grabs (*E. coli*) parameter groups. The sampling period extends over 19 months and includes 156 sample events.

BRA will establish and maintain continuous flow monitoring gages at 5 sites (1 per segment). These sites shall be located as close to the confluence with the Little Brazos River as is feasible. Continuous sampling will extend over 19 months.

BRA will conduct two biological assessement events on the Little Brazos River in order to evaluate the cumulative impact of the impaired segments on stream health and biological communities.

Through TSSWCB project 09-52, *Bacterial Source Tracking for Little Brazos River Tributaries Bacteria Assessment*, Texas AgriLife Research will conduct bacterial source tracking (BST) in the study area to assess and identify different sources contributing to bacteria loadings. BRA will collect duplicate water samples from a subset of those collected through this project and deliver those samples to AgriLife for BST. This BST subset is precisely described in the 09-52 QAPP. BRA will work with AgriLife to ensure sample collection activities employ adequate QA/QC mechanisms for BST as described in the 09-52 QAPP.

BRA will transfer the data obtained from these monitoring activities to TSSWCB, at least quarterly, for inclusion in the TCEQ SWQMIS.

BRA will cooperate with Texas AgriLife Research to conduct a load duration curve (LDC) analysis of all historic and existing water quality monitoring data from the study area and refine those LDCs using water quality monitoring data collected through this project.

BRA will collect information that can be used to evaluate recreational uses in the waterbodies in the study area. Methods used shall be consistent with the TCEQ *Procedures for a Comprehensive RUAA and a Basic RUAA Survey* (May 2009). BRA will conduct field surveys at selected sites during the period people would most likely be using the waterbody for contact

recreation; surveys shall ascertain the suitability of the streams for contact recreation use and shall document the hydrological characteristics of the stream.

Using GIS inventory and current land use classification, BRA has identified sites for RUAA data collection, as defined in Table B1.1. Sites are located in areas where the waterbody is accessible to the public and has the highest potential for recreational use (primary contact). The sites are well-spaced and, where practical, distributed such that there are 3 sites for every 5 miles of stream. Sites are identified for the entirety of each of the five segments in the study area.

BRA will conduct 2 field surveys at each site, as defined in Table B1.1. Surveys shall be conducted during a normal warm season (air temperature $\geq$ 70°F) during baseflow conditions. Baseflow conditions are sustained or typical dry, warm-weather flows between rainfall events, excluding unusual antecedent conditions of drought or wet weather. The surveys should be performed during the period people would most likely be using the waterbody for contact recreation, typically March to October (e.g., spring break, summer, holidays, weekends).

To ascertain the suitability of the streams for contact recreation use, field surveys shall document hydrological characteristics of the stream, such as width and depth of channel and substantial pools, flow/discharge, air/stream temperature, bank access, and stream substrate. Information to be collected shall at least satisfy those questions found on the Field Data Sheet from the TCEQ *Procedures for a Comprehensive RUAA and a Basic RUAA Survey* (May 2009).

In the interest of generating complete descriptions of all project waterbodies, it is the intent of TSSWCB to fully complete RUAA surveys on waterbodies where obvious primary contact recreation occurs or that may be at other than baseflow conditions. This protocol deviates from the guidance in the TCEQ *Procedures for a Comprehensive RUAA and a Basic RUAA Survey* (May 2009) which suggests terminating the survey when such conditions are encountered.

BRA shall document and describe antecedent (prior to fieldwork) rainfall conditions (approximately 30 days) at each selected site.

BRA shall collect a digital photographic record of each selected site during the field surveys. Photographs shall include upstream, left and right bank, and downstream views. Any evidence of observed uses or indications of human use shall be photographed. Photographs should clearly depict the entire channel and each transect measured.

See Appendix B for the project-related work plan tasks related to data collection and schedule of deliverables for a description of work defined in this QAPP.

See Section B1 for monitoring to be conducted under this QAPP.

**Revisions to the QAPP**

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 most recently approved QAPPs shall remain in effect until revisions

have been fully approved; reissuances (i.e., annual updates) must be submitted to the TSSWCB for approval before the last version has expired. If the entire QAPP is current, valid, and accurately reflects the project goals and organization's policy, the annual reissuance 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**

Amendments to the QAPP may be necessary to reflect changes in project organization, tasks, schedules, objectives, and methods; address deficiencies and nonconformances; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Requests for amendments are directed from the BRA Project Manager to the TSSWCB Project Manager in writing. The changes are effective immediately upon approval by the TSSWCB Project Manager and Quality Assurance Officer.

Amendments to the QAPP and the reasons for the changes will be documented, and revised pages will be forwarded–to all persons on the QAPP distribution list by the BRA QAO. Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process or within 120 days of the initial approval in cases of significant changes.

# A7 Quality Objectives and Criteria

## 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.

Field splits are used to assess the variability of sample handling, preservation, and storage, as well as the analytical process, and are prepared by splitting samples in the field. Control limits for field splits are defined in Section B5.

Laboratory precision is assessed by comparing replicate analyses of sample/duplicate pairs in the case of bacterial analysis. 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 Table A7.1.

## Representativeness

Site selection, the appropriate sampling regime, the sampling of all pertinent media, and use of only approved analytical methods will assure that the measurement data represents the conditions at the site. Water quality data that are collected on a routine frequency 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). Although data may be collected during varying regimes of weather and flow, the routine sampling conducted every two weeks will not be biased toward unusual conditions of flow, runoff, or season. The goal for meeting total representation of the waterbody will be tempered by the potential funding for complete representativeness.

Representativeness is a measure of how accurately a monitoring program reflects the actual water quality conditions and recreational uses. The representativeness of the data is dependent on the sampling locations, the conditions under which surveys are performed, and the survey procedures. According to TCEQ guidance, the RUAA field surveys would ideally be performed at a frequency of three sites per five stream miles. This would assure maximum capture of stream recreational uses. The stream segments in this study are unclassified with limited public access; therefore, TSSWCB and BRA determined that deviation from the guidance was appropriate. Survey stations were selected at all public road crossings; in addition a few private landowner access locations were used to fill in large gaps between public road crossings this is designed to be sufficient to achieve representativeness. Additionally, sites will be surveyed preferentially during high recreational use potential, both temporally and hydrologically. The final determination of the applicability of individual and collective site recreational use conditions will be made in the Technical Report.

## Completeness

The completeness of the data is basically a relationship of how much of the data is 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 that 90% data completion is achieved.

**Comparability**

Confidence in the comparability of data sets for this project 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. 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 Section B10.

**Limit of Quantitation**

AWRLs (Table A7.1) are used in this project as the *limit of quantitation* specification, so data collected under this QAPP can be compared against the TSWQS. Laboratory *limits of quantitation* (Table A7.1) must be at or below the AWRL for each applicable parameter.

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

## Table A7.1 Measurement Performance Specifications for Instream and Effluent Monitoring

| Parameter | Units | Matrix | Method | Parameter Code | AWRL | LOQ | Recovery at LOQ (%) | Precision (RPD of LCS/LCSD) | Bias % Rec. of LCS | Completeness (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| pH | pH/ units | water | SWQM Vol. 1 | 00400 | NA | NA | NA | NA | NA | 90 |
| DO | mg/L | water | SWQM Vol. 1 | 00300 | NA | NA | NA | NA | NA | 90 |
| DO % Saturation | % | water | SWQM Vol. 1 | 00301 | NA | NA | NA | NA | NA | 90 |
| Conductivity | uS/cm | water | SWQM Vol. 1 | 00094 | NA | NA | NA | NA | NA | 90 |
| Temperature | °C | water | SWQM Vol. 1 | 00010 | NA | NA | NA | NA | NA | 90 |
| Flow | cfs | water | TCEQ SOP | 00061 | NA | NA | NA | NA | NA | 90 |
| Flow Measurement Method | 1=gage;<br>2=electric;<br>3=mechanical;<br>4=weir/flume;<br>5=doppler | water | SWQM Vol. 1 | 89835 | NA | NA | NA | NA | NA | 90 |
| Flow severity | 1=no flow;<br>2=low;<br>3=normal;<br>4=flood;<br>5=high;<br>6=dry | water | TCEQ SOP V1 | 01351 | NA | NA | NA | NA | NA | 90 |
| Present Weather | 1=clear;<br>2=partly cloudy;<br>3=cloudy;<br>4=rain;<br>5=other | NA | TCEQ SOP V1 | 89966 | NA | NA | NA | NA | NA | 90 |
| Wind Intensity | 1=calm;<br>2=slight;<br>3=moderate;<br>4=strong | NA | TCEQ SOP V1 | 89965 | NA | NA | NA | NA | NA | 90 |
| Days since last significant rainfall | days | NA | TCEQ SOP V1 | 72053 | NA | NA | NA | NA | NA | |
| E. coli | MPN/100ml | water | Colilert System | 31699 | 1 | 1 | NA | 0.53 | NA | 90 |

***References:*** USEPA *Methods for Chemical Analysis of Water and Wastewater*, Manual #EPA-600/4-79-020.
American Public Health Association, American Water Works Association and Water Environment Federation, *Standard Methods for the Examination of Water and Waste Water*, 20th Ed.
TCEQ *SWQM Procedures*, Volume 1.

## Table A7.2 Measurement Performance Specifications for Biological Monitoring

| Parameter | Units | Matrix | Method | Parameter Code | AWRL | LOQ | Recovery at LOQ (%) | Precision (RPD of LCS/LCSD) | Bias %Rec. of LCS | Completeness (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Biological Data Reporting Units | 1=number of individuals from subsample; 2=number of individuals/$ft^2$; 3=number of individuals/$m^2$; 4=total number in kicknet | Water | TCEQ SOP, V2 | 89899 | NA | NA | NA | NA | NA | 90 |
| Benthic Sampler | 1=Surber; 2=Ekman; 3=kicknet; 4=Petersen; 5=Hester-Dendy | Water | TCEQ SOP, V2 | 89950 | NA | NA | NA | NA | NA | 90 |
| Area of snag surface sampled | $m^2$ | Water | TCEQ SOP, V2 | 89975 | NA | NA | NA | NA | NA | 90 |
| Undercut bank at sample point | % | Water | TCEQ SOP, V2 | 89921 | NA | NA | NA | NA | NA | 90 |
| Overhanging brush at sample point | % | Water | TCEQ SOP, V2 | 89922 | NA | NA | NA | NA | NA | 90 |
| Gravel substrate at sample point | % | Water | TCEQ SOP, V2 | 89923 | NA | NA | NA | NA | NA | 90 |
| Sand substrate at sample point | % | Water | TCEQ SOP, V2 | 89924 | NA | NA | NA | NA | NA | 90 |
| Soft bottom at sample point | % | Water | TCEQ SOP, V2 | 89925 | NA | NA | NA | NA | NA | 90 |
| Macrophyte bed at sample point | % | Water | TCEQ SOP, V2 | 89926 | NA | NA | NA | NA | NA | 90 |
| Snags and brush at sample point | % | Water | TCEQ SOP, V2 | 89927 | NA | NA | NA | NA | NA | 90 |
| Bedrock at sample point | % | Water | TCEQ SOP, V2 | 89928 | NA | NA | NA | NA | NA | 90 |
| Benthic Organisms, None Present | NA | Water | TCEQ SOP, V2 | 90005 | NA | NA | NA | NA | NA | 90 |
| Mesh Size, any net or sieve, average bar (diagonal measurement) for benthic collection | cm | NA | TCEQ SOP, V2 | 89946 | NA | NA | NA | NA | NA | 90 |
| Stream Order | # | NA | TCEQ SOP, V1 | 84161 | NA | NA | NA | NA | NA | 90 |

| Parameter | Units | Matrix | Method | Parameter Code | AWRL | LOQ | Recovery at LOQ (%) | Precision (RPD of LCS/LCSD) | Bias %Rec. of LCS | Completeness (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Ecoregion (Texas Ecoregion Code) | # | NA | TCEQ SOP, V1 | 89961 | NA | NA | NA | NA | NA | 90 |
| Total Taxa Richness, Benthos | # | Water | TCEQ SOP, V2 | 90055 | NA | NA | NA | NA | NA | 90 |
| Diptera Taxa | # | Water | TCEQ SOP, V2 | 90056 | NA | NA | NA | NA | NA | 90 |
| Ephemeroptera Taxa | # | Water | TCEQ SOP, V2 | 90057 | NA | NA | NA | NA | NA | 90 |
| Intolerant Taxa, Benthos | # | Water | TCEQ SOP, V2 | 90058 | NA | NA | NA | NA | NA | 90 |
| Individuals as EPT Taxa | % | Water | TCEQ SOP, V2 | 90060 | NA | NA | NA | NA | NA | 90 |
| Chironomidae | % | Water | TCEQ SOP, V2 | 90062 | NA | NA | NA | NA | NA | 90 |
| Tolerant Taxa, Benthos | % | Water | TCEQ SOP, V2 | 90066 | NA | NA | NA | NA | NA | 90 |
| Grazers | % | Water | TCEQ SOP, V2 | 90020 | NA | NA | NA | NA | NA | 90 |
| Filterers | % | Water | TCEQ SOP, V2 | 90030 | NA | NA | NA | NA | NA | 90 |
| Dominance (3 Taxa) | % | Water | TCEQ SOP, V2 | 90067 | NA | NA | NA | NA | NA | 90 |
| Kicknet Effort, area kicked | $m^2$ | Water | TCEQ SOP, V2 | 89903 | NA | NA | NA | NA | NA | 90 |
| Kicknet Effort, minutes kicked | minutes | Water | TCEQ SOP, V2 | 89904 | NA | NA | NA | NA | NA | 90 |
| Snags and Shoreline Sampling Effort, minutes picked | minutes | Water | TCEQ SOP, V2 | 89905 | NA | NA | NA | NA | NA | 90 |
| Number of individuals in benthic RBA sub-sample ($\forall$ 100) | # | Water | TCEQ SOP, V2 | 89906 | NA | NA | NA | NA | NA | 90 |
| EPT Index, Abundance | # | Water | TCEQ SOP, V2 | 90008 | NA | NA | NA | NA | NA | 90 |
| Biotic Index (HBI) | NA | Water | TCEQ SOP, V2 | 90007 | NA | NA | NA | NA | NA | 90 |
| Dominant Taxon, Benthos | % | Water | TCEQ SOP, V2 | 90042 | NA | NA | NA | NA | NA | 90 |
| Dominant FFG | % | Water | TCEQ SOP, V2 | 90010 | NA | NA | NA | NA | NA | 90 |
| Predators | % | Water | TCEQ SOP, V2 | 90036 | NA | NA | NA | NA | NA | 90 |
| Ratio of Intolerant:Tolerant taxa, Benthos | NA | Water | TCEQ SOP, V2 | 90050 | NA | NA | NA | NA | NA | 90 |
| Total Trichoptera as Hydropsychidae | % | Water | TCEQ SOP, V2 | 90069 | NA | NA | NA | NA | NA | 90 |
| Non-insect taxa | # | Water | TCEQ SOP, V2 | 90052 | NA | NA | NA | NA | NA | 90 |
| Collector-gatherers | % | Water | TCEQ SOP, V2 | 90025 | NA | NA | NA | NA | NA | 90 |
| Total number as Elmidae | % | Water | TCEQ SOP, V2 | 90054 | NA | NA | NA | NA | NA | 90 |
| Nekton, none captured | NA | Water | TCEQ SOP, V2 | 98005 | NA | NA | NA | NA | NA | 90 |
| Electrofishing effort, duration of shocking | seconds | Water | TCEQ SOP, V2 | 89944 | NA | NA | NA | NA | NA | 90 |

| Parameter | Units | Matrix | Method | Parameter Code | AWRL | LOQ | Recovery at LOQ (%) | Precision (RPD of LCS/LCSD) | Bias %Rec. of LCS | Completeness (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Seining effort | # of hauls | Water | TCEQ SOP, V2 | 89947 | NA | NA | NA | NA | NA | 90 |
| Combined length of seine hauls | meters | Water | TCEQ SOP, V2 | 89948 | NA | NA | NA | NA | NA | 90 |
| Seining effort, duration | minutes | Water | TCEQ SOP, V2 | 89949 | NA | NA | NA | NA | NA | 90 |
| Seine Minimum Mesh Size, net average bar, Nekton | in | Water | TCEQ SOP, V2 | 89930 | NA | NA | NA | NA | NA | 90 |
| Seine Maximum Mesh Size, net average bar, Nekton | in | Water | TCEQ SOP, V2 | 89931 | NA | NA | NA | NA | NA | 90 |
| Net length | meters | Water | TCEQ SOP, V2 | 89941 | NA | NA | NA | NA | NA | 90 |
| Electrofishing method | 1=boat; 2=backpack; 3=tote barge | Water | TCEQ SOP, V2 | 89943 | NA | NA | NA | NA | NA | 90 |
| Area seined | $m^2$ | Water | TCEQ SOP, V2 | 89976 | NA | NA | NA | NA | NA | 90 |
| Total number fish species | # | Water | TCEQ SOP, V2 | 98003 | NA | NA | NA | NA | NA | 90 |
| Total native cyprinid species, fish | # | Water | TCEQ SOP, V2 | 98032 | NA | NA | NA | NA | NA | 90 |
| Total benthic invertivore species, fish | # | Water | TCEQ SOP, V2 | 98052 | NA | NA | NA | NA | NA | 90 |
| Total benthic species, fish | # | Water | TCEQ SOP, V2 | 98053 | NA | NA | NA | NA | NA | 90 |
| Total sunfish species (except bass) | # | Water | TCEQ SOP, V2 | 98008 | NA | NA | NA | NA | NA | 90 |
| Total intolerant fish species | # | Water | TCEQ SOP, V2 | 98010 | NA | NA | NA | NA | NA | 90 |
| Tolerant individuals (excluding Western Mosquitofish), fish | % | Water | TCEQ SOP, V2 | 98070 | NA | NA | NA | NA | NA | 90 |
| Omnivore individuals, fish | % | Water | TCEQ SOP, V2 | 98017 | NA | NA | NA | NA | NA | 90 |
| Invertivore individuals, fish | % | Water | TCEQ SOP, V2 | 98021 | NA | NA | NA | NA | NA | 90 |
| Piscivore individuals, fish | % | Water | TCEQ SOP, V2 | 98022 | NA | NA | NA | NA | NA | 90 |
| Total Individuals seining | # | Water | TCEQ SOP, V2 | 98039 | NA | NA | NA | NA | NA | 90 |
| Total Individuals electroshocking | # | Water | TCEQ SOP, V2 | 98040 | NA | NA | NA | NA | NA | 90 |
| Individuals/seine haul | # | Water | TCEQ SOP, V2 | 98062 | NA | NA | NA | NA | NA | 90 |

| Parameter | Units | Matrix | Method | Parameter Code | AWRL | LOQ | Recovery at LOQ (%) | Precision (RPD of LCS/LCSD) | Bias %Rec. of LCS | Completeness (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Individuals/minute electroshocking | # | Water | TCEQ SOP, V2 | 98069 | NA | NA | NA | NA | NA | 90 |
| Individuals as non-native species | % | Water | TCEQ SOP, V2 | 98033 | NA | NA | NA | NA | NA | 90 |
| Individuals w/ disease/anomalies | % | Water | TCEQ SOP, V2 | 98030 | NA | NA | NA | NA | NA | 90 |
| Streambed slope over evaluated reach (from USGS map) | NA | Water | TCEQ SOP, V2 | 72052 | NA | NA | NA | NA | NA | 90 |
| Approximate drainage area above the most downstream transect from USGS map | $km^2$ | Water | TCEQ SOP, V2 | 89859 | NA | NA | NA | NA | NA | 90 |
| Length of stream | km | Water | TCEQ SOP, V2 | 89860 | NA | NA | NA | NA | NA | 90 |
| Lateral transects made | # | Water | TCEQ SOP, V2 | 89832 | NA | NA | NA | NA | NA | 90 |
| Average stream width | meters | Water | TCEQ SOP, V2 | 89861 | NA | NA | NA | NA | NA | 90 |
| Average stream depth | meters | Water | TCEQ SOP, V2 | 89862 | NA | NA | NA | NA | NA | 90 |
| Channel Flow Status | 1=no flow;<br>2=low;<br>3=moderate;<br>4=high | Water | TCEQ SOP, V2 | 89848 | NA | NA | NA | NA | NA | 90 |
| Maximum pool width at time of study | meters | Water | TCEQ SOP, V2 | 89864 | NA | NA | NA | NA | NA | 90 |
| Maximum pool depth in study area | meters | Water | TCEQ SOP, V2 | 89865 | NA | NA | NA | NA | NA | 90 |
| Total stream bends | # | Water | TCEQ SOP, V2 | 89839 | NA | NA | NA | NA | NA | 90 |
| Well-defined stream bends | # | Water | TCEQ SOP, V2 | 89840 | NA | NA | NA | NA | NA | 90 |
| Moderately defined stream bends | # | Water | TCEQ SOP, V2 | 89841 | NA | NA | NA | NA | NA | 90 |
| Poorly defined stream bends | # | Water | TCEQ SOP, V2 | 89842 | NA | NA | NA | NA | NA | 90 |
| Riffles | # | Water | TCEQ SOP, V2 | 89843 | NA | NA | NA | NA | NA | 90 |
| Dominant substrate | 1=clay;<br>2=silt;<br>3=sand;<br>4=gravel;<br>5=cobble;<br>6=boulder;<br>7=bedrock;<br>8=other | Water | TCEQ SOP, V2 | 89844 | NA | NA | NA | NA | NA | 90 |

| Parameter | Units | Matrix | Method | Parameter Code | AWRL | LOQ | Recovery at LOQ (%) | Precision (RPD of LCS/LCSD) | Bias %Rec. of LCS | Completeness (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Avg. % of substrate gravel >2mm | % | Water | TCEQ SOP, V2 | 89845 | NA | NA | NA | NA | NA | 90 |
| Avg. % instream cover | % | Water | TCEQ SOP, V2 | 84159 | NA | NA | NA | NA | NA | 90 |
| Stream Cover Types | # | Water | TCEQ SOP, V2 | 89929 | NA | NA | NA | NA | NA | 90 |
| Avg. % stream bank erosion potential | % | Water | TCEQ SOP, V2 | 89846 | NA | NA | NA | NA | NA | 90 |
| Avg. stream bank angle | degrees | Water | TCEQ SOP, V2 | 89847 | NA | NA | NA | NA | NA | 90 |
| Avg. width natural riparian vegetation | meters | Water | TCEQ SOP, V2 | 89866 | NA | NA | NA | NA | NA | 90 |
| Avg. % trees as riparian vegetation | % | Water | TCEQ SOP, V2 | 89849 | NA | NA | NA | NA | NA | 90 |
| Avg. % shrubs as riparian vegetation | % | Water | TCEQ SOP, V2 | 89850 | NA | NA | NA | NA | NA | 90 |
| Avg. % grasses and forbs as riparian vegetation | % | Water | TCEQ SOP, V2 | 89851 | NA | NA | NA | NA | NA | 90 |
| Avg. % cultivated fields as riparian vegetation | % | Water | TCEQ SOP, V2 | 89852 | NA | NA | NA | NA | NA | 90 |
| Avg. % other as riparian vegetation | % | Water | TCEQ SOP, V2 | 89853 | NA | NA | NA | NA | NA | 90 |
| Avg.% tree canopy coverage | % | Water | TCEQ SOP, V2 | 89854 | NA | NA | NA | NA | NA | 90 |
| Overall Aesthetics | 1=wilderness; 2=natural; 3=common; 4=offensive | Water | TCEQ SOP, V2 | 89867 | NA | NA | NA | NA | NA | 90 |
| Land development impact | 1=unimpacted; 2=low; 3=moderate; 4=high | Water | TCEQ SOP, V2 | 89962 | NA | NA | NA | NA | NA | 90 |
| 24-Hr D.O. Avg. | mg/l | Water | TCEQ SOP, V1 | 89857 | NA | NA | NA | NA | NA | 90 |
| Max Daily DO | mg/l | Water | TCEQ SOP, V1 | 89856 | NA | NA | NA | NA | NA | 90 |
| Min Daily DO | mg/l | Water | TCEQ SOP, V1 | 89855 | NA | NA | NA | NA | NA | 90 |
| #DO measurements during 24-Hrs | # meas. | Water | TCEQ SOP, V1 | 89858 | NA | NA | NA | NA | NA | 90 |
| 24-Hr Avg. water Temperature | ° Celsius | Water | TCEQ SOP, V1 | 00209 | NA | NA | NA | NA | NA | 90 |
| Max Daily water Temperature | ° Celsius | Water | TCEQ SOP, V1 | 00210 | NA | NA | NA | NA | NA | 90 |
| Min Daily water Temperature | ° Celsius | Water | TCEQ SOP, V1 | 00211 | NA | NA | NA | NA | NA | 90 |

| Parameter | Units | Matrix | Method | Parameter Code | AWRL | LOQ | Recovery at LOQ (%) | Precision (RPD of LCS/LCSD) | Bias %Rec. of LCS | Completeness (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| # water temp measurements during 24-Hrs. | # meas. | Water | TCEQ SOP, V1 | 00221 | NA | NA | NA | NA | NA | 90 |
| 24-Hr Avg. Spec Conductance | uS/cm | Water | TCEQ SOP, V1 | 00212 | NA | NA | NA | NA | NA | 90 |
| Max Spec Conductance | uS/cm | Water | TCEQ SOP, V1 | 00213 | NA | NA | NA | NA | NA | 90 |
| Min Spec Conductance | uS/cm | Water | TCEQ SOP, V1 | 00214 | NA | NA | NA | NA | NA | 90 |
| # Spec Conductance measurements during 24-Hrs. | # meas. | Water | TCEQ SOP, V1 | 00222 | NA | NA | NA | NA | NA | 90 |
| Max Daily pH | Standard units | Water | TCEQ SOP, V1 | 00215 | NA | NA | NA | NA | NA | 90 |
| Min Daily pH | Standard units | Water | TCEQ SOP, V1 | 00216 | NA | NA | NA | NA | NA | 90 |
| # pH measurements during 24-Hrs. | # meas. | Water | TCEQ SOP, V1 | 00223 | NA | NA | NA | NA | NA | 90 |
| 24-Hr Salinity Avg. | ppt | Water | TCEQ SOP, V1 | 00218 | NA | NA | NA | NA | NA | 90 |
| Max Daily Salinity | ppt | Water | TCEQ SOP, V1 | 00217 | NA | NA | NA | NA | NA | 90 |
| Min Daily Salinity | ppt | Water | TCEQ SOP, V1 | 00219 | NA | NA | NA | NA | NA | 90 |
| # salinity measurement during 24-Hrs | # meas. | Water | TCEQ SOP, V1 | 00220 | NA | NA | NA | NA | NA | 90 |

TCEQ SOP, V1 - *TCEQ SWQM Procedures, Volume 1: Physical and Chemical Monitoring Methods*, 2008 (RG-415).
TCEQ SOP, V2 - *TCEQ SWQM Procedures, Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data*, 2005 (RG-416)

## Table A7.3 Measurement Performance Specifications for Data Collection to be used for RUAA Assessment

| Parameter | Units | Matrix | Method | Parameter Code | AWRL | LOQ | Recovery at LOQ (%) | Precision (RPD of LCS/LCSD) | Bias %Rec. of LCS | Completeness (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Temperature | °C | air | SWQM Vol. 1 | | NA | NA | NA | NA | NA | 90 |
| pH | pH/ units | water | SWQM Vol. 1 | 00400 | NA | NA | NA | NA | NA | 90 |
| DO | mg/L | water | SWQM Vol. 1 | 00300 | NA | NA | NA | NA | NA | 90 |
| DO % Saturation | % | water | SWQM Vol. 1 | 00301 | NA | NA | NA | NA | NA | 90 |
| Conductivity | uS/cm | water | SWQM Vol. 1 | 00094 | NA | NA | NA | NA | NA | 90 |
| Temperature | °C | water | SWQM Vol. 1 | 00010 | NA | NA | NA | NA | NA | 90 |
| Flow | cfs | water | TCEQ SOP | 00061 | NA | NA | NA | NA | NA | 90 |
| Flow Measurement Method | 1=gage;<br>2=electric;<br>3=mechanical;<br>4=weir/flume;<br>5=doppler | water | SWQM Vol. 1 | 89835 | NA | NA | NA | NA | NA | 90 |
| Flow severity | 1=no flow;<br>2=low;<br>3=normal;<br>4=flood;<br>5=high;<br>6=dry | water | TCEQ SOP V1 | 01351 | NA | NA | NA | NA | NA | 90 |
| Present Weather | 1=clear;<br>2=partly cloudy;<br>3=cloudy;<br>4=rain;<br>5=other | NA | TCEQ SOP V1 | 89966 | NA | NA | NA | NA | NA | 90 |
| Wind Intensity | 1=calm;<br>2=slight;<br>3=moderate;<br>4=strong | NA | TCEQ SOP V1 | 89965 | NA | NA | NA | NA | NA | 90 |
| Days since last significant rainfall | days | NA | TCEQ SOP V1 | 72053 | NA | NA | NA | NA | NA | |
| Stream Order | # | Water | TCEQ SOP, V2 | 84161 | NA | NA | NA | NA | NA | 90 |
| Length of stream evaluated | m | Water | TCEQ SOP, V2 | 89860 | NA | NA | NA | NA | NA | 90 |
| Lateral transects made | # | Water | TCEQ SOP, V2 | 89832 | NA | NA | NA | NA | NA | 90 |
| Average stream width | meters | Water | TCEQ SOP, V2 | 89861 | NA | NA | NA | NA | NA | 90 |
| Average stream depth | meters | Water | TCEQ SOP, V2 | 89862 | NA | NA | NA | NA | NA | 90 |
| Channel Flow Status | 1=no flow;<br>2=low;<br>3=moderate;<br>4=high | Water | TCEQ SOP, V2 | 89848 | NA | NA | NA | NA | NA | 90 |

| Parameter | Units | Matrix | Method | Parameter Code | AWRL | LOQ | Recovery at LOQ (%) | Precision (RPD of LCS/LCSD) | Bias %Rec. of LCS | Completeness (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Maximum pool width at time of study | meters | Water | TCEQ SOP, V2 | 89864 | NA | NA | NA | NA | NA | 90 |
| Maximum pool depth in study area | meters | Water | TCEQ SOP, V2 | 89865 | NA | NA | NA | NA | NA | 90 |
| Dominant substrate | 1=clay;<br>2=silt;<br>3=sand;<br>4=gravel;<br>5=cobble;<br>6=boulder;<br>7=bedrock;<br>8=other | Water | TCEQ SOP, V2 | 89844 | NA | NA | NA | NA | NA | 90 |

## A8 Special Training/Certification

Field personnel will receive training in proper sampling and field analysis. Before actual sampling or field analysis occurs, they will demonstrate to the Field Operations Manager their ability to properly operate the samplers and retrieve samples. The Field Operations Manager will document the proficiency of individual field staff within each of their field training books.

Field personnel will receive training on the set up and routine maintenance on the ISCO 4230 Flowmeter used for continuous flow monitoring.

Field personnel will receive training on the calibration and operation of the SonTek Doppler Flowmeter and the RiverCat Flowmeter for taking flow measurements.

BRA must ensure that laboratories analyzing samples under this QAPP meet the requirements contained in section 5.4.4 of the NELAC standards (concerning Review of Requests, Tenders and Contracts).

# A9 Documents and Records

## Laboratory Test Reports

- Test/data reports from the laboratory will document the test results clearly and accurately. Routine data reports will be consistent with the NELAC standards (Section 5.5.10) and include the information necessary for the interpretation and validation of data.

The information in test reports will be consistent with the information that is needed to prepare data submittals to TSSWCB.

Reports will be consistent with the NELAC standards and will include any additional information critical to the review, verification, validation, and interpretation of data.

## Field Generated Reports

## RUAA Reports and Forms

- Information to be collected shall at least satisfy those questions found on Contact Information Form from the TCEQ *Procedures for a Comprehensive RUAA and a Basic RUAA Survey* (May 2009)
- Field Data Sheets and Data Summary in electronic format
- Digital photographic record, cataloged in an appropriate manner
- Interview Forms and Data Summary in electronic format

## Electronic Data

Data will be submitted to the TSSWCB (PM and QAO) in the event/result format specified in the *TCEQ Data Management Reference Guide* (DMRG) for transfer to TCEQ and upload to the Surface Water Quality Monitoring Information System (SWQMIS). The Data Summary as contained in Appendix C of this document will be submitted with the data. No measurement data collected for the RUAA field surveys will be submitted by TSSWCB to TCEQ for the express purpose of inclusion in SWQMIS.

A SLOC request will not be submitted for transect sites (RUAA field surveys) since the data is not intended for upload to SWQMIS.

All reported Events will have a unique TagID (see DMRG). TagIDs used in this project will be seven-character alphanumerics with the structure of the two-letter Tag prefix followed by a five digit number.

Reporting Entity, Monitoring Entity, and Monitoring Type 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). The TSSWCB QAO should be consulted to assure proper use of the Monitoring Type code.

## Records and Documents Retention Requirements

| Document/Record | Location at BRA | Retention | Form |
|---|---|---|---|
| QAPP, amendments, and appendices | Central Files | 5 years | Paper |
| QAPP distribution documentation | Central Files | 5 years | Paper/Electronic |
| Training records | Central Files | 5 years | Paper/Electronic |
| Field notebooks or field data sheets | Central Files | 5 years | Paper |
| Field equipment calibration/maintenance l | Central Files | 5 years | Paper |
| RUAA Contact Information, Field Data, and Interview Forms | Central Files | 5 years | Paper |
| COC records | Central Files | 5 years | Paper |
| Field SOPs | Central Files | 5 years | Paper |
| Laboratory QA manuals | QAO Office | 5 years | Paper/Electronic |
| Laboratory SOPs | Lab | 5 years | Paper/Electronic |
| Laboratory procedures | Lab | 5 years | Paper |
| Instrument raw data files | Lab | 5 years | LIMS Electronic |
| Instrument readings/printouts | Lab | 5 years | Paper |
| Laboratory data reports/results | Lab | 5 years | Paper |
| Laboratory equipment maintenance logs | Lab | 5 years | Paper |
| Laboratory calibration records | Lab | 5 years | LIMS Electronic |
| Corrective action documentation | Lab | 5 years | Paper/Electronic |

## B1 Sampling Process Design (Experimental Design)

To provide sufficient water quality data to characterize bacteria loadings across the various flow regimes, BRA will conduct routine ambient monitoring once every two weeks at ten sites. Currently routine monitoring is conducted quarterly at one site Campbells Creek at SH 6 (16395). When authorization to enter wastewater treatment facilities (WWTF) at Calvert, Bremond and Franklin is obtained from both the TCEQ and the respective municipalities, BRA will conduct effluent monitoring at the three WWTFs once every two weeks in an effort to estimate possible contributions from wastewater discharges. BRA will conduct biased-flow monitoring under high flow (storm event) conditions at the same ten stream sites and three WWTFs during at least twelve storm events. BRA will conduct biological monitoring on the Little Brazos River below the confluence of the tributaries to assess the cumulative impact of the impaired segments on stream health and biological communities.

BRA will collect information that can be used to evaluate recreational uses in the waterbodies in the study area. Methods used and sampling process design shall be consistent with the TCEQ *Procedures for a Comprehensive RUAA and a Basic RUAA Survey* (May 2009). BRA will conduct field surveys at selected sites during the period people would most likely be using the waterbody for contact recreation; surveys shall ascertain the suitability of the streams for contact recreation use and shall document the hydrological characteristics of the stream.

Field data and samples will be collected following procedures detailed in the *TCEQ SWQM Procedures, Volume 1: Physical and Chemical Monitoring Methods, 2008 (RG-415).*

## Table B1.1 Monitoring Sites

| Segment | Site Number | Site Description | Latitude Longitude | Sample Matrix | Monitoring Frequencies | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Field | Flow | *E. coli* | Biased Flow | Continuous Flow | Biological | RUAA Survey |
| 1242E | 11591 | Little Brazos River @ SH 21 | 30.6417 -96.5208 | water | 2 | 2 | --- | --- | --- | 2 | |
| 1242I | 99915 | Campbell's Creek at Mumford-Benchly Rd | 30.7433 -96.4970 | water | 2 | 2 | | | | | 2 |
| 1242I | 16395 | Campbells Creek @ Old Hearne Rd | 30.7890 -96.4860 | water | 43* | 43* | 41* | 12** | 22 Months | --- | 2 |
| 1242I | 20561 | Campbells Creek @ Jack Rabbit Lane | 30.7904 -96.4547 | water | 43* | 43* | 41* | 12** | --- | --- | 2 |
| 1242I | 99916 | Campbell's Creek1 | 30.8187 -96.4284 | water | 2 | 2 | | | | | 2 |
| 1242I | 99917 | Campbell's Creek2 | 30.8348 -96.4195 | water | 2 | 2 | | | | | 2 |
| 1242K | 16402 | Mud Creek @ SH 6 | 30.9468 -96.6473 | water | 43* | 43* | 41* | 12** | 22 Months | --- | 2 |
| 1242K | 99906 | Mud Creek at Mud Creek Rd | 30.9659 -96.6192 | water | 2 | 2 | | | | | 2 |
| 1242K | 20562 | Mud Creek @ Jack Brewer Rd. | 30.9775 -96.5680 | water | 43* | 43* | 41* | 12** | --- | --- | 2 |
| 1242K | 99907 | Mud Creek at Hwy 79 | 31.0162 -96.5007 | water | 2 | 2 | | | | | 2 |
| 1242K | 99908 | Mud Creek at FM 1644 | 31.0230 -96.4969 | water | 2 | 2 | | | | | 2 |
| 1242L | 16401 | Pin Oak Creek @ DS of SH 6 | 30.8510 -96.5650 | water | 43* | 43* | 41* | 12** | 22 Months | --- | 2 |
| 1242L | 20385 | Pin Oak Creek at FM 2549 | 30.8718 -96.5132 | water | 2 | 2 | | | | | 2 |
| 1242L | 20563 | Pin Oak Creek @ CR 391 | 30.8900 -96.5130 | water | 43* | 43* | 41* | 12** | --- | --- | 2 |
| 1242L | 99910 | Pin Oak Creek at Pin Oak Rd/CR 329 (South) | 30.9153 -96.5097 | water | 2 | 2 | | | | | 2 |
| 1242L | 99911 | Pin Oak Creek at Pin Oak Rd | 30.9430 -96.4994 | water | 2 | 2 | | | | | 2 |
| 1242L | 99912 | Spring Creek at Old Hearne Rd | 30.7913 -96.5156 | water | 2 | 2 | | | | | 2 |
| 1242M | 16394 | Spring Creek @ SH 6/US190 | 30.8022 -96.5122 | water | 43* | 43* | 41* | 12** | 22 Months | --- | 2 |

| Segment | Site Number | Site Description | Latitude Longitude | Sample Matrix | Monitoring Frequencies | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Field | Flow | *E. coli* | Biased Flow | Continuous Flow | Biological | RUAA Survey |
| 1242M | 20564 | Spring Creek @ Jack Rabbit Lane | 30.8356 -96.4897 | water | 43∗ | 43∗ | 41∗ | 12** | --- | --- | 2 |
| 1242M | 99913 | Spring Creek at Camp Arrow Moon Rd** | 30.8476 -96.4855 | water | 2 | 2 | | | | | 2 |
| 1242M | 99914 | Spring Creek at FM 391 | 30.8949 -96.4599 | water | 2 | 2 | | | | | 2 |
| 1242O | 16403 | Walnut Creek @ SH 6 | 31.0102 -96.7025 | water | 43∗ | 43∗ | 41∗ | 12** | 22 Months | --- | 2 |
| 1242O | 20021 | Walnut Creek at CR 123 | 31.0362 -96.6708 | water | 2 | 2 | | | | | 2 |
| 1242O | 99901 | Walnut Creek1 | 31.0536 -96.6572 | water | 2 | 2 | | | | | 2 |
| 1242O | 20565 | Walnut Creek @ Nesbit Rd/Tidwell Road | 31.0891 -96.6313 | water | 43∗ | 43∗ | 41∗ | 12** | --- | --- | 2 |
| 1242O | 99902 | Walnut Creek at SH 46 | 31.1217 -96.6172 | water | 2 | 2 | | | | | 2 |
| 1242O | 99903 | Walnut Creek at FM 2293 | 31.1650 -96.5880 | water | 2 | 2 | | | | | 2 |
| 1242O | 99904 | Walnut Creek at Walnut Rd | 31.1783 -96.5810 | water | 2 | 2 | | | | | 2 |
| 1242O | 99905 | Walnut Creek at Wasik Rd | 31.2016 -96.5548 | water | 2 | 2 | | | | | 2 |
| 1242O | TX0023442 | Bremond WWTF Outfall | Not available | water | 41∗ | 41∗ | 41∗ | 12** | --- | --- | |
| 1242K | TX0054020 | Calvert WWTF Outfall† | Not available | water | 41∗ | 41∗ | 41∗ | 12** | --- | --- | |
| 1242K | TX0021318 | Franklin WWTF Outfall | Not available | water | 41∗ | 41∗ | 41∗ | 12** | --- | --- | |

* Sampling (instream and WWTF) once every two weeks from November 2008 to May 2010
** Storm events over 19 months (November 2008 through May 2010)
† Pending authorization from the WWTF operators and TCEQ

## B2 Sampling Methods

### Field Sampling Procedures

Field sampling will be conducted according to procedures documented in the *TCEQ SWQM Procedures Volume 1: Physical and Chemical Monitoring Methods, 2008 (RG-415) and Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data, 2007* (*RG-416).*

Flow-gauging stations will be added at five sites. Flow gauges will be programmed to take hourly flow measurements.

Biased-flow monitoring will be conducted at all routine sample locations within 48 hours of the Robertson County area experiencing a precipitation event of 0.45 inch or more within 12 hours. Precipitation amounts will be determined using the National Weather Service's Hourly Mean Areal Precipitation Estimates for the site at Hearne.

For the RUAA field surveys, information to be collected shall at least satisfy those questions found on the Field Data Sheet from the TCEQ *Procedures for a Comprehensive RUAA and a Basic RUAA Survey* (May 2009).

Routine sample collection will follow the field sampling procedures for conventional and microbiological parameters documented in the *TCEQ SWQM Procedures Volume 1: Physical and Chemical Monitoring Methods, 2008 (RG-415).*

The sample volumes, container types, minimum sample volume, preservation requirements, and holding time requirements are specified in table B2.

### Table B2.1 Instream and Effluent Monitoring

| Parameter | Matrix | Sample Type | Container | Preservation | Sample Volume | Holding Time |
|---|---|---|---|---|---|---|
| *E. coli* | water | Grab | 100 ml IDEXX bottle | ice, dark | 100 ml | 8 hours |

### Processes to Prevent Cross Contamination

Procedures outlined in the *TCEQ SWQM Procedures* outline the necessary steps to prevent cross-contamination of samples. These include such things as direct collection into sample containers and the use of commercially pre-cleaned sample containers.

### Documentation of Field Sampling Activities

Field sampling activities are documented on the Field Data Sheet as presented in Appendix F. For all visits, station ID, location, sampling time, sampling date, sampling depth, preservatives added to samples, and sample collector's name/signature are recorded. Values for all measured field parameters are recorded. Detailed observational data are recorded including water

appearance, weather, biological activity, stream uses, unusual odors, specific sample information, missing parameters, days since last significant rainfall, and flow severity.

The following will be recorded for all visits:

1. Station ID
2. Sampling Date
3. Location
4. Sampling depth
5. Sampling time
6. Sample collector's name/signature
7. Values for all field parameters
8. Detailed observational data, including:
    a. water appearance
    b. weather
    c. biological activity
    d. unusual odors
    e. pertinent observations related to water quality or stream uses (e.g., exceptionally poor water quality conditions/standards not met; stream uses such as swimming, boating, fishing, irrigation pumps, etc.)
    f. watershed or instream activities (events impacting water quality, e.g., bridge construction, livestock watering upstream, etc.)
    g. specific sample information (number of sediment grabs, type/number of fish in a tissue sample, etc.)
    h. missing parameters (i.e., when a scheduled parameter or group of parameters is not collected)

Field sampling activities for recreational use attainability tasks shall at least satisfy those questions found on the Field Data Sheets, Interview Forms, and Summary Sheets as specified by the TCEQ *Procedures for a Comprehensive RUAA and a Basic RUAA Survey*.(May 2009) Versions of these forms for this project are found in Appendix G.

**Recording Data**

For the purposes of this section and subsequent sections, all personnel follow the basic rules for recording information as documented below:

1. Legible writing in indelible, waterproof ink with no modifications, write-overs or cross-outs;
2. Changes should be made by crossing out original entries with a single line, entering the changes, and initialing and dating the corrections.
3. Close-outs on incomplete pages with an initialed and dated diagonal line.

**Deficiencies, Nonconformances and Corrective Action Related to Sampling Requirements**

Deficiencies are defined as unauthorized deviation from procedures documented in the QAPP. Nonconformances are deficiencies which affect quality and render the data unacceptable or

indeterminate. Deficiencies related to sampling methods requirements include, but are not limited to, such things as sample container, volume, and preservation variations, improper/inadequate storage temperature, holding-time exceedances, and sample site adjustments.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the appropriate field or laboratory supervisor who will notify the BRA QAO. The BRA QAO will notify the BRA Project Manager of the potential nonconformance within 24 hours. The BRA staff member identifying the deficiency will initiate a record on the Deficiency Worksheet to document the deficiency.

The BRA QAO, in consultation with BRA Project Manager (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the deficiency worksheet will be completed accordingly. If it is determined a nonconformance does exist, the BRA QAO in consultation with BRA Project Manager will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the BRA QAO by completion of a CAR.

CARs document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. 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 both verbally and in writing.

# B3 Sampling Handling and Custody

## Sample Labeling

Samples from the field are labeled on the container with an indelible marker. Label information includes:

1. Sample Number, Bottle Letter, and Site Number
2. Date and time of collection
3. Sample Depth
4. Initials of collector

## Sample Handling

Samples are collected in the field and stored in coolers on ice. Samples are delivered to the Authority's water quality laboratory in coolers with field data sheets (COC Forms) attached. The laboratory staff examines each sample container for anomalies and ensures that all container information matches the information on the appropriate field data sheet. If the information is present and correct, the lab staff will receive the samples by signing the field data sheet "received by" block and entering the samples into the laboratory sample log book. At this instant, the samples become the responsibility of the Authority's water quality laboratory.

Internal sample handling, custody, and storage procedures for laboratory are described in the BRA's Environmental Laboratory Quality Manual and Sample Receiving SOP.

## 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 field data sheet serves as the COC form to document sample handling during transfer from the field to the laboratory. The following information concerning the sample is recorded on the field data sheet form (See Appendix G).

1. Date and time of collection
2. Site identification
3. Sample matrix
4. Number of containers
5. Residual chlorine
6. Preservative used
7. Was the sample filtered
8. Analyses required
9. Name of collector
10. Custody transfer signatures and dates and time of transfer

**Deficiencies, Nonconformances and Corrective Action Related to Chain-of Custody**

Deficiencies are defined as unauthorized deviation from procedures documented in the QAPP. Nonconformances are deficiencies which affect quality and render the data unacceptable or indeterminate. Deficiencies related to chain-of-custody include but are not limited to delays in transfer, resulting in holding time violations; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the appropriate field or laboratory supervisor who will notify the BRA QAO. The BRA QAO will notify the BRA Project Manager of the potential nonconformance within 24 hours. The BRA staff member identifying the deficiency will initiate a record on the Deficiency Worksheet to document the deficiency.

The BRA QAO, in consultation with BRA Project Manager (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the deficiency worksheet will be completed accordingly. If it is determined a nonconformance does exist, the BRA QAO in consultation with BRA Project Manager will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the BRA QAO by completion of a CAR.

CARs document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. 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 both verbally and in writing.

## B4 Analytical Methods

The analytical methods are listed in Table A.1 of Section A7. Laboratories collecting data under this QAPP are compliant with the NELAC Standards.

Copies of laboratory SOPs are retained by the BRA and are available for review by the TSSWCB. Laboratory SOPs are consistent with EPA requirements as specified in the method.

### 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.

### Deficiencies, Nonconformances and Corrective Action Related to Analytical Methods

Deficiencies are defined as unauthorized deviation from procedures documented in the QAPP. Nonconformances are deficiencies which affect quality and render the data unacceptable or indeterminate. Deficiencies related to field and laboratory measurement systems include but are not limited to instrument malfunctions, blank contamination, quality control sample failures, etc.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the appropriate field or laboratory supervisor who will notify the BRA QAO. The BRA QAO will notify the BRA Project Manager of the potential nonconformance within 24 hours. The BRA staff member identifying the deficiency will initiate a record on the Deficiency Worksheet to document the deficiency.

The BRA QAO, in consultation with BRA Project Manager (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the deficiency worksheet will be completed accordingly. If it is determined a nonconformance does exist, the BRA QAO in consultation with BRA Project Manager will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the BRA QAO by completion of a CAR.

CARs document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. 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 both verbally and in writing.

# B5 Quality Control

## Sampling Quality Control Requirements and Acceptability Criteria

Detailed laboratory QC requirements are contained within the ES Laboratory QM.

Field Split – A field split is a single sample subdivided by field staff immediately following collection and submitted to the laboratory as two separately identified samples according to procedures specified in the *TCEQ SWQM Procedures*. Split samples are preserved, handled, shipped, and analyzed identically and are used to assess variability in all of these processes. Field splits are collected for 10 percent of samples.

## Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Method Specific QC requirements – QC samples, other than those specified later this section, are run (e.g., sample duplicates, positive control, negative control, and media blank) 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 QM. The minimum requirements that all participants abide by are stated below.

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 bacteriological duplicate is considered to be a special type of laboratory duplicate. Bacteriological duplicate analyses are performed on samples from the sample bottle on a 10% basis. Results of bacteriological duplicates are evaluated by calculating the logarithm of each result and determining the range of each pair.

Measurement performance specifications are used to determine the acceptability of duplicate analyses as specified in Table A7.1. The specifications for bacteriological duplicates in Table A7.1 apply to samples with concentrations >10 MPN/100mL.

## Deficiencies, Nonconformances and Corrective Action Related to Quality Control

Deficiencies are defined as unauthorized deviation from procedures documented in the QAPP. Nonconformances are deficiencies which affect quality and render the data unacceptable or indeterminate. Deficiencies related to Quality Control include but are not limited to quality control sample failures.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the appropriate field or laboratory supervisor who will notify the BRA QAO. The BRA QAO will notify the BRA Project Manager of the potential nonconformance within 24

hours. The BRA staff member identifying the deficiency will initiate a record on the Deficiency Worksheet to document the deficiency.

The BRA QAO, in consultation with BRA Project Manager (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the deficiency worksheet will be completed accordingly. If it is determined a nonconformance does exist, the BRA QAO in consultation with BRA Project Manager will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the BRA QAO by completion of a CAR.

CARs document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. 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 both verbally and in writing.

## B6 Instrument/Equipment Testing, Inspection and Maintenance

Flow gauge testing and maintenance requirements are contained with Appendix E of this document.

All instream sampling equipment testing and maintenance requirements are detailed in the *TCEQ SWQM Procedures*. Equipment records are kept on all field equipment and a supply of critical spare parts is maintained by the BRA Field Supervisor.

All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory QM. Testing and maintenance records are maintained and are available for inspection by the TSSWCB. Instruments requiring daily or in-use testing may include, but are not limited to, water baths, ovens, incubators, refrigerators, and laboratory pure water. Critical spare parts for essential equipment are maintained to prevent downtime. Maintenance records are available for inspection by the TSSWCB.

## B7 Instrument/Equipment Calibration and Frequency

Calibration and operation procedures for the SonTek Doppler flowmeter are included in Appendix F of this document. Calibration and operation procedures for the RiverCat flowmeter are included in Appendix F. Calibration requirements for the ISCO 4230 Flowmeter is included in Appendix E of this document.

Hydrolab calibration requirements are contained in the *TCEQ SWQM 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 TSSWCB.

Detailed laboratory calibrations are contained within the BRA SOP for the individual methods.

## B8 Inspection/Acceptance of Supplies and Consumables

New batches of supplies are tested and the results recorded in the appropriate logbook before use to verify that they are not contaminated. The ESL QM provides additional details on acceptance requirements for laboratory supplies and consumables.

## B9 Non-direct Measurements

Historical data will be retrieved from the SWQMIS. Historical data were collected and analyzed consistently with *TCEQ SWQM Procedures* under the SWQM QAPP or CRP QAPP or EPA approved Brazos/Navasota QAPP and therefore are considered representative of ambient conditions and will be comparable to data collected under this project. Table B9.1 shows the date range of data for each of six existing sites for which SWQMIS has historical data. The mean and median will be computed for each parameter as well as the number of water quality criteria exceedances, as applicable. This information will be compared statistically to the results of data collected under this project. Due to the historical data's comparability to the data collected under this project, there are not limitations on their use.

### Table B9.1 Historical Data

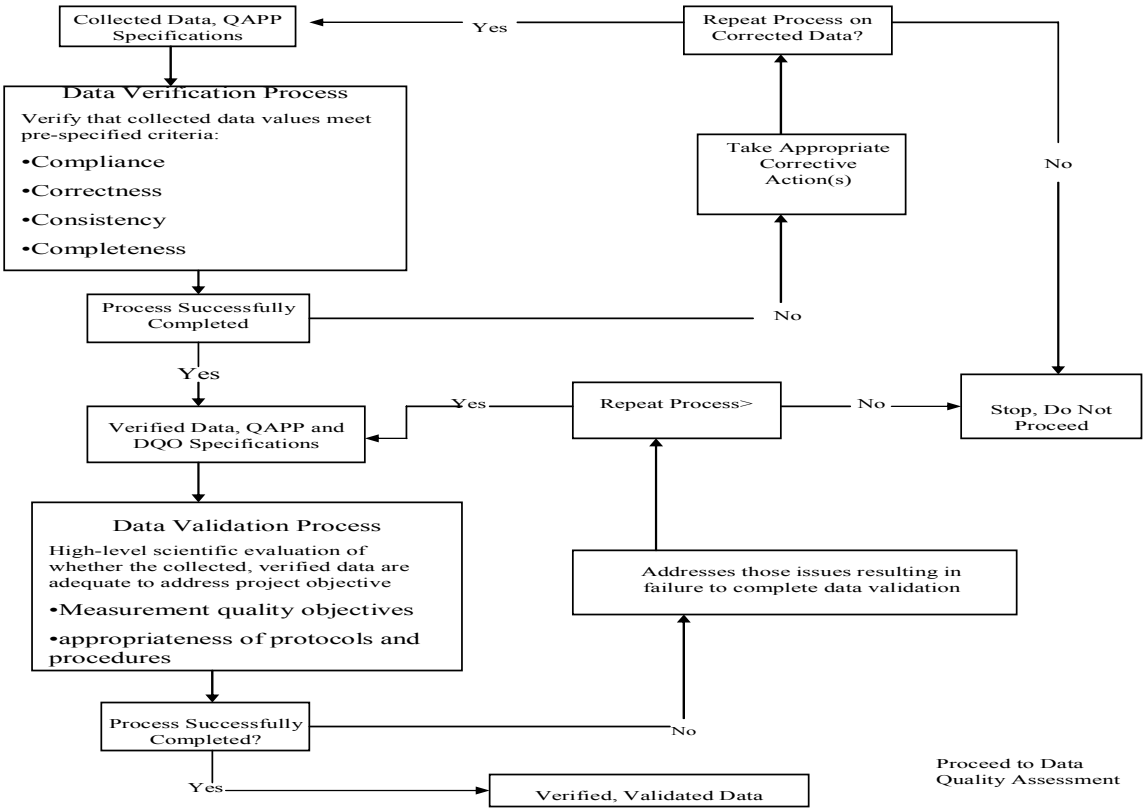
| Site Number | Site Name | Date Range of Historical Data |
|---|---|---|
| 11591 | Little Brazos River @ SH 21 | 05/97 – 08/99 and 09/07 – 08/08 |
| 16394 | Spring Creek @ SH 6/US190 | 09/99 – 08/07 |
| 16395 | Campbells Creek @ Old Hearne Rd | 09/99 – 08/00 and 09/05 – 08/08 |
| 16401 | Pin Oak Creek @ downstream of SH 6 | 09/98 – 08/07 |
| 16402 | Mud Creek @ SH 6 | 09/98 – 08/07 |
| 16403 | Walnut Creek @ SH 6 | 09/98 – 08/07 |

In order to obtain information on existing and historical uses and stream characteristics, BRA shall conduct interviews of 1) users present during the field surveys, 2) streamside landowners along the field survey transects, 3) local residents, and 4) commercial providers of outdoor recreation goods and services. Survey instrument shall include at least those questions found on the Interview Form from the TCEQ *Procedures for a Comprehensive RUAA and a Basic RUAA Survey* (May 2009*)*.

# B10 Data Management

## Data Management Process

### Figure B10.1 Data Flow




## Data Path

Samples are collected and are transferred to the laboratory for analyses as described in Sections B1 and B2. Sampling information (e.g. site location, date, time, sampling depth, etc.) is used to generate a unique sampling event in an interim database built on an autogenerated alphanumeric key field. Measurement results from both the field data sheets and laboratory data sheets are manually entered into the interim database for their corresponding event. Customized data entry forms facilitate accurate data entry. Following data verification and validation, the data are exported from the interim database to prepare ASCII delimited text files for reporting in TCEQ format. Once TSSWCB approval of the data is obtained, the interim data are appended to the primary database.

**Record-keeping and Data Storage**

BRA recordkeeping and document control procedures are contained in the BRA Environmental Services QM and this QAPP. Original field and laboratory data sheets are stored in the BRA Central Files in a fireproof file in accordance with the record-retention schedule in Section A9. There is a Differential and Transaction Log backup of the database every four hours. A full backup is done once a week. The backup process is done by the SQL software. A tape backup is made of the entire system every night and transmitted to an offsite facility for storage.

**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.

Laboratory technicians review all data before finalizing data reports, if needed and the sample is still within holding time the technician will reanalyze samples not meeting QA requirements. The Laboratory Manager reviews all data following analysis and checks for calculation errors or data entry errors. The BRA QAO performs a third review of data to determine validity within this QAPP.

Data that is not valid, for quality reasons, is rejected by the data manager, and the corresponding LIMS data is automatically sent to a "Rejected Data" table.

**Forms and Checklists**

See Appendix F for the Field and Laboratory Data Sheets.

See Appendix C for the Data Summary.

See Appendix G for RUAA forms.

**Data Handling**

*Water Quality Database (LIMS)* – The BRA's laboratory database serves as a repository of water sample tracking and water quality analysis data until all appropriate tests and analyses have been performed and the results have undergone quality control review. The database resides on the Authority's network server, as described above, and is maintained through third party software application named SampleMaster by Accelerated Technology Laboratories, Inc. Laboratory staff maintains the database through Dell OptiPlex® GX520-1 Pentium®-based computers provided with Microsoft Access® as the front end and Microsoft SQL® as the back end. Data input and access to the laboratory water quality database are restricted by password and network access to the Environmental Chemist, Laboratory Technician, Quality Assurance and Data Manager and the IT Project Administrator/Database Analyst. These data also are reported to the TSSWCB, TCEQ, Texas Water Development Board, and other agencies.

## Hardware and Software Requirements

Hardware configurations are sufficient to run Microsoft Access 2003 under the Windows Server 2003 operating system in a networked environment. 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 develop applications based on user requests and assure full system compatibility prior to implementation.

## Information Resource Management Requirements

BRA information technology (IT) policy is contained in IT SOPs which are available for review at BRA offices.

# C1 Assessments and Response Actions

## Table C1.1 Assessments and Response Actions

| Assessment Activity | Approximate Schedule | Responsible Party | Scope | Response Requirements |
|---|---|---|---|---|
| Status Monitoring Oversight, etc. | Continuous | BRA Project Manager | Monitoring of the project status and records to ensure requirements are being fulfilled. | Report to TSSWCB in Quarterly Progress Reports |
| Laboratory Inspection | At least once per life of the project; dates to be determined by the TSSWCB | TSSWCB QAO | Analytical and quality control procedures employed at the laboratory | 30 days to respond in writing to the TSSWCB to address corrective actions |
| Monitoring Systems Audit | At least once per life of the project; dates to be determined by TSSWCB | TSSWCB QAO | The assessment will be tailored in accordance with objectives needed to assure compliance with the QAPP. Field sampling, handling and measurement; facility review; and data management as they relate to the project | 30 days to respond in writing to the TSSWCB to address corrective actions |
| Laboratory Inspection | Based on work plan and or discretion of BRA | BRA QAO | Analytical and quality control procedures employed at the laboratory and the contract laboratory | 30 days to respond in writing to the BRA QAO to address corrective actions |
| Monitoring Systems Audit | Based on work plan and or discretion of BRA | BRA QAO | The assessment will be tailored in accordance with objectives needed to assure compliance with the QAPP. Field sampling, handling and measurement; facility review; and data management as they relate to the project | 30 days to respond in writing to the BRA QAO to address corrective actions |
| Site Visit | At least once per fiscal year; dates to be determined by TSSWCB | TSSWCB PM | Status of activities. Overall compliance with work plan and QAPP | As needed |

## Corrective Action

The BRA Environmental Services Manager is responsible for implementing and tracking corrective action procedures as a result of audit findings. Records of audit findings and corrective actions are maintained by both the TSSWCB PM and the BRA QAO.

If audit findings and corrective actions cannot be resolved, then the authority and responsibility for terminating work is specified in the TSSWCB QMP and in agreements or contracts between participating organizations.

## C2 Reports to Management

### Reports to TSSWCB Project Management

All reports detailed in this section are contract deliverables and are transferred to the TSSWCB in accordance with contract requirements.

Quarterly Progress Report – Summarizes the BRA' activities for each task; reports problems, delays, and corrective actions; and outlines the status of each task's deliverables.

Final Project Report – Summarizes the BRA activities for the entire project period including a description and documentation of major project activities; evaluation of the project results and environmental benefits:

- monitoring data files and Data Summary;
- Technical Report characterizing trends and variability in historical water quality monitoring data;
- Technical Report characterizing trends and variability in collected water quality monitoring data.
- Technical Report summarizing historical information review, field surveys, and user interviews; Technical Report shall at least include those contents described for a Comprehensive RUAA in the TCEQ *Procedures for a Comprehensive RUAA and a Basic RUAA Survey* (May 2009)

### Reports to BRA Project Management

Environmental Services Manager and QAO conduct bimonthly management review reports to cover QA/QC activities, data completion, and status of project objectives.

## D1 Data Review, Verification, and Validation

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 ESL QM, SOPs, and this 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 DQOs 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 used in the project.

The procedures for verification and validation of data are described in Section D2. The BRA Field Supervisor is responsible for ensuring that field data are properly reviewed and verified for integrity. The Laboratory Supervisor is responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and bias, and reviewed for integrity. The BRA Data Manager will be responsible for ensuring that all data are properly reviewed and verified, and submitted in the required format to the project database. The BRA QAO is responsible for validating a minimum of 10% of the data produced in each task. Finally, the BRA Project Manager, with the concurrence of the BRA QAO, is responsible for validating that all data to be reported meet the objectives of the project and are suitable for reporting to TCEQ.

## D2 Verification and Validation Methods

All field and laboratory data will be reviewed, verified and validated to ensure they conform to project specifications and meet the conditions of 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 staff are listed in the first two sections of Table D2, respectively. 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 higher level project management to establish the appropriate course of action, or the data associated with the issue are rejected. Field and laboratory reviews, verifications, and validations are documented.

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 is performed by the BRA Data Manager 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.

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 BRA Project Manager validates that the data meet the DQOs of the project and are suitable for reporting to TSSWCB.

If any requirements or specifications 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 BRA Data Manager with the data. This information is communicated to the TSSWCB by the BRA in the Data Summary.

## Table D2.1 Data Review Tasks

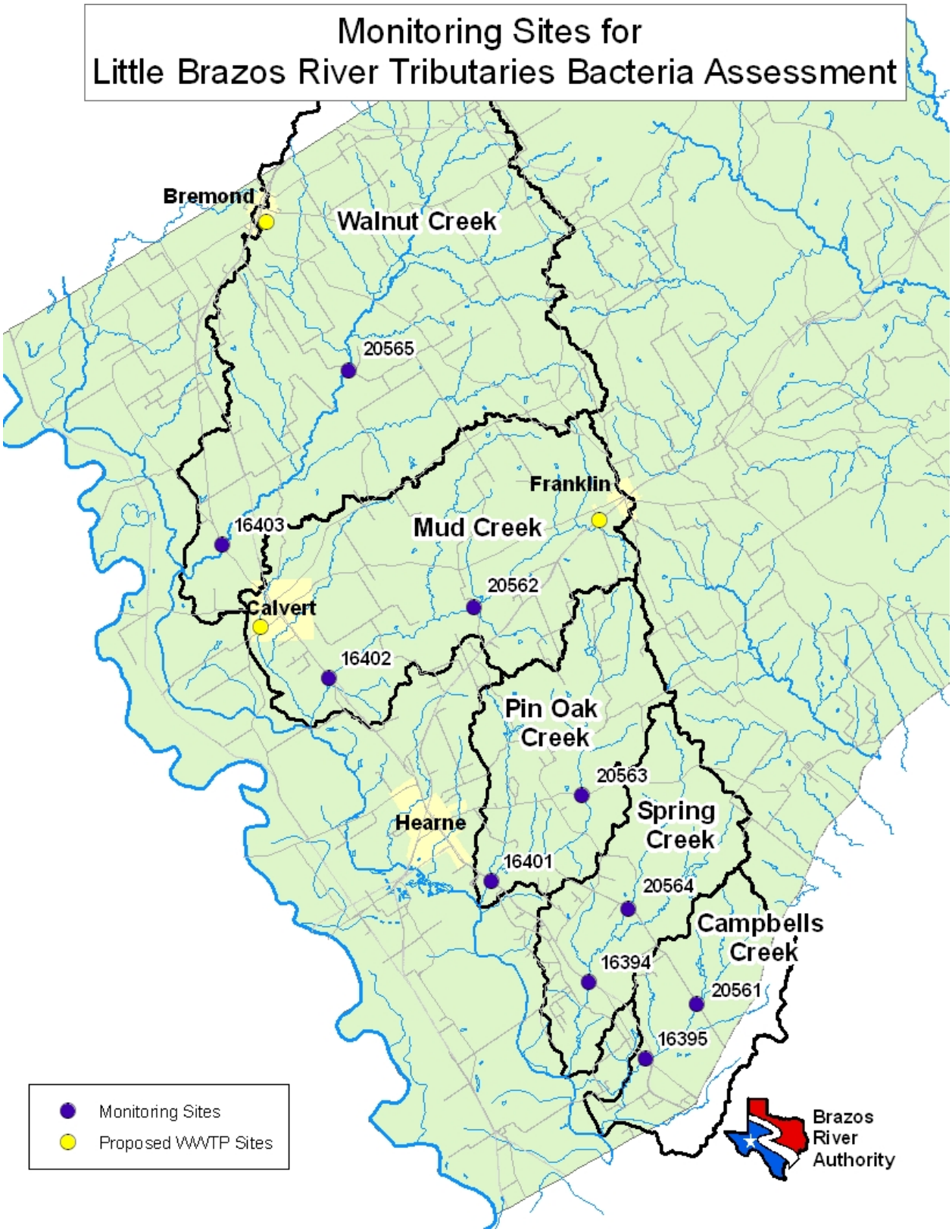
| **Field Data Review** | **Responsibility** |
|---|---|
| Field data reviewed for conformance with data collection, sample handling and COC, analytical and QC requirements | Field Operations Manager / QAO |
| Post-calibrations checked to ensure compliance with error limits | Field Operations Manager / QAO |
| Field data calculated, reduced, and transcribed correctly | Field Operations Manager / QAO |
| **Laboratory Data Review** | **Responsibility** |
| Laboratory data reviewed for conformance with data collection, sample handling and COC, analytical and QC requirements to include documentation, holding times, sample receipt, sample preparation, sample analysis, project and program QC results, and reporting | Laboratory Manager / QAO |
| Laboratory data calculated, reduced, and transcribed correctly | Laboratory Manager / QAO |
| LOQs consistent with requirements for AWRLs. | Laboratory Manager / QAO |
| Analytical data documentation evaluated for consistency, reasonableness and/or improper practices | Laboratory Manager / QAO |
| Analytical QC information evaluated to determine impact on individual analyses | Laboratory Manager / QAO |
| All laboratory samples analyzed for all parameters | Laboratory Manager / QAO |
| **Data Set Review** | **Responsibility** |
| The test report has all required information as described in Section A9 of the QAPP | BRA Data Manager / PM |
| Confirmation that field and laboratory data have been reviewed | BRA Data Manager / PM |
| Data set (to include field and laboratory data) evaluated for reasonableness and if corollary data agree | BRA Data Manager / PM |
| Outliers confirmed and documented | BRA Data Manager / PM |
| Field QC acceptable (e.g., field splits and trip, field and equipment blanks) | BRA Data Manager / PM |
| Sampling and analytical data gaps checked and documented | BRA Data Manager / PM |
| Verification and validation confirmed. Data meets conditions of end use and are reportable | BRA Data Manager / PM |

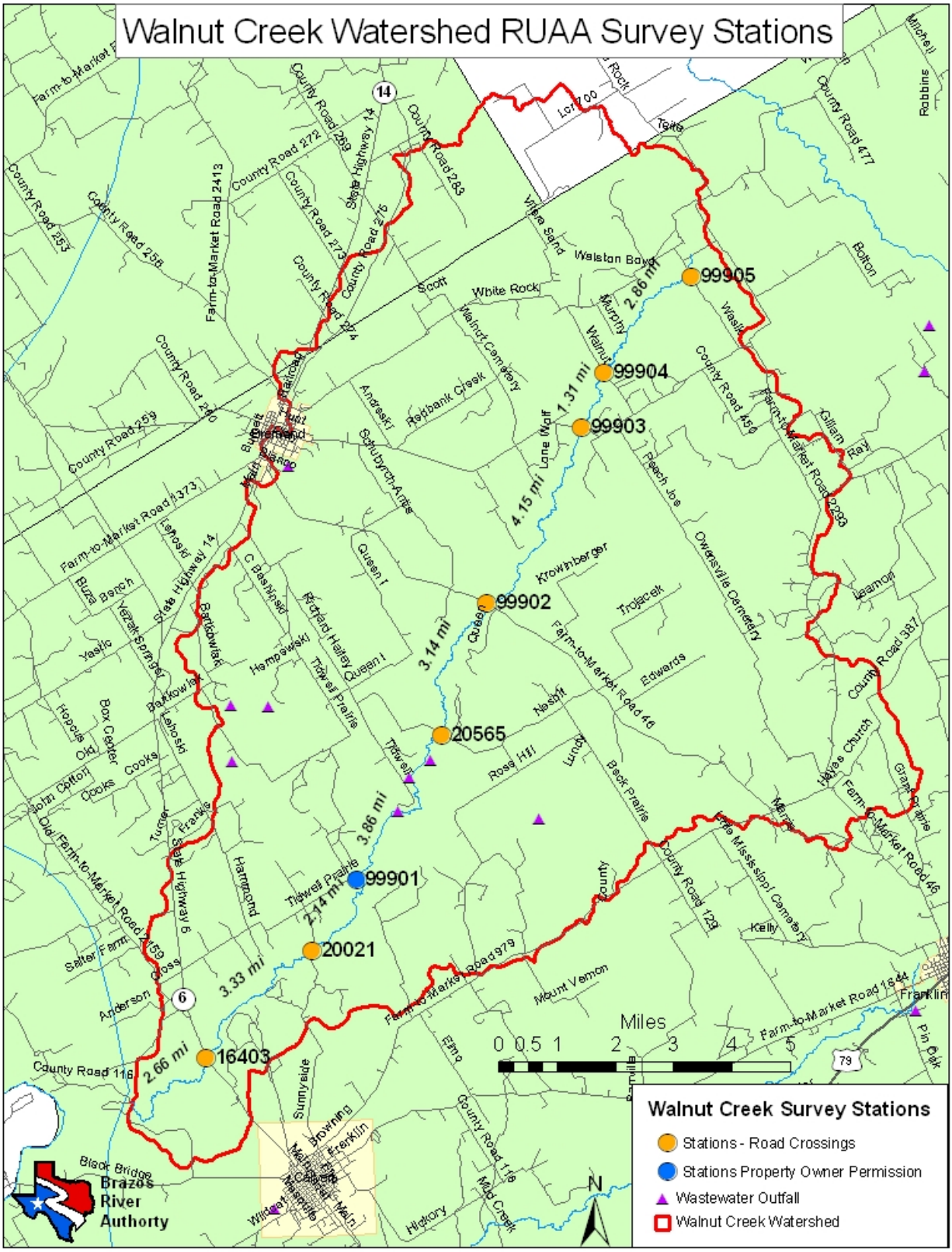
## D3 Reconciliation with User Requirements

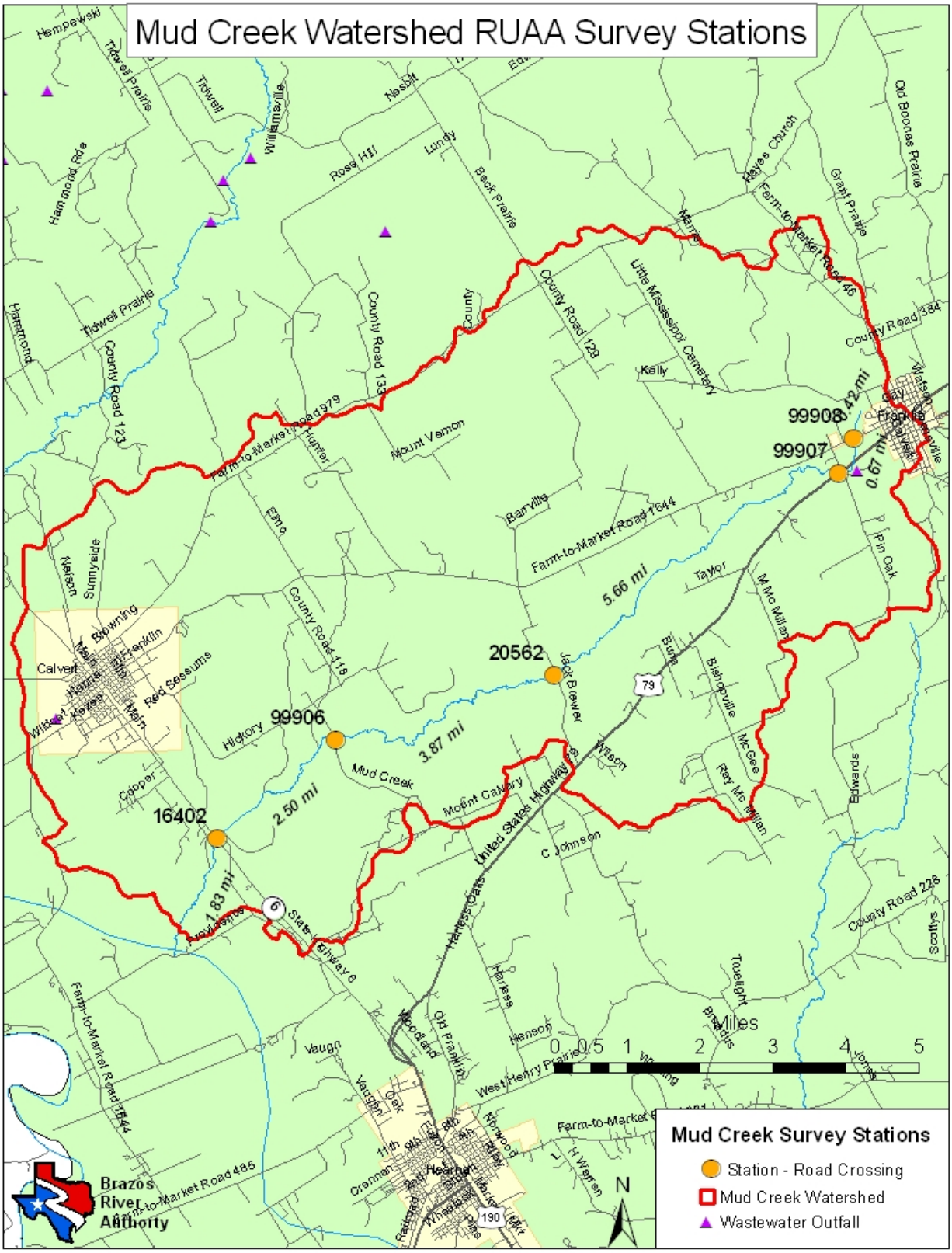
Data produced in this project, and data collected by other organizations (e.g., USGS, TCEQ, etc.), will be analyzed and reconciled with project data quality requirements. Data meeting project requirements will be used by TSSWCB and other project partners to assess sources of bacteria through data analysis and modeling and to ascertain the suitability of the streams for contact recreation use in order to facilitate local decision-making. Additionally, data meeting project requirements will be submitted to the TCEQ for use in the biennial CWA §305(b) assessment for the *Texas Water Quality Inventory and 303(d) List.* Data which do not meet requirements will not be submitted to SWQMIS nor will be considered appropriate for any of the uses noted above.

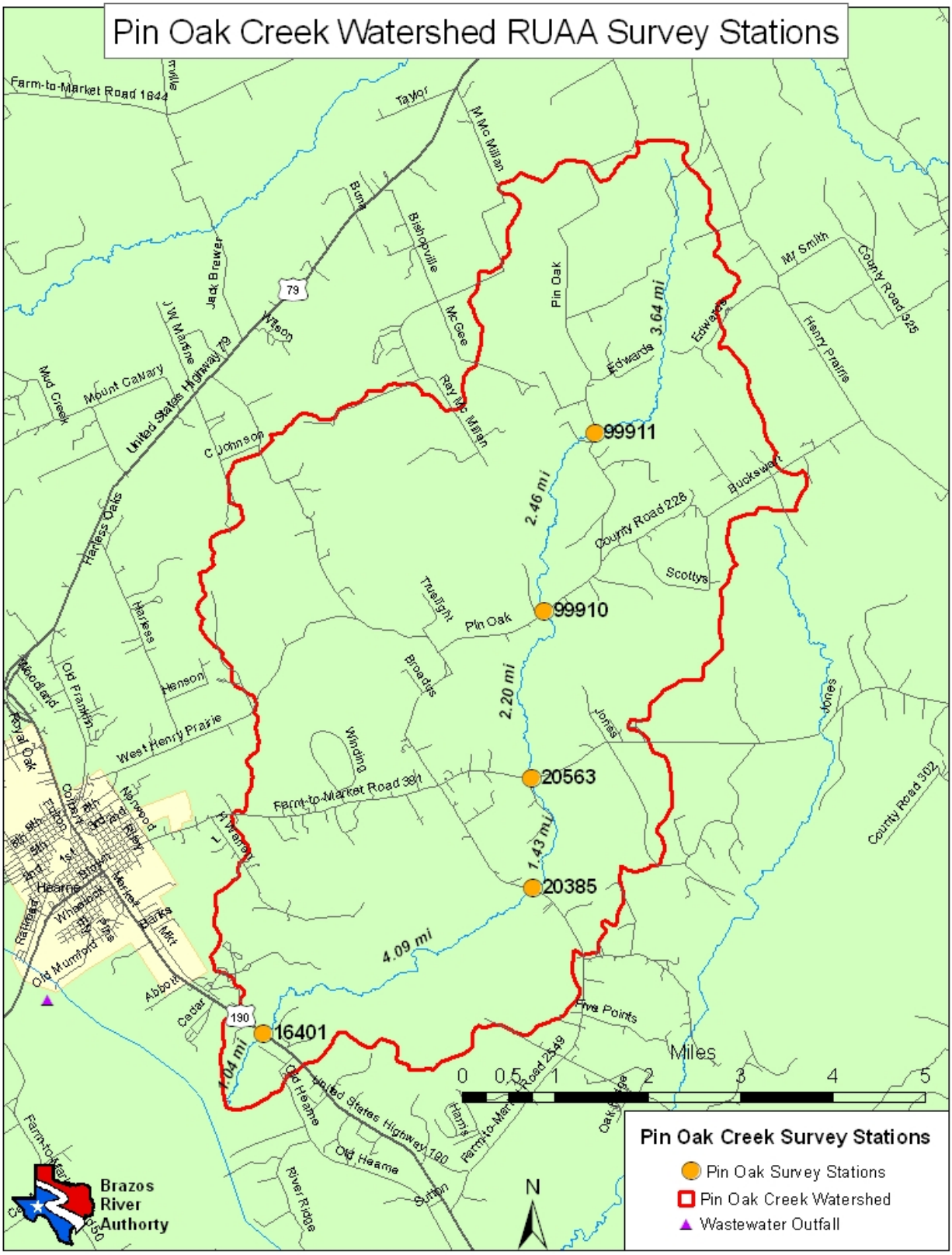
The overall goal of the project is to collect data that provides stakeholders and agencies with sufficient information to address bacteria impairments on five tributaries of the Little Brazos River. The data may be utilized to initiate a TMDL, WPP or RUAA after this project has been completed.

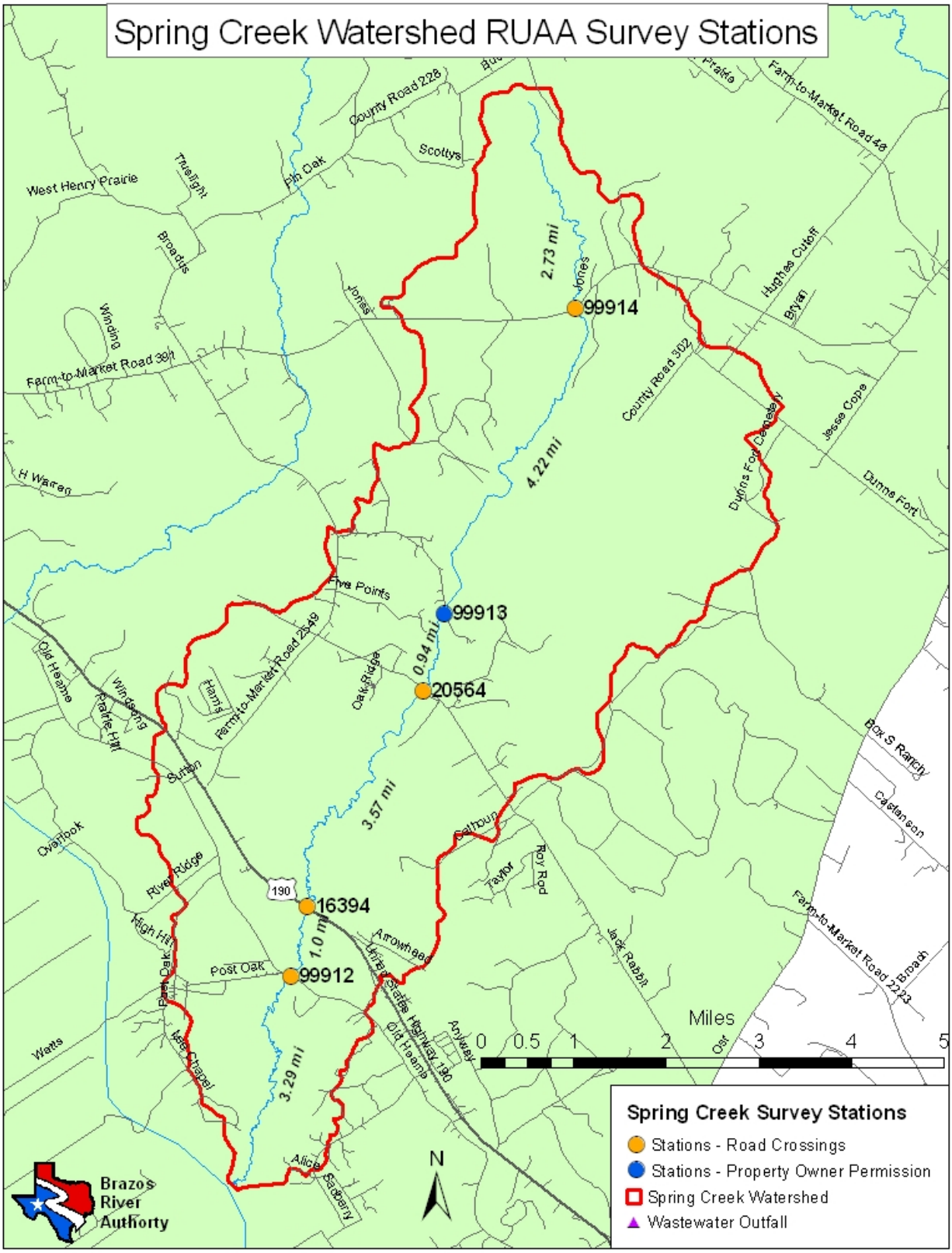
# Appendix A: Maps of Area Location and RUAA Stations

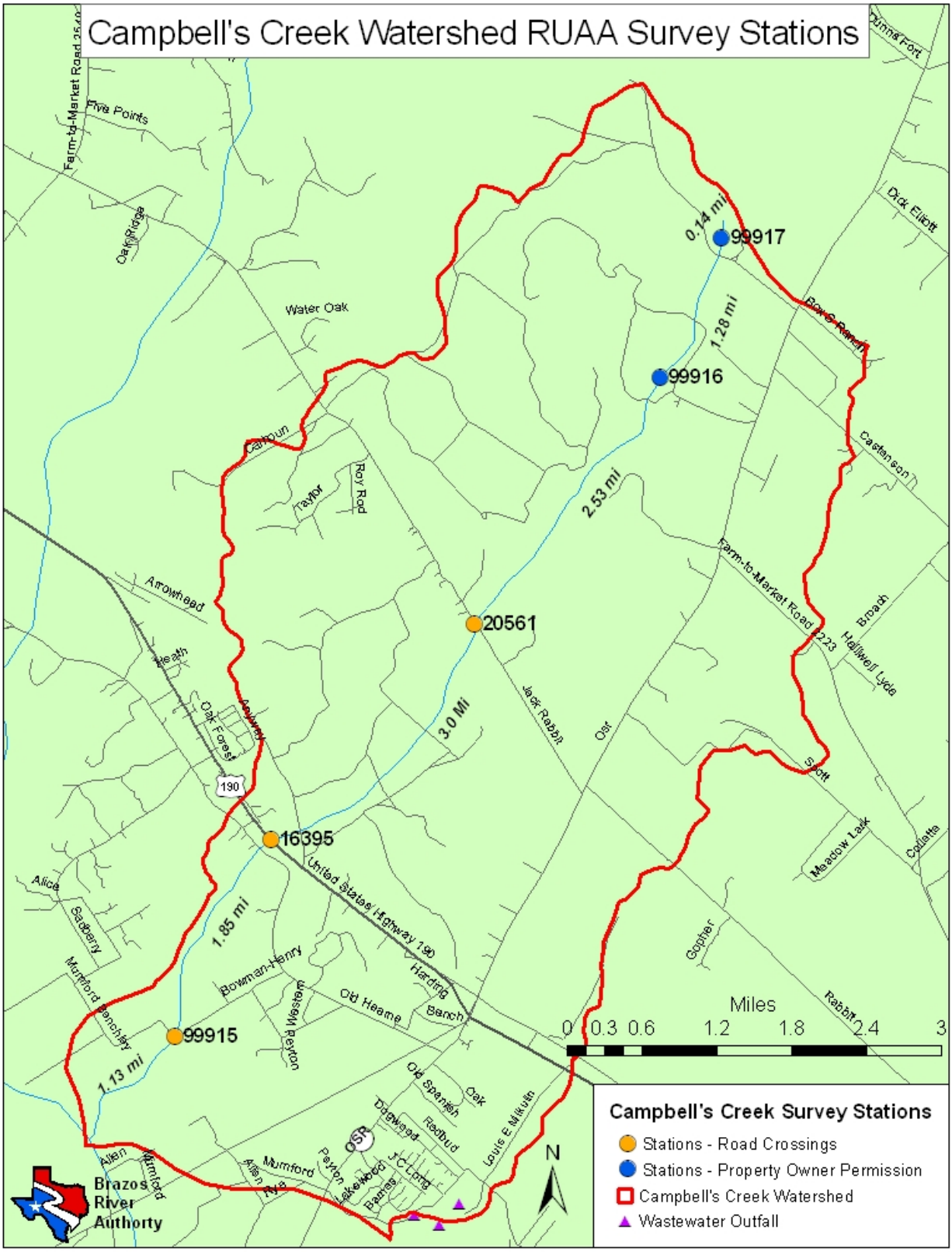

Monitoring Sites for
Little Brazos River Tributaries Bacteria Assessment
Bremond
Walnut Creek
20565
Franklin
16403
Mud Creek
20562
Calvert
16402
Pin Oak
Creek
20563
Spring
Creek
Hearne
16401
20564
Campbells
Creek
16394
20561
16395
Monitoring Sites
Proposed WWTP Sites
Brazos
River
Authority


Walnut Creek Watershed RUAA Survey Stations
99905
99904
99903
99902
20565
99901
20021
16403
2.86 mi
1.31 mi
4.15 mi
3.14 mi
3.86 mi
2.14 mi
3.33 mi
2.66 mi
Miles
0 0.5 1 2 3 4 5
Walnut Creek Survey Stations
Stations - Road Crossings
Stations Property Owner Permission
Wastewater Outfall
Walnut Creek Watershed
Black Bridge
Brazos River Authority
N


Mud Creek Watershed RUAA Survey Stations
99908
99907
20562
99906
16402
0.42 mi
0.67 mi
5.66 mi
3.87 mi
2.50 mi
1.83 mi
Miles
0 0.5 1 2 3 4 5
N
Mud Creek Survey Stations
Station - Road Crossing
Mud Creek Watershed
Wastewater Outfall
Brazos River Authority


Pin Oak Creek Watershed RUAA Survey Stations
99911
99910
20563
20385
16401
3.64 mi
2.46 mi
2.20 mi
1.43 mi
4.09 mi
1.04 mi
Miles
0 0.5 1 2 3 4 5
N
Brazos River Authority
Pin Oak Creek Survey Stations
Pin Oak Survey Stations
Pin Oak Creek Watershed
Wastewater Outfall


Spring Creek Watershed RUAA Survey Stations
99914
99913
20564
16394
99912
2.73 mi
4.22 mi
0.94 mi
3.57 mi
1.0 mi
3.29 mi
Miles
0 0.5 1 2 3 4 5
N
Spring Creek Survey Stations
Stations - Road Crossings
Stations - Property Owner Permission
Spring Creek Watershed
Wastewater Outfall
Brazos River Authority


Campbell's Creek Watershed RUAA Survey Stations
99917
99916
20561
16395
99915
0.14 mi
1.28 mi
2.53 mi
3.0 Mi
1.85 mi
1.13 mi
Miles
0 0.3 0.6 1.2 1.8 2.4 3
N
Campbell's Creek Survey Stations
Stations - Road Crossings
Stations - Property Owner Permission
Campbell's Creek Watershed
Wastewater Outfall
Brazos River Authority
Five Points
Water Oak
Calhoun
Taylor
Roy Rod
Arrowhead
Heath
Oak Forest
Bowman-Henry
Old Hearne
Harding
Bench
Webster
Reyton
Mumford
Allen
Peyton
Lakewood
Banes
J C Long
Old Spanish
Oak
Dogwood
Redbud
Louis E Mikulin
Jack Rabbit
Osr
Scott
Meadow Lark
Gopher
Rabbit
Castanson
Farm-to-Market Road 2223
United States Highway 190
190
OSR

# Appendix B: Work Plan Excerpt

| Tasks, Objectives and Schedules | | | | |
|---|---|---|---|---|
| Task 5: | Surface Water Quality Monitoring | | | |
| Costs: | $ 196,625 | | | |
| Objective: | To provide sufficient water quality data to characterize bacteria loadings across the various flow regimes at a number of locations throughout the study area. | | | |
| Subtask 5.1: | BRA will conduct routine ambient monitoring at 10 sites once every two weeks, collecting field, flow and bacteria parameter groups. The QAPP, as detailed in Task 3, will precisely identify sites. Five of these sites shall be the same as those in Subtask 5.4. The sampling period extends over 22 months. Total number of sample events scheduled for collection through this subtask is 480. Currently, routine ambient monitoring is conducted quarterly at 1 station by BRA (16395). BRA will avoid duplicative routine ambient monitoring at site 16395. | | | |
| | Start Date: | Month 3 | Completion Date: | Month 24 |
| Subtask 5.2: | BRA will conduct effluent monitoring at 3 WWTFs once every two weeks, collecting field, flow and bacteria parameter groups. The QAPP, as detailed in Task 3, will precisely identify sites. The sampling period extends over 22 months. Total number of sample events scheduled for collection through this subtask is 144. Coordination between TPDES permittees and the TCEQ Regional Office will be required. | | | |
| | Start Date: | Month 3 | Completion Date: | Month 24 |
| Subtask 5.3: | BRA will conduct biased-flow monitoring under high flow (storm event influenced) conditions at the 10 stream sites (Subtask 5.1) and the 3 WWTFs (Subtask 5.2) during at least 12 storm events collecting field, flow and bacteria parameter groups (grab samples). The sampling period extends over 22 months. Total number of sample events budgeted for collection through this subtask is 156. | | | |
| | Start Date: | Month 3 | Completion Date: | Month 24 |
| Subtask 5.4: | BRA will establish, and maintain, continuous flow monitoring gages at 5 sites (1 per segment). These sites shall be located as close to the confluence with the Little Brazos River as is feasible. Continuous sampling extends over 22 months. | | | |
| | Start Date: | Month 3 | Completion Date: | Month 24 |
| Subtask 5.5: | BRA will conduct biological monitoring at least once on the Little Brazos River to assess the cumulative impact of the impaired segments on stream health and biological communities. | | | |
| | Start Date: | Month 3 | Completion Date: | Month 24 |
| Subtask 5.6: | BRA will transfer monitoring data from activities in Task 5 to TSSWCB for inclusion in the TCEQ SWQMIS at least quarterly. Data will be transferred in the correct format using the TCEQ file structure, along with a completed Data Summary, as described in the most recent version of *TCEQ Surface Water Quality Monitoring Data Management Reference Guide*. BRA will submit Station Location Requests as needed to obtain TCEQ station numbers for new monitoring sites. Data Correction Request Forms will be submitted to TSSWCB whenever errors are discovered in data already reported. BRA will post monitoring data from activities in Task 5 to the BRA website in a timely manner. | | | |
| | Start Date: | Month 3 | Completion Date: | Month 24 |
| Subtask 5.7 | BRA will cooperate with TAMU BAEN, through TSSWCB project 08-55, to 1) conduct an LDC analysis of all historic and existing water quality monitoring data from the study area, and 2) refine those LDCs using water quality monitoring data collected through this project (Subtasks 5.1-5.4). | | | |
| | Start Date: | Month 3 | Completion Date: | Month 21 |

<table>
<tr><td>Subtask 5.8:</td><td colspan="4">Through TSSWCB project 09-52, AgriLife SAML will conduct bacterial source tracking (BST) in the study area to assess and identify different sources contributing to bacteria loadings. Library-independent BST utilizing the Bacteroidales PCR genetic test will be combined with limited library-dependent BST utilizing the ERIC-PCR and RP combination method.<br><br>BRA will collect duplicate water samples from a subset of those collected through Subtasks 5.1-5.3 and deliver those samples to AgriLife SAML for BST. This BST subset shall be precisely described in the 09-52 QAPP. BRA will work with AgriLife SAML to ensure sample collection activities employ adequate QA/QC mechanisms for BST as described in the 09-52 QAPP.<br><br>Results from the source survey (Subtask 4.5) will be used by AgriLife SAML to make appropriate adjustments to the BST sampling design and to assess the adequacy of the Texas Known Source Library.</td></tr>
<tr><td></td><td>Start Date:</td><td>Month 11</td><td>Completion Date:</td><td>Month 21</td></tr>
<tr><td>Deliverables</td><td colspan="4">• Station Location Request Forms (as needed) in electronic format<br>• Monitoring data files and Data Summary in electronic format<br>• Data Correction Request Forms (as needed) in electronic format<br>• Monitoring data updates posted to the BRA website<br>• Technical Report characterizing trends and variability in historical water quality monitoring data<br>• Technical Report characterizing trends and variability in collected water quality monitoring data</td></tr>
</table>

| Tasks, Objectives and Schedules | | | | |
|---|---|---|---|---|
| Task 6 | Assess Attainability of Recreational Use | | | |
| Costs | $ 20,539 | | | |
| Objective | To collect information that can be used to evaluate attainability of recreational use in tributaries of the Little Brazos River. | | | |
| Subtask 6.1 | Utilizing information from Task 4 (comprehensive GIS inventory and current land use classification) and other relevant information, BRA will identify sites for RUAA data collection. Proposed sites should be located in areas where the waterbody is accessible to the public and has the highest potential for recreational use (primary contact). The sites should be well-spaced and, where practical, distributed such that there are 3 sites for every 5 miles of stream. Sites shall be identified for the entirety of each of the five segments in the study area. Proposed sites shall at least include those from Subtask 5.1. The QAPP, as detailed in Task 3, will precisely identify selected sites. BRA will submit Station Location Requests as needed to obtain TCEQ station numbers for new monitoring sites. | | | |
| | Start Date | Month 11 | Completion Date | Month 22 |
| Subtask 6.2 | BRA shall conduct a thorough historical information review of the recreational uses of the waterbody back to November 28, 1975. Historical resources that should be examined include, but are not limited to, photographic evidence, local newspapers, museum collections, published reports, historical society records, and long-term landowners/residents. Texas Parks and Wildlife Department and commercial providers of outdoor recreation goods and services should be consulted for historical information. | | | |
| | Start Date | Month 11 | Completion Date | Month 22 |
| Subtask 6.3 | BRA will conduct 2 field surveys at each site, as defined in the QAPP (Subtask 6.1). Surveys shall be conducted during a normal warm season (air temperature $\geq$ 70°F) during baseflow conditions. Baseflow conditions are sustained or typical dry, warm-weather flows between rainfall events, excluding unusual antecedent conditions of drought or wet weather. The surveys should be performed during the period people would most likely be using the waterbody for contact recreation, typically March to October (e.g., spring break, summer, holidays, weekends).<br><br>To ascertain the suitability of the streams for contact recreation use, field surveys shall document hydrological characteristics of the stream, such as width and depth of channel and substantial pools, flow/discharge, air/stream temperature, bank access, and stream substrate. Information to be collected shall at least satisfy those questions found on the Field Data Sheet from the latest version of the TCEQ staff draft *Recreational Use-Attainability Analyses (RUAAs) – Procedures for a Comprehensive RUAA and a Basic RUAA Survey*.<br><br>BRA shall document and describe antecedent (prior to fieldwork) rainfall conditions (approximately 30 days) at each selected site. | | | |
| | Start Date | Month 11 | Completion Date | Month 22 |
| Subtask 6.4 | BRA shall collect a digital photographic record of each selected site during the field surveys. Photographs shall include upstream, left and right bank, and downstream views. Any evidence of observed uses or indications of human use shall be photographed. Photographs should clearly depict the entire channel and each transect measured. | | | |
| | Start Date | Month 11 | Completion Date | Month 22 |
| Subtask 6.5 | In order to obtain information on existing and historical uses and stream characteristics, BRA shall conduct interviews of 1) users present during the field surveys, 2) streamside landowners along the field survey transects, 3) local residents, and 4) commercial providers of outdoor recreation goods and services. Survey instrument shall include at least those questions found on the Interview Form from the latest version of the TCEQ staff draft *Recreational Use-Attainability Analyses (RUAAs) – Procedures for a Comprehensive RUAA and a Basic RUAA Survey*. | | | |
| | Start Date | Month 11 | Completion Date | Month 22 |

| | |
|---|---|
| Deliverables | • Station Location Request Forms (as needed) in electronic format<br>• Contact Information Form from the latest version of the TCEQ staff draft *Recreational Use-Attainability Analyses (RUAAs) – Procedures for a Comprehensive RUAA and a Basic RUAA Survey*<br>• Field Data Sheets and Data Summary in electronic format<br>• Digital photographic record, cataloged in an appropriate manner<br>• Interview Forms and Data Summary in electronic format<br>• Technical Report summarizing historical information review, field surveys, and user interviews; Technical Report shall at least include those contents described for a Comprehensive RUAA in the the latest version of the TCEQ staff draft *Recreational Use-Attainability Analyses (RUAAs) – Procedures for a Comprehensive RUAA and a Basic RUAA Survey* |

# Appendix C: Data Summary

# Data Summary

## Data Information

**Data Source:** **Brazos River Authority _ MS Access Database**

**Date Submitted:** _____

**Tag_ID Range:** _____

**Date Range:** _____

## Comments

Please explain in the space below any data discrepancies including:

- Inconsistencies with AWRL specifications;
- Failures in sampling methods and/or laboratory procedures that resulted in data that could not be reported to the TCEQ; and
- Other discrepancies.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Planning Agency Data Manager: _____

Date: _____

# Appendix D: Flow Logger and Automated Sampler SOP

**Bubbler Flow Meter Specifications**
ISCO Model 4230

1.0 INSTRUMENT

A. There shall be furnished a recording, totalizing open channel flow meter suitable for portable or fixed-site monitoring. A bubbler system shall be used to measure level.

1.1 BUBBLER

A. A pressure transducer in the flow meter shall measure the liquid level. An internal air compressor shall provide a continuous supply of air to the bubble tube. The bubble tube shall be 1/8 in. (0.32 cm) inside diameter and 50 ft. long. The flow meter shall include automatic bubble line purge to minimize plugging of the bubble tube.

B. The level measurement range of the bubbler shall be from 0.01 to 10 feet (0.003 to 3.05 m). The level shall be measured with a maximum error of +/- 0.005 feet (+/- 0.002 m) over a range of 0.01 to 1.0 feet (0.003 to 0.31 m), +/- 0.010 feet (+/- 0.003 m) over a range of 0.01 to 5.0 feet (0.003 to 1.52 m), and +/- 0.035 feet (+/- 0.011 m) from 0.01 to 10 feet (0.003 to 3.05 m). The temperature coefficient shall be +/- 0.0003 times the level in feet times the temperature change from 77 degrees F (+/- 0.00054 times the level in meters times the temperature change from 25 degrees C) over the compensated temperature range of 32 to 140 degrees F (0 to 60 degrees C).

C. The flow meter shall include automatic drift compensation to periodically reference both sides of the transducer to atmospheric pressure and automatically compensate for errors due to temperature, warm-up and long-term drift. After a 5 minute warm-up period, automatic drift compensation shall correct the zero level to +/- 0.002 feet (+/- 0.0006 m) at intervals between 2 and 15 minutes.

1.2 FLOW METER

A. Measured liquid level readings shall be converted into corresponding flow rate readings using internal conversion algorithms. The flow meter shall contain conversions for V-notch weirs, rectangular weirs with and without end contractions, Cipolletti weirs, ISCO Flow Metering Inserts, and Parshall, Palmer-Bowlus, Leopold-Lagco, trapezoidal, H, HS and HL flumes. For monitoring in applications using the Manning formula in round, U-shaped, rectangular and trapezoidal channels, the flow meter shall accept information for channel shape and size, and slope and roughness coefficient. The flow meter shall accept 4 sets of level-flow rate points, with up to 50 pairs of points in each set. The flow meter shall accept a two-term, level-flow rate polynomial equation.

B. The flow meter shall contain a tactile keypad and a 2-line, 80-character, backlit alphanumeric liquid crystal display (LCD). The LCD shall visually prompt the user through the programming sequence. The LCD shall display level, flow rate, and total

flow. The totalizer on the LCD shall be resettable. The LCD shall display the signal strength from the ultrasonic sensor to aid in installation and troubleshooting.

C. The internal data storage memory in the flow meter shall have a capacity of 80,000 bytes, divided into up to 12 user-defined partitions. Each partition shall be programmable to store level, and flow rate. Timing for the data storage shall be selectable in 1, 2, 5, 10, 15, 30, 60, or 120 minute intervals. Each partition shall be programmable to operate in either rollover, slate or triggered slate mode. The internal data storage memory in the flow meter shall be programmed using a windows based software program on an IBM PC or compatible computer. The software shall also retrieve stored data from the flow meter, and generate graphs and reports from stored data. The computer shall communicate with the flow meter using a 2400 baud telephone modem in the flow meter. Windows based software shall be supplied with the flow meter.

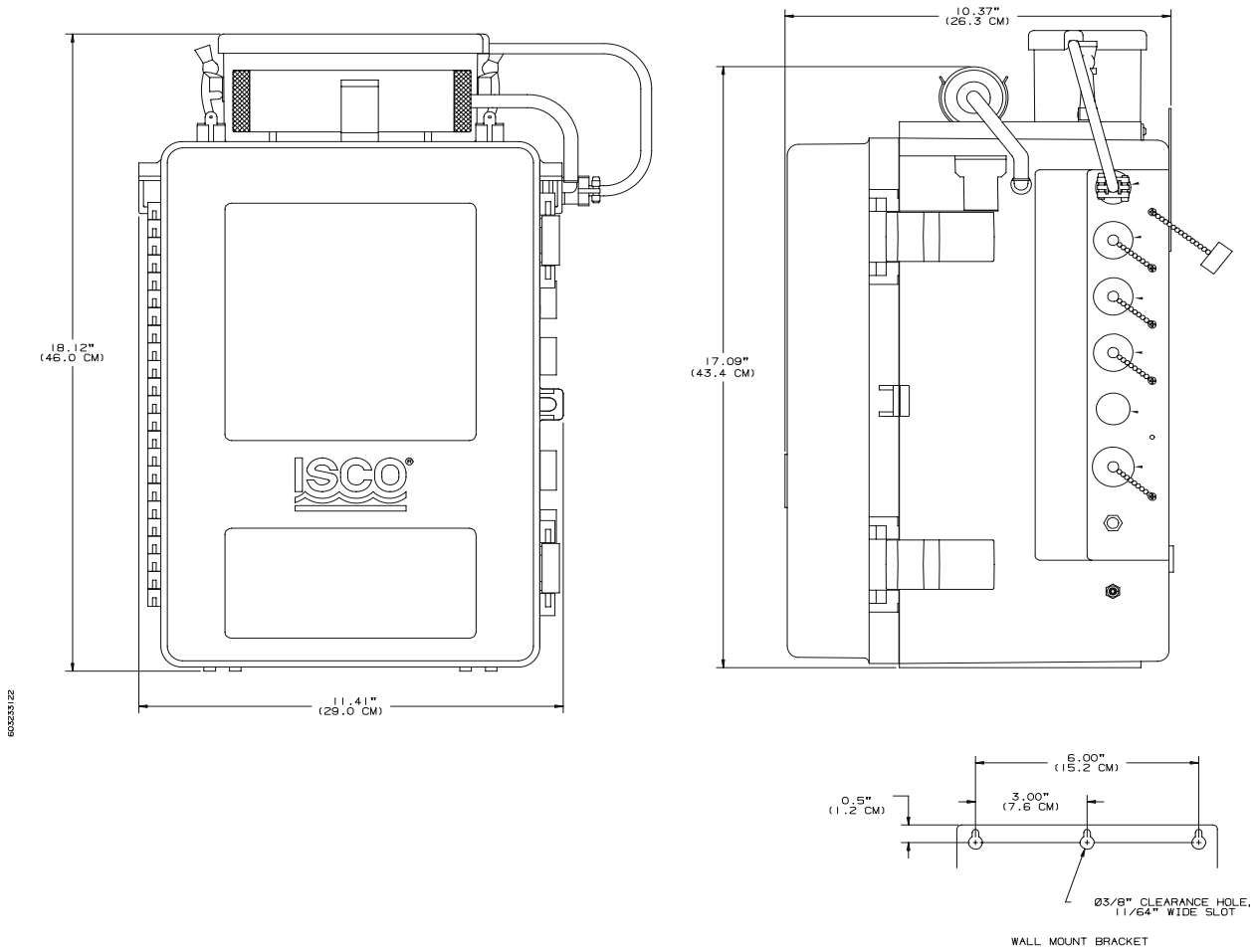
D. The flow meter shall have an RS-232 serial output to transmit information on all of its current readings. The data on the serial output shall be in ASCII format with values separated by commas. The serial output shall be at 1200, 2400, 4800 or 9600 baud. The flow meter shall output this data in response to the reception of a command on the serial port. The flow meter shall also be programmable to automatically transmit this data on a periodic time interval. The data shall include the flow meter description, ID number, model number, date and time, battery voltage, level, flow rate, and total flow.

E. The program memory in the flow meter shall be non-volatile, programmable flash memory. The program memory shall be capable of being updated via the serial port on the flow meter without opening the enclosure.

F. The flow meter shall require 12 volt DC power for operation. Power shall be supplied from a user-supplied 12 V DC source. An external 12 DC connect cable shall be supplied with the flow meter.

G. The flow meter shall be housed in a rugged, lockable, watertight, dust-tight, corrosion resistant (self-certified NEMA 4X and IP65) enclosure. The enclosure shall include a carrying strap, wall mounting bracket and a clear polycarbonate window for viewing the LCD and printer without opening the enclosure. An internal, easily replaceable, rechargeable desiccant canister shall keep the inside of the flow meter free of moisture.

# Isco 4230 Bubbler Flow Meter



# Appendix E: Flow Measurement Methods

**SonTek Flow Tracker Steps**

1. Vent the handheld controller.
2. Press the **Yellow** button to turn on unit.
3. Press **ENTER** for Main Menu.
4. From the Main Menu, press **3** to Start Data Run.
5. Press **1** to specify file name. This will be the LIMS#. Use the numbered keys for either number or letters. Press **ENTER**.
6. Press **9** to accept name.
7. Press **1** to enter Site name. This will be the station ID #. Use the numbered keys for either numbers or letters. Press **ENTER**.
8. Press **2** to specify operator. Use the numbered keys for either number or letters. Press **ENTER**.
9. Press **9** when ready to start data collection.
10. Press **ENTER**.
11. Press **1** to "Run Test" on the first measurement of the day. Press **2** to "Skip Test" on subsequent measurements.
12. Press **LEW/REW** to indicate right edge water or left edge water. This will be Station 0 and a depth of 0. The location may vary depending how the tag line is setup. If your tape is setup so that the waters edge is at zero then enter location as Zero. If the waters edge is at a different number then enter the measurement at the waters edge.
13. Press **Next Station**.
14. Press **Set Location**. Enter you distance away from the edge. Press **ENTER**.
15. Press **Set Depth**. Enter depth. Press **ENTER**.
16. If everything is correct, press **Measure**. If you make a mistake and need to change location or depth you can do so before you press Measure.
    NOTE: If you press measure and it gives you a QC Boundary Good, Fair, Poor question you can either reposition or move obstacles or just press whatever it says to just go ahead and take the measurement. (Follow the screen instructions. Best and Good are good, I try to improve Fair and Poor).
17. After 40 seconds either a velocity measurement or QC warnings will be displayed. If you see a QC WARNING, determine if you need to repeat measurement, move obstacles, or adjust location. See common QC warnings. If you feel you need to repeat the measurement, press **2** and repeat measurement**.** If you are satisfied with the measurement press **1** to accept. The FlowTracker will automatically advance to the next Station.
18. Repeat Steps 13-16.
    NOTE: For each consecutive station the FlowTracker will default to the next location in the same increment as the station before. In most cases this will be correct and you will only need to change the depth for each station and press Measure. If you feel velocity or depth increases significantly, shorten you increments by using **Set Location**.
19. When you get to the last station you will almost always have to **Set Location** because it will be shorter than the other sections. Press **End Section**. Depth will be automatically set to 0.
20. Press **End Section** again. FlowTracker will then remind you of any QC errors, look for stations with > 10 % of the flow. Add a station before or after those stations. Press **End Section** when complete. Review GC errors again.
21. Press **1** to End Section.

22. Press **ENTER.**
23. This is the point of no return. Changes can not be made to the measurement after this step. Press **Calculate Discharge.** Press **Calculate Discharge** again.
24. Press **0** to Exit.

Answers to Typical Questions:

1. Abort will only abort the one measurement you are taking. If you press it, you will be able to Accept or Repeat the measurement. If you want to chuck the whole thing, you have to at least get to the point where you can End Section and Calculate Discharge. You can begin again but will have to start over and come up with a new file name.
2. Delete will only delete things you enter, like file name when you are typing or location or depth.
3. If you do forget to enter depth or location, when the measurement is finished, just press 2 to repeat measurement and you can reenter set depth or location before you press measure.
4. You can redo a measurement at anytime BEFORE you completely End Section. You just have to input the correct location. It may ask you a few questions to make sure you want to redo the location, but it can be done.

Common QC Warnings:

1. High Angle- As long as the sensor is perpendicular to the tape, you are fine.
2. High Spikes- Note your velocity reading. Check for obstacles and repeat. If you get the warning again see if velocities from first and second measurements are consistent. If they are accept reading. If not adjust probe and repeat.
3. SNR variation- Repeat once.

For the whole list see the manual software release notes Firmware 3.1 Software 2.10

**SonTek RiverCat Quick Guide**

SERIAL #M51 LICENSE #:914-495-672

1) **Turn System ON:**
   Once the RiverCat has been assembled and the radio has been connected to the PC; turn on the RiverCat by pushing the Red Power Button. A series of red & green lights will flash on.

2) **Open RiverSurveyor 4.60:**
   a) Double click the RiverSurveyor icon to open program.
   b) Click on the "Systems" icon.
   c) Choose the Comm port the "ADP" is connected.
   d) Make sure Baud Rate is 9600.
   e) Click "OK".

3) **Connect to ADP:**
   a) Once the instrument is "Found", click on the "Go To ADP Setup" box.
   b) A status bar should appear as the software communicates with the ADP.
   c) Under Utilities on the right side: Click on Set System Time.
   d) Adjust clock or Click on "Match to Computer Time".
   e) Once the clock is adjusted, click on "Close".

4) **Calibrate the Compass:**
   a) NOTE: Perform this operation outside and away from metal objects
   b) Under Utilities on the right side: Click on "Calibrate Compass"
   c) This will open a new box; choose "Start"
   d) Slowly and gently rock the RiverCat side-to-side & front to back while rotating at least 720 degrees. Take at least 1 – 2 minutes for this process.
   e) Once the rotation is complete, Select "Stop".
   f) A report will appear on the quality of the calibration. Repeat the calibration if necessary. Otherwise, Click on "Close".

5) **Create a File:**

   **Under "Basic Settings" Tab:**
   a) Type in File name (up to 5 characters)
   b) Adjust the averaging interval as required – refer to manual about averaging intervals.
   c) Enter the "Magnetic Declination".
   d) Enter the "Water Salinity".
   e) Enter the Depth of Transducer head mounted below the water surface.

   **Under the "Profiling Range" Tab:**
   a) Enter the Maximum Depth of the water to be measured.
   b) The "Number of Cells", "Cell Size", and "Blanking Distance" will automatically be calculated by the software. Manual adjustment is available.

**Under the "Advanced Settings" Tab:**

a) Select the type of coordinate system – default is "ENU".
b) Ensure that Bottom Track has "YES" selected.
c) Recorder should be "Disabled".
d) Temperature Mode – "Measured".
e) Click "OK"
f) "Transferring Files" Status bar should appear.
g) Both "ADP" and "Btrack" on the bottom right side of the screen should be Green.

**6) Collect Data**

a) Near the top left side of the screen, click on the Green Triangle (Play Button).
b) A status bar with "Interfacing with the ADP" and then "Verifying Settings" will appear.
c) Click on the Red Circle (Record Button) to begin recording data
d) Select "Left or Right Bank"
e) Enter the Measured Distance from the edge of water.
f) Select Bank Type – Sloped or Vertical.
g) After a pass has been completed, Click on the Red Circle again.
h) Enter the Ending Distance to the edge of water.
i) To make another pass, repeat steps 6c through 6h.
j) Once all of the measurements have been completed, Select the Black Box (Stop Button).
k) The system will disconnect from the PC.

**NOTES:**

1) To change units (English to Metric); Select File and then Configuration.
2) To view collected data, Select File and then Discharge Summary.
3) For Best Results the boat speed should be slower or the same as the measured water speed (velocity). The Bs/Ws box will be black when the speeds are similar; Yellow when boat speed is 1X the velocity; Red when boat speed is 2X the velocity.

***SonTek Technical Support: 858.546.8327***

# Appendix F: Field and Laboratory Data Sheets

# BRAZOS RIVER AUTHORITY
## FIELD DATA SHEETS FOR SAMPLES COLLECTED FOLLOWING SWQM VOL.I

**LIMS #**/SITE ID #

SITE NAME:

DATE:

TIME:

COLLECTORS: Baack Grimm

RUN: Little Brazos Tributary

Hydrolab SN# 46 47 51 05B 106 608 347 348 349

| TNRCC Test Code | | Description |
|---|---|---|
| 89966 | | SKIES: 1=CLEAR, 2=PT/CLOUDY, 3=CLOUDY, 4=RAIN |
| 89965 | | WIND: 1=CALM, 2=SLIGHT, 3=MOD, 4=STRONG |
| 00078 | | TRANSPARENCY, SECCHI DISC (METERS) |
| 89861 | | AVG STREAM WIDTH (METERS) |
| 01351 | | FLOW SEVERITY: 1=NO FLOW, 2=LOW, 3=NORMAL, 4=FLOOD, 5=HIGH, 6=DRY |
| 89835 | | FLOW METHOD: 1=USGS, 2=MARSH MCBIRNEY, 3=MECH, 4=WEIR/FLUE, 5=DOPPLER |
| 00061 | | STREAM FLOW INSTANTANEOUS (CFS) |
| 89926 | | AQUATIC VEGETATION @ COLLECTION SITE (PERCENT) |
| 72053 | | DAYS SINCE LAST SIGNIFICANT PRECIPITATION (DAYS) |
| | | |
| | | |
| | | |
| | | |

| | Temp | D.O. | Specific Conductance | pH | Salinity | DO | Cl Res | Other: | |
|---|---|---|---|---|---|---|---|---|---|
| | (ºC) | (mg/L) | (µs/cm) | (s.u.) | (ppt) | (% Sat.) | (mg/L) | | |
| DEPTH | 00010 | 00300 | 00094 | 00400 | 00480 | 00301 | | | Sample Type |
| Surface 0.3m | | | | | | | | | *E. coli* |

**COMMENTS**

All Samples collected preserved on ice.

Meters into feet: Multiply by 3.281 Feet into meters: Multiply by 0.3048

**Receiver's Signature** **Form Completed by:**

**Time of Receipt:** **Date of Receipt:**

**MPN Total Coliform and *Escherichia coli* Analysis - IDEXX, BRA-017**

Actual "In" Time _____

Run Name _____ Run Date _____ Incubator ID _____ **Take out between** _____ **and** _____

Run ID _____

Start Temp. (°C) Upper Shelf _____ End Temp. (°C) Upper Shelf _____ Sample# on Upper Shelf _____

Corrected Temp. (°C) _____ Corrected Temp. (°C) _____ Thermometer ID _____

Start Temp. (°C) Lower Shelf _____ End Temp. (°C) Lower Shelf _____ Sample#('s) on Lower Shelf _____

Corrected Temp. (°C) _____ Corrected Temp. (°C) _____ Thermometer ID _____

**(Is Temperature 35 +/- 0.5°C??)**

| LIMS Number - TCEQ Monitoring Station Number | Time of Collection | Dilution Factor | Sample Set Time | # of Large wells Positive | # of Small wells Positive | MPN Reading from Table (Total Coliform) | MPN Reading x Dilution Factor (MPN/100ml) | # of Large wells Fluorescent | # of Small wells Fluorescent | MPN Reading from Table (*E. coli*) | MPN Reading x Dilution Factor (MPN/100ml) | 31699 - Reported *E. coli* concentration (MPN/100ml) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | | | | | | | | | | | | |
| 2. | | | | | | | | | | | | |
| 3. | | | | | | | | | | | | |
| 4. | | | | | | | | | | | | |
| 5. | | | | | | | | | | | | |
| 6. | | | | | | | | | | | | |
| 7. | | | | | | | | | | | | |
| 8. | | | | | | | | | | | | |
| 9. | | | | | | | | | | | | |
| 10. | | | | | | | | | | | | |
| 11. | | | | | | | | | | | | |
| 12. | | | | | | | | | | | | |
| 13. | | | | | | | | | | | | |
| 14. | | | | | | | | | | | | |
| 15. | | | | | | | | | | | | |

Notes: _____

**Lot Numbers:** Media _____ Trays _____ 125 ml Bottles _____ 290 ml Bottles _____ DI Water _____ Pipettes _____

**Samples Set by** _____

**Samples Read on** _____ at _____ by _____ **Media Type:** Colilert 18 Colilert 24

# Appendix G: RUAA Contact Information, Field Data, Interview and Summary Forms

# Contact Information Form

(This form must be completed prior to conducting a Basic RUAA Survey and/or Comprehensive RUAA.)

*The TCEQ Water Quality Standards Group will not consider or review a RUAA unless the appropriate entities listed below have been notified prior to the beginning of a RUAA. A RUAA should not be conducted until you have received a Notice to Proceed from the TCEQ Water Quality Standards Group.*

River or stream name: _____

## Required Local Contacts:

*Ask the contacts if a recreational use-attainability analysis is appropriate for the river or stream and check Yes or No below. Document the name of the person contacted and the date they were notified about the proposed RUAA project.*

| | | |
|---|---|---|
| Clean Rivers Program Partner (River Authority and other local partners) | ☐ Yes ☐ No | Date Notified: _____ Name: _____ |
| Texas Parks and Wildlife Department region staff | ☐ Yes ☐ No | Date Notified: _____ Name: _____ |
| TCEQ region staff | ☐ Yes ☐ No | Date Notified: _____ Name: _____ |
| Texas State Soil and Water Conservation Board Statewide Resource Management Group srm-team@tsswcb.state.tx.us | ☐ Yes ☐ No | Date Notified: _____ Name: _____ |

## Suggested Additional Local Contacts:

*If contacted, ask the contacts if a recreational use-attainability analysis is appropriate for the river or stream and check Yes or No below If contacted, include information regarding notification date and person contacted on a separate page and attach it to this form.*

| | | | | |
|---|---|---|---|---|
| Local Parks and Recreation Departments | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Municipal Government/Jurisdiction | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| County Government/Jurisdiction | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Local Recreation Groups | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Conservation Groups | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Local Soil and Water Conservation Districts | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Texas AgriLife Extension Service (local County Extension Agent) | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| USDA Natural Resources Conservation Service (local field staff) | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Watershed Groups | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Long-term Landowners/Adjacent Landowners | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Texas Stream Team (formerly Texas Watch) | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Canoe Clubs | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| City Commissioners Office | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Real estate agents | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Local non-profits | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| City/county offices (Engineer, Health, Law Enforcement) | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Flood control districts | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Councils of Governments | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Texas Parks and Wildlife Department Game Warden | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |
| Other:_____ | ☐ Yes | ☐ No | ☐ Entity Not Contacted | ☐ Entity Not in Project Area |

## Draft Definitions (2010 TSWQS Revision)

- Primary contact recreation: Water recreation activities, such as wading by children, swimming, water skiing, diving, tubing, surfing, and whitewater kayaking, canoeing, and rafting, involving a significant risk of ingestion of water.
- Secondary contact recreation 1: Water recreation activities, such as fishing, commercial and recreational boating, and limited body contact incidental to shoreline activity, not involving a significant risk of water ingestion and that commonly occur.
- Secondary contact recreation 2: Water recreation activities, such as fishing, commercial and recreational boating, and limited body contact incidental to shoreline activity, not involving a significant risk of water ingestion but that occur less frequently than for secondary contact recreation 1 due to (1) physical characteristics of the waterbody and/or (2) limited public access.
- Noncontact recreation: Activities, such as ship and barge traffic, birding, and using hike and bike trails near a waterbody, not involving a significant risk of water ingestion, and where primary and secondary contact recreation should not occur because of unsafe conditions.

## Information from Local Contacts:

1. If any entity answered no, please list the reason(s) why:

   _____
   _____
   _____

2. Did the local entities confirm that primary contact recreation activities frequently occur? ☐ Yes ☐ No
   Please describe how often the activities occur? ☐ Unknown ☐ Never ☐ Daily ☐ Monthly ☐ Yearly
   If no, explain: _____
   _____

3. Did the local entities confirm that secondary contact recreation 1 activities frequently occur? ☐ Yes ☐ No
   Please describe how often the activities occur? ☐ Unknown ☐ Never ☐ Daily ☐ Monthly ☐ Yearly
   If no, explain: _____
   _____

4. Did the local entities confirm that secondary contact recreation 2 activities frequently occur? ☐ Yes ☐ No
   Please describe how often the activities occur? ☐ Unknown ☐ Never ☐ Daily ☐ Monthly ☐ Yearly
   If no, explain: _____
   _____

5. Did the local entities confirm that noncontact recreation activities frequently occur? ☐ Yes ☐ No
   Please describe how often the activities occur? ☐ Unknown ☐ Never ☐ Daily ☐ Monthly ☐ Yearly
   If no, explain: _____
   _____

6. Do the local entities know if this waterbody provides substantial flow to a waterbody with primary contact recreation activities (e.g., swimming in a state/local park) or a bathing beach that is located immediately downstream? ☐ Yes ☐ No ☐ Unknown

   If yes, have the local entities provide the name of the waterbody and a description of the location of the primary contact recreation uses or bathing beach.

   _____
   _____

## Notify TCEQ Water Quality Standards Group (required):

*Send an e-mail notification to the TCEQ Water Quality Standards Group at standards@tceq.state.tx.us.*
Notified: ☐ Yes ☐ No
Date Notified by e-mail: _____
Date TCEQ WQS e-mail Response Received: _____
WQS Group Contact Person Providing Response: _____
Did the WQS Group provide a Notice to Proceed with the RUAA? ☐ Yes ☐ No

## Additional Local Contacts Made:

Name: _____
Entity: _____
Date Notified: _____

Name: _____
Entity: _____
Date Notified: _____

Name: _____
Entity: _____
Date Notified: _____

Name: _____
Entity: _____
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Date Notified: _____

Name: _____
Entity: _____
Date Notified: _____

# Field Data Sheets – Basic RUAA Survey

(to be completed for each site)

| | |
|---|---|
| Data Collectors & Contact Information: | |
| Date & Time: | County Name: |
| Stream Name: | |
| Segment No. or nearest downstream Segment No.: | |
| Description of Site: | |

**A. Stream Characteristics:**

1. Check the following channel flow status that applies.
   ☐ dry ☐ no flow ☐ low ☐ normal ☐ high ☐ flooded

2. Check the following stream type that applies on the day of the survey:
   ☐ Ephemeral: A stream which flows only during or immediately after a rainfall event, and contains no refuge pools capable of sustaining a viable community of aquatic organisms.
   ☐ Intermittent: A stream which has a period of zero flow for at least one week during most years. Where flow records are available, a stream with a 7Q2 flow of less than 0.1 cubic feet per second is considered intermittent.
   ☐ Intermittent w/ perennial pools: An intermittent stream which maintains persistent pools even when flow in the stream is less than 0.1 cubic feet per second.
   ☐ Perennial: A stream which flows continuously throughout the year. Perennial streams have a 7Q2 equal to or greater than 0.1 cubic feet per second.
   ☐ Designated or unclassified tidal stream: A stream that is tidally influenced. If you checked this box, you will need to contact the Water Quality Standards Group and evaluate whether or not a bathing beach is located along the tidal stream and whether or not a bathing beach is located along the estuary, bay or Gulf water that the tidal stream flows into.

3. Streamflow
   Use USGS gage data (if a gage is located at a site or within a quarter mile of a site) or use the Stream Flow (Discharge) Measurement Form and follow the procedures outlined in the most recent TCEQ Surface Water Quality Monitoring Procedures, Volume 1, RG-415. If USGS gage data is used for a site, include that information as an attachment and list the streamflow on the sampling date below. If the stream flow taken at one site is representative of the flow at another site(s), then that flow can be used as the observed flow and should be documented below. If the stream flow measured at one site is different from another site, then stream flow should be taken at both sites.
   _____ cfs

4. Water Quality Data (Field Parameters)
   *Field parameters should be collected in accordance with the procedures outlined in the most recent TCEQ Surface Water Quality Monitoring Procedures, Volume 1.*
   Air Temp: _____° C Water Temp: _____° C

5. Riparian Zone (Mark dominant categories with L (Left Bank) and R (Right Bank). Bank orientation is determined by the investigator facing downstream.)

| | | |
|---|---|---|
| _____ Forest | _____ Urban | _____ Rip rap |
| _____ Shrub dominated corridor | _____ Pasture | _____ Concrete |
| _____ Herbaceous marsh | _____ Row crops | Other (specify): _____ |
| _____ Mowed/maintained corridor | _____ Denuded/Eroded bank | |

6. Ease of bank access to the water body: ☐ Easy ☐ Moderately easy ☐ Moderately difficult ☐ Difficult

7. Please describe access opportunities or explain why the site is not easily accessible (Attach photos for documentation):
   _____
   _____

8. Dominant Primary Substrate
   ☐Cobble ☐Sand ☐Silt ☐Mud/Clay ☐Gravel ☐Bedrock ☐Rip rap ☐ Concrete

Stream Name: _____ Site: _____
Date: _____ Time: _____

**B. Primary Contact Water Recreation Evaluation**:

- Primary contact recreation draft definition: Water recreation activities, such as wading by children, swimming, water skiing, diving, tubing, surfing, and whitewater kayaking, canoeing, and rafting, involving a significant risk of ingestion of water.

1. Were water recreation activities that involve a significant risk of ingestion (full body immersion) observed at this site? ☐ Yes ☐ No primary contact recreation activities were observed

   a. Check the following boxes of primary contact recreation activities observed at the time of the sampling event at the site (Attach photos of the activities or lack of activities).
   ☐ Wading-Children ☐ Tubing ☐ No primary contact activities that commonly occur were observed
   ☐ Wading-Adults ☐ Surfing ☐ Swimming ☐ Whitewater-kayaking, canoeing, rafting
   ☐ Water skiing ☐ Diving ☐ Other: _____
   ☐ frequent public swimming-created by publicly owned land or commercial operations

   b. Check the number of individuals observed at the site: ☐ None ☐ 1-10 ☐ 11-20 ☐ 20-50 ☐ >50

   c. Check the following that apply regarding the individuals proximity to the water body.
   ☐ Water in mouth or nose of the individual
   ☐ Primary touch: Individual's body (or portion) immersed in water
   ☐ Secondary touch: fishing, pets and related contact with water
   ☐ Individual is in a boat touching water
   ☐ Individual is on shore near water within 8 meters (25ft) of water
   ☐ Individual is well away from water between 8 and 30 meters (100 ft) ☐ Not applicable

2. If primary contact recreation activities are not observed, describe the physical characteristics of the water body that may hinder the frequency of primary contact (depth, etc.) (Attach photos, etc. for documentation).
   _____
   _____

3. Describe if there is public access (e.g., parks, roads, etc.) (Attach photos, maps, etc. for documentation).
   _____
   _____

4. Is an area with primary contact recreation activities or a bathing beach (e.g., state/local parks with swimming, etc.) located near (e.g., within 5 miles upstream and downstream) this site?

**C. Secondary Contact Water Recreation Evaluation:**

- Secondary contact recreation 1: Water recreation activities, such as fishing, commercial and recreational boating, and limited body contact incidental to shoreline activity, not involving a significant risk of water ingestion and that commonly occur.
- Secondary contact recreation 2: Water recreation activities, such as fishing, commercial and recreational boating, and limited body contact incidental to shoreline activity, not involving a significant risk of water ingestion but that occur less frequently than for secondary contact recreation 1 due to (1) physical characteristics of the water body and/or (2) limited public access.

1. Were water recreation activities observed at the site, but the nature of the recreation does not involve a significant risk of ingestion (e.g., secondary contact recreation activities)? ☐ Yes ☐ No secondary contact recreation activities were observed.

   a. Check the following boxes of secondary contact recreation activities that were observed at the time of the sampling event at the site (Attach photos of activities or lack of activities).
   ☐ Fishing
   ☐ Boating-commercial, recreational
   ☐ Non-whitewater-kayaking, rafting, canoeing
   ☐ No secondary contact recreation activities were observed
   ☐ Other secondary contact activities: _____

Stream Name: _____ Site: _____
Date: _____ Time: _____

b. Check the number of individuals observed at the site.
☐ None ☐ 1-10 ☐ 11-20 ☐ 20-50 ☐ greater than 50

c. Check the following that apply regarding the individuals proximity to the water body.
☐ Secondary touch: fishing, pets and related contact with water
☐ In a boat touching water
☐ Body on shore near water within 8 meters (25ft) of water
☐ Body well away from water between 8 and 30 meters (100 ft)

2. If secondary contact recreation activities are not observed, describe the physical characteristics of the water body that may hinder the frequency of secondary contact (Attach photos, etc. for documentation).

_____
_____

3. If secondary contact recreation activities are observed, how often do water recreational activities occur that do not involve a significant risk of water ingestion? ☐ frequently ☐ infrequently
Please describe how often the activities occur? ☐ Unknown ☐ Never ☐ Daily ☐ Monthly ☐ Yearly

4. If infrequently, what is the reason?
☐ physical characteristics of the water body ☐ limited public access ☐ other
If other, list reasons: _____

5. Describe the physical characteristics of the water body that hinders the frequency of secondary contact recreation (depth, etc.) (Attach photos or depth measurements, etc. for documentation).

_____
_____
_____

6. Describe why there is limited public access (e.g., lack of roads, river or stream banks overgrown, etc.) (Attach photos, maps, etc. for documentation).

_____
_____
_____

**D. Noncontact Recreation Evaluation**

*Noncontact recreation applies to water bodies where recreation activities do not involve a significant risk of water ingestion, and where primary and secondary contact recreation uses do not occur because of unsafe conditions, such as barge traffic.*

1. Provide site-specific information and documentation (including photographs) regarding unsafe conditions, recreation activities, and presence or absence of water recreation activities.

_____
_____
_____
_____
_____
_____

# Field Data Sheets – Basic RUAA Survey

Stream Name: _____ Site: _____
Date: _____ Time: _____

**E. Stream Channel and Substantial Pools Measurements**

Please check the following which best describes the river or stream: ☐ Wadeable ☐ Non-wadeable

1. Wadeable Streams

Determine whether or not the average depth at the thalweg is greater than 0.5 meters and if there are substantial pools with a depth of 1 meter or greater. Walk an approximately 300 meter reach (total) at the site and take the following measurements within the 300 meter reach. Measurements should be taken during base flow conditions (sustained or typical dry, warm-weather flows between rainfall events, excluding unusual antecedent conditions of drought or wet weather

Also, take photos facing upstream, downstream, left bank, and right bank at the 30 meters, 150 meters, and 300 meters.

Photos #s (30 meters) Upstream____ Downstream____ Left Bank____ Right Bank____
Photos #s (150 meters) Upstream____ Downstream____ Left Bank____ Right Bank____
Photos #s (300 meters) Upstream____ Downstream____ Left Bank____ Right Bank____

a) Substantial pools - Measure the length of each pool (if > 10 pools only measure 10 pools), the width (at the widest point), and the deepest depth. A substantial pool is considered a pool greater than 10 meters in length for the purposes of a Basic RUAA Survey. If depth and/or width measurements were not attainable, explain why.

| | **Length (meters)** | **Width (meters)** | **Depth (meters)** |
|---|---|---|---|
| Pool 1 | | | |
| Pool 2 | | | |
| Pool 3 | | | |
| Pool 4 | | | |
| Pool 5 | | | |
| Pool 6 | | | |
| Pool 7 | | | |
| Pool 8 | | | |
| Pool 9 | | | |
| Pool 10 | | | |

b) Average depth at the thalweg –Take depth measurements approximately every 30 meters to calculate an average depth at the thalweg (at least 10 measurements needed). If depth and/or width measurements were not attainable, explain why.

| **Distance** | **Depth (meters)** |
|---|---|
| 30 meters | |
| 60 meters | |
| 90 meters | |
| 120 meters | |
| 150 meters | |
| 180 meters | |
| 210 meters | |
| 240 meters | |
| 270 meters | |
| 300 meters | |
| **Average** | |

Stream Name: _____ Site: _____
Date: _____ Time: _____

c) Stream width – Measure (1) the width at one point which represents the typical average width of the 300 meter reach; (2) the width at the narrowest point of the stream within the 300 meter reach; and (3) the width at the widest point of the stream within the 300 meter reach.

| Measurement Type | Width (meters) |
|---|---|
| Typical Average Width of 300 meter reach | |
| Width at narrowest point of the stream within 300 meter reach | |
| Width at the widest point of the stream within 300 meter reach | |

d) Is there sufficient water within a 300 meter stream reach during base flow conditions to support primary contact recreation? ☐ Yes ☐ No
Comments:_____
_____

2. Non-wadeable Streams
If accessible, take 10 width measurements which represent typical widths of the 300 meter reach. If the water is too deep and not accessible record the estimated average width of the water body.

Also, take photos facing upstream, downstream, left bank, and right bank at .
Photos #s (30 meters) Upstream____ Downstream____ Left Bank____ Right Bank____
Photos #s (150 meters) Upstream____ Downstream____ Left Bank____ Right Bank____
Photos #s (300 meters) Upstream____ Downstream____ Left Bank____ Right Bank____

| # Measurements | Width (meters) |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |

Stream Name: _____ Site: _____
Date: _____ Time: _____

## F. Additional RUAA Information

1. Check the following activities observed over the site reach.
   - ☐ Drinking or water in mouth
   - ☐ Bathing
   - ☐ Walking
   - ☐ Jogging/running
   - ☐ Bicycling
   - ☐ Standing
   - ☐ Sitting
   - ☐ Lying down/sleeping
   - ☐ Playing on shoreline
   - ☐ Picnicking
   - ☐ Motorcycle/ATV
   - ☐ Hunting/Trapping
   - ☐ Wildlife watching
   - ☐ None
   - ☐ Other: _____

2. Are there permanent or long-term hydrologic modifications that are constructed and operated in a way that affects the recreational uses? ☐ Yes ☐ No (If yes, please provide supporting documentation and photos.)
   Comments: _____

3. Check any channel obstructions that apply (Attach photos).
   - ☐ Culverts
   - ☐ Barbed wire
   - ☐ Utility pipe
   - ☐ Fences
   - ☐ Dams
   - ☐ Other (specify): _____
   - ☐ Log jams
   - ☐ Thick vegetation
   - ☐ Rip rap
   - ☐ Low bridges
   - ☐ Water control structure
   - ☐ None

4. Check all surrounding conditions that promote recreational activities (Attach photos of evidence or unusual items of interest).
   - ☐ Campgrounds
   - ☐ Playgrounds
   - ☐ Rural area
   - ☐ Residential
   - ☐ National forests
   - ☐ Urban/suburban location
   - ☐ Golf Course
   - ☐ Sports Field
   - ☐ Stairs/walkway
   - ☐ Boating access (ramps)
   - ☐ Beach
   - ☐ Bridge crossing
   - ☐ Commercial boating
   - ☐ Trails/paths (hiking/biking)
   - ☐ Paved parking lot
   - ☐ Unimproved parking lot
   - ☐ Roads (paved/unpaved)
   - ☐ Populated area
   - ☐ Docks or rafts
   - ☐ Commercial outfitter
   - ☐ Nearby school
   - ☐ Power Line Corridor
   - ☐ Parks (national/city/county/state)
   - ☐ Public Property
   - ☐ Other: _____
   - ☐ None of the Above

   Comments: _____

5. Check all surrounding conditions that impede recreational activities (Attach photos of evidence or unusual items of interest).
   - ☐ Private Property
   - ☐ Barge/ship traffic
   - ☐ Steep slopes
   - ☐ Other: _____
   - ☐ Fence
   - ☐ Wildlife
   - ☐ None of the Above
   - ☐ No roads
   - ☐ No trespass sign
   - ☐ Industrial
   - ☐ No public access

   Comments: _____

6. Check any indications of human use (Attach photos).
   - ☐ Roads
   - ☐ Rope swings
   - ☐ Dock/platform
   - ☐ Foot paths/prints
   - ☐ Other: _____
   - ☐ RV/ATV Tracks
   - ☐ Camping Sites
   - ☐ Fire pit/ring
   - ☐ Fishing Tackle
   - ☐ NPDES Discharge
   - ☐ Gates on corridor
   - ☐ Children's toys
   - ☐ Remnant's of Kid's play
   - ☐ Organized event
   - ☐ No Human Presence

   Comments: _____

## Field Data Sheets – Basic RUAA Survey

Stream Name: _____ Site: _____
Date: _____ Time: _____

7. Check all water characteristics that apply (Attach photos).
   Aquatic Vegetation: ☐ absent ☐ rare ☐common ☐abundant
   Algae Cover: ☐ absent ☐ rare ☐common ☐abundant
   Odor: ☐ none ☐ rare ☐common ☐abundant
   Color: ☐ clear ☐ green ☐red ☐ brown ☐ black
   Bottom Deposit: ☐ sludge ☐ solids ☐ fine sediments ☐none ☐other
   Water Surface: ☐ clear ☐ scum ☐ foam ☐ debris ☐ oil
   Other: _____
   _____

8. Vertebrates Observed within 300 meter reach
   Snakes ☐ None ☐ slight presence ☐ moderate presence ☐ large presence
   Water Dependent Birds ☐ None ☐ slight presence ☐ moderate presence ☐ large presence
   Alligators ☐ None ☐ slight presence ☐ moderate presence ☐ large presence
   Comments: _____

9. Mammals Observed within 300 meter reach
   Wild ☐ None ☐ slight presence ☐ moderate presence ☐ large presence
   Domesticated Pets ☐ None ☐ slight presence ☐ moderate presence ☐ large presence
   Livestock ☐ None ☐ slight presence ☐ moderate presence ☐ large presence
   Feral Hogs ☐ None ☐ slight presence ☐ moderate presence ☐ large presence
   Comments: _____

10. Evidence of wild animals or evidence of birds, cattle, hogs, etc.
    ☐ Tracks ☐ Fecal droppings ☐ Bird nests

11. Garbage Observed
    Large garbage in the channel ☐ None ☐ Rare ☐ Common ☐ Abundant
    Small garbage in the channel ☐ None ☐ Rare ☐ Common ☐ Abundant
    Bank Garbage ☐ None ☐ Rare ☐ Common ☐ Abundant
    Briefly describe the kinds of garbage observed:
    _____
    _____

12. Is the site located in a wildlife preserve with large wildlife (i.e., waterfowl) population? ☐ Yes ☐ No

13. Please document any other relevant information regarding recreational activities and the water body in general (for example, area outside of the stream reach evaluated).
    _____
    _____
    _____
    _____
    _____

## Field Data Sheet - Basic RUAA Survey

Stream Flow (Discharge) Measurement

Stream:_____ Date:_____

Site:_____ Site Description:_____

Time Begin:_____ Time End:_____ Meter Type:_____

Observers:_____ Stream Width*:_____ Section Width (W):_____

Observations:_____

| Section Midpoint (ft) (m) | Section Depth (ft) (m) (cm) (D) | Observational Depth** (ft) (m) | Velocity (V) | | Flow (Q) ($m^3/s$) ($ft^3/s$) Q = (W)(D)(V) |
|---|---|---|---|---|---|
| | | | At Point (ft/s)(m/s) | Average (ft/s)(m/s) | |
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**Comprehensive RUAA Interview Form**

Stream Name: _____ Segment #: _____ Site: _____

Interviewer's Name: _____
Date & Time (include AM or PM): _____
Interviewed: ☐ In person ☐ By phone ☐ By mail

☐ No interviews were conducted
If no interviews were conducted, please provide an explanation:

_____
_____

*Are you willing to respond to a short survey about this stream? ☐ Yes ☐ No
If yes, complete contact information for the interviewee below. Do not collect name or contact information if interviewee is a minor. The contact information portion is not required if the interviewee does not want to provide this information.

Legal name: _____ Daytime phone number: _____
Mailing address: _____
**Interviewee selected because** (e.g., house adjacent to stream; standing by stream, etc.)

_____
_____

## Questions:

1. Are you familiar with this stream? ☐ Yes ☐ No If yes, how many years? _____
   If yes, proceed to #2. If no, stop here and do not conduct an interview.

2. Describe the location(s) of the stream reach the interviewee is familiar with:

   _____
   _____

3. Have the interviewer characterize the stream flow. Since the interviewer may not be familiar with TCEQ's definitions or distinction between the different water bodies, please refer to the definitions listed below when asking this question.

   - ☐ Ephemeral: A stream which flows only during or immediately after a rainfall event, and contains no refuge pools capable of sustaining a viable community of aquatic organisms.
   - ☐ Intermittent: A stream which has a period of zero flow for at least one week during most years. Where flow records are available, a stream with a 7Q2 flow of less than 0.1 cubic feet per second is considered intermittent. (Channel contains flowing water for only a portion of the year and surface water may be absent at times.)
   - ☐ Intermittent w/ perennial pools: An intermittent stream which maintains persistent pools even when flow in the stream is less than 0.1 cubic feet per second. (When not flowing, the water may remain in isolated pools.)
   - ☐ Perennial: A stream which flows continuously throughout the year. Perennial streams have 7Q2equal to or greater than 0.1 cubic feet per second.

4. Have you or your family personally used the stream for recreation? ☐ Yes ☐ No
   If yes, proceed to #6. If no, proceed to #5.

5. a. List reasons stream not used.

   _____
   _____

   b. Proceed to #7.

**Comprehensive RUAA Interview Form**

Stream Name: _____ Segment #: _____ Site: _____

6. How do you use the stream? When did these uses occur (e.g., year(s); season) and how often (times/year)? What location did these uses occur (get specific location and mark on a map)?
   ☐ Swimming ☐ Skin Diving ☐ Water Skiing ☐ Wind surfing ☐ Hunting ☐ Wading-Adults
   ☐ Tubing ☐ Kayaking ☐ Rafting ☐ Trapping ☐ SCUBA diving
   ☐ Snorkeling ☐ Fishing ☐ Boating ☐ Canoeing ☐ Wading-Children

   _____
   _____

7. Have you observed others using this stream for recreation? ☐ Yes ☐ No
   If yes, proceed to #8. If no, proceed to #9.

8. What kinds of uses have you witnessed? When did you witness these uses occurring (e.g., year(s); season) and how often (times/year)? What location did these uses occur (get specific location and mark on a map)?
   ☐ Swimming ☐ Skin Diving ☐ Water Skiing ☐ Wind surfing ☐ Hunting ☐ Wading-Adults
   ☐ Tubing ☐ Kayaking ☐ Rafting ☐ Trapping ☐ SCUBA diving
   ☐ Snorkeling ☐ Fishing ☐ Boating ☐ Canoeing ☐ Wading-Children

   _____
   _____

9. Have you heard about anyone using this stream for recreation? ☐ Yes ☐ No
   If yes, proceed to #10. If no, conclude the interview.

10. What kind of uses have you heard about? When did you hear that these uses occur (e.g., year(s); season) and how often (times/year)? What location did these uses occur (get specific location and mark on a map)?
    ☐ Swimming ☐ Skin Diving ☐ Water Skiing ☐ Wind surfing ☐ Hunting ☐ Wading-Adults
    ☐ Tubing ☐ Kayaking ☐ Rafting ☐ Trapping ☐ SCUBA diving
    ☐ Snorkeling ☐ Fishing ☐ Boating ☐ Canoeing ☐ Wading-Children

    _____
    _____

11. Can you recommend someone else we could contact that knows the stream? ☐ Yes ☐ No
    If yes, list person's contact information:

    _____
    _____

12. Additional comments (from the interviewee or interviewer):

    _____
    _____
    _____

**RUAA Summary**
**(Not part of the Field Data Sheet)**

*This form should be filled out after RUAA data collection is completed. Use the Contact Information Form, Field Data Sheets from all sites, Interview Forms from all interviews conducted, Historical Information Review, and other relevant information to answer the following questions on the water body.*

Name of waterbody: _____
Segment # or Nearest Downstream Segment #: _____
Classified Segment?: _____
County: _____

1. Observations on Use
   a. Do primary contact recreation activities occur on the water body?
      □ frequently □ seldom □ not observed or reported □ unknown

   b. Do secondary contact recreation 1 activities occur on the water body?
      □ frequently □ seldom □ not observed or reported □ unknown

   c. Do secondary contact recreation 2 activities occur on the water body?
      □ frequently □ seldom □ not observed or reported □ unknown

   d. Do noncontact recreation activities occur on the water body?
      □ frequently □ seldom □ not observed or reported □ unknown

2. Physical Characteristics of waterbody
   a. What is the average thalweg depth? _____ meters

   b. Are there substantial pools deeper than 1 meter? □ yes □ no

   c. What is the general level of public access?
      □ easy □ moderate □ very limited

3. Hydrological Conditions (Based on Palmer Drought Severity Index)
   □ Mild-Extreme Drought □ Incipient dry spell □ Near Normal
   □ Incipient wet spell □ Mild-Extreme Wet