Clean Water Act Section 319(h) Nonpoint Source Pollution Control Program

Coordinating Facilitation and Implementation of the Double Bayou Watershed Protection Plan and Monitoring for Implementation Effectiveness

TSSWCB Project No. 18-07
Revision No.1

Monitoring Quality Assurance Project Plan

Texas State Soil and Water Conservation Board

Prepared by:

Houston Advanced Research Center/
Geotechnology Research Institute (GTRI),
United States Geological Survey

Effective Period: Upon EPA Approval through August 31, 2022
(with annual revisions required)

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A1 APPROVAL PAGE

Monitoring Quality Assurance Project Plan (QAPP) for *Coordinating Facilitation and Implementation of the Double Bayou Watershed Protection Plan and Monitoring for Implementation Effectiveness*

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Name: Anthony Suttice
Title: EPA Texas Nonpoint Source Project Officer

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Texas State Soil and Water Conservation Board (TSSWCB)

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Name: Stephanie Glenn
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Name: Mustapha Beydoun
Title: GTRI Safety Coordinator and QAO

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United States Geological Survey (USGS)

Name: Thomas Sample
Title: Project Chief

Signature: _____ Date: _____

Name: Michael Lee
Title: GCPO Water Science Center QAO

Signature: _____ Date: _____

North Water District Laboratory Services (NWDLS)

Name: Deena McDaniels
Title: NWDLS Project Manager

Signature: _____ Date: _____

GTRI will secure written documentation (via a return receipt memorandum) from each project participant within 30 days, e.g., laboratories, partners, etc., stating the organization's awareness of and commitment to requirements contained in this quality assurance plan and any amendments or revisions of this plan. The GTRI QAO will maintain this documentation as part of the project's quality assurance records.

A2 TABLE OF CONTENTS

A1 APPROVAL PAGE 3
A2 TABLE OF CONTENTS 7
A3 DISTRIBUTION LIST 8
A4 PROJECT/TASK ORGANIZATION 11
A5 PROBLEM DEFINITION/BACKGROUND 15
A6 PROJECT/TASK DESCRIPTION 18
A7 QUALITY OBJECTIVES AND CRITERIA 20
A8 SPECIAL TRAINING/CERTIFICATION 26
A9 DOCUMENTS AND RECORDS 27
B1 SAMPLING PROCESS DESIGN 30
B2 SAMPLING METHODS 33
B3 SAMPLE HANDLING AND CUSTODY 37
B4 ANALYTICAL METHODS 40
B5 QUALITY CONTROL 42
B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE 48
B7 INSTRUMENT CALIBRATION AND FREQUENCY 49
B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES 50
B9 NON-DIRECT MEASUREMENTS 51
B10 DATA MANAGEMENT 53
C1 ASSESSMENTS AND RESPONSE ACTIONS 56
C2 REPORTS TO MANAGEMENT 57
D1 DATA REVIEW, VERIFICATION, AND VALIDATION 58
D2 VERIFICATION AND VALIDATION METHODS 59
D3 RECONCILIATION WITH USER REQUIREMENTS 61
References 62
Appendix A. USGS Field Forms 64
Appendix B. Laboratory Forms 79
Appendix C. Corrective Action Report 80
Appendix D. Data Summary Report 81

Figures and Tables

Figure A4.1 - Project Organizational Chart* – Lines of Communication 14
Figure A5.2- Double Bayou Watershed and Sampling Locations 17
Table A6.1 - QAPP Milestones 18
Table A7.1 - Measurement Performance Specifications for Water Quality 21
Table A7.2 - Data Quality Objectives for Laboratory Parameters (in Water) 23
Table A9.1 - Project Quality Assurance Documents and Records 28
Table B1.1 - Sampling regime with site locations and number of samples of each type. 32
Table B2.1 - Min. Sample Vol., Container Types, and Preservation & Holding Requirements 34
Table B5.1 - Number and type of field quality-control samples 42
Table B10.1 - Codes for Data Submittals 54
Table C1.1 - Assessments and Response Requirements 56
Table D2.1 - Data Review Tasks 60

A3 DISTRIBUTION LIST

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

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Title: GCPO Water Science Center QAO

North Water District Laboratory Services (NWDLS)
8725 Fawn Trail
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Name: Deena McDaniels
Title: NWDLS Project Manager

GTRI will provide copies of this QAPP and any amendments or appendices of this QAPP to each person on this list and to each sub-tier project participant, e.g., subcontractors, other units of government, laboratories. GTRI will document distribution of the QAPP and any amendments and appendices, maintain this documentation as part of the project's QA records, and will be available for review.

List of Acronyms

ADAPS	Automated Data Processing System
ADCP	Acoustic Doppler Current Profiler
ARRA	American Recovery and Reinvestment Act
ASR	Analytical Services Request
ASTM	American Society for Testing and Materials
AWRL	Ambient Water Reporting Limits
CAR	Corrective Action Report
CCV	Continuing Calibration Verification
COC	Chain of Custody
CWA	Clean Water Act
DO	Dissolved Oxygen
DQO	Data Quality Objective
EPA	Environmental Protection Agency
GBEP	Galveston Bay Estuary Program
GIS	Geographic Information System
GTRI	Geotechnology Research Institute
HARC	Houston Advanced Research Center
H-GAC	Houston-Galveston Area Council
IT	Information Technology
LCS	Laboratory Control Standard
LIMS	Laboratory Information Management System
MS	Matrix Spikes
NCDC	National Climatic Data Center
NCR	Nonconformance Report
NELAP	National Environmental Laboratory Accreditation Program
NPS	Non-point source
NWDLS	North Water District Laboratory Services
NWIS	National Water Information System
NWQL	National Water Quality Laboratory

PM	Project Manager
QA	Quality Assurance
QA/QC	Quality Assurance Quality Control
QAM	Quality Assurance Manual
QAO	Quality Assurance Officer
QAPP	Quality Assurance Performance Plan
QC	Quality Control
QM	Quality Manual
QMS	Quality Management System
QWDATA	USGS Water Quality Database
RL	Reporting Limit
RPD	Relative Percent Difference
SOP	Standard Operating Procedure
SWQMIS	TCEQ Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TPDES	Texas Pollutant Discharge Elimination System
TSSWCB	Texas State Soil and Water Conservation Board
USGS	United States Geological Survey
USGSADAPS	USGS Automated Data Processing System
USGS NWIS	USGS National Water Information System
WPP	Watershed Protection Plan
WQMP	Water Quality Management Plan
WSC	Water Science Center
WWTF	Waste Water Treatment Facility

A4 PROJECT/TASK ORGANIZATION

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

EPA, Region 6

Anthony Suttice, EPA Project Officer
Responsible for managing the project for EPA. Reviews project progress and reviews and approves QAPP and QAPP amendments.

TSSWCB

Brian Koch, TSSWCB PM
Responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. Provides the primary point of contact between GTRI and TSSWCB. Tracks and reviews deliverables to ensure that tasks in the workplan are completed as specified in the contract. Responsible for verifying that the QAPP is followed by GTRI and USGS. Notifies the TSSWCB QAO of significant project nonconformances and corrective actions taken as documented in quarterly progress reports from GTRI PM. Enforces corrective action.

Mitch Conine, TSSWCB QAO
Reviews and approves QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TSSWCB participants. Assists the TSSWCB PM on QA-related issues. Coordinates reviews and approvals of QAPPs and amendments or revisions. Conveys QA problems to appropriate TSSWCB management. Monitors implementation of corrective actions. Coordinates and conducts audits.

GTRI

Stephanie Glenn, PM/Data Manager and Analyst
Guides and oversees the work of the GTRI Software Engineer and GIS Analyst. The PM drafts progress reports, communicates and coordinates with the, TSSWCB PM and subcontractors. The PM acquires agency data, and with assistance from other members of the project team, conducts statistical analyses and oversees the final graphic and textual deliverables. Responsible for the ensuring that data are properly reviewed and verified. Responsible for the transfer of project quality-assured water quality data to the TSSWCB. The PM also revises and submits the QAPP as needed, distributes the QAPP and revisions to project team members, and ensures that all quality assurance elements of the project are implemented by project staff and subcontractors per the QAPP and workplan. Ensures TSSWCB PM and/or QAO are notified of deficiencies and nonconformances, and that issues are resolved. Responsible for validating that data collected are acceptable

for reporting to the TSSWCB. Conducts statistical analyses of the quality assured date following QA procedures as outlined in the QAPP.

Mustapha Beydoun, GTRI QAO
The GTRI QAO assists the GTRI PM in the development and review of the QAPP and other QA/QC elements of the project as required by GTRI QA guidelines and granting agencies. The QAO is not directly involved in the data validation process at the project level. Data validation is overseen by the GTRI PM.

Likun Chen, GTRI Acting Software Engineer
Works under the supervision of the GTRI PM to construct and maintain databases required for the Double Bayou Project. The Software Engineer also maintains project servers, and is responsible for all data backups. The Software Engineer follows QA procedures outlined in the QAPP under the direct supervision of the GTRI PM.

Qian Song, GTRI GIS Analyst
Works under the supervision of the GTRI PM to develop mapping and GIS products required for the Double Bayou Project. The analyst follows QA procedures outlined in the QAPP under the direct supervision of the GTRI PM.

Ryan Bare, GTRI Data Manager and Analyst
Works under the supervision of the GTRI PM to obtain data and associated metadata and performs spatial and statistical analyses. The Research Associate follows QA procedures outlined in the QAPP under the direct supervision of the GTRI PM.

United States Geological Survey

Thomas Sample, Project Chief, Data Manager, Gulf Coast Branch of Texas Water Science Center
Responsible for overall project coordination and completion of all water-quality sample collection along the East and West Forks of Double Bayou. Duties also include data assessment, coordination of electronic data transfer, data collection and management activities to ensure that procedures meet project objectives, and are consistent with this QAPP. This includes adherence to established protocol, data-accuracy criteria, documentation procedures, and entry of information into the database. Responsible for communication with laboratories to ensure compliance with project specifications.

Michael Lee, Acting QAO, GCPO Water Science Center
Responsible for water-quality analyses performed in the USGS Houston laboratory, maintaining QC documentation for instrumentation and equipment, and verification of analytical data provided by the USGS NWQL and contract laboratories.

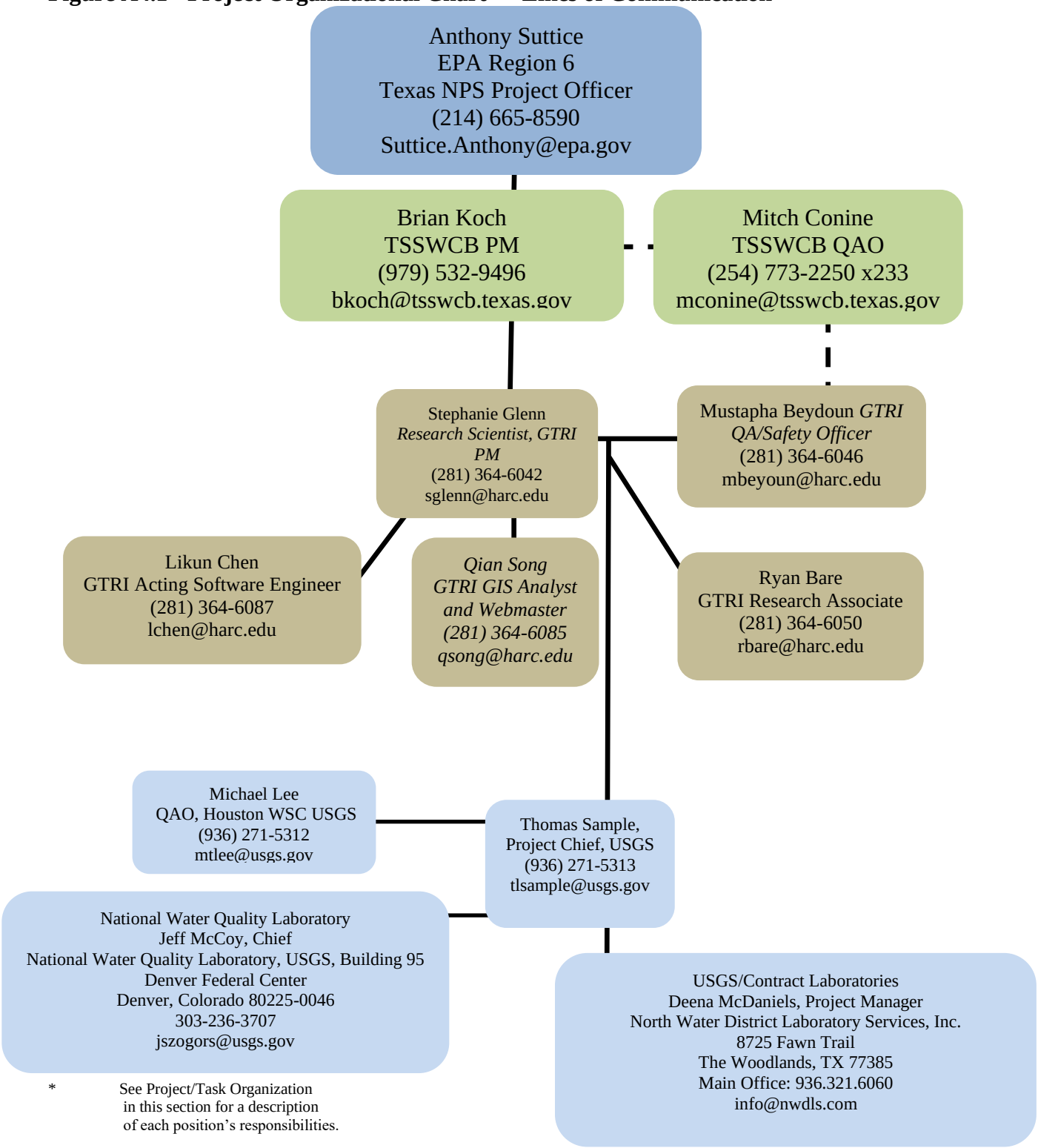
Jeff McCoy, Chief, National Water Quality Laboratory

Responsible for oversight of the National Water Quality Laboratory, which provides quality analytical data, consistent with this QAPP, and maintains verification of procedures that establish the level of quality.

Contract Laboratory

Deena McDaniels, NWDLS Project Manager, North Water District Laboratory Services (NWDLS)
Responsible for supervision of laboratory personnel that generate analytical data for the project. Responsible for ensuring NELAP accreditation is obtained and maintained in order to analyze project samples. 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 laboratory operations relating to the project and ensuring that all QA/QC requirements are met, documentation related to the analysis is complete and adequately maintained, and that results are reported accurately. Responsible for ensuring that corrective actions are implemented, documented, reported and verified.

Figure A4.1 - Project Organizational Chart* – Lines of Communication



* See Project/Task Organization in this section for a description of each position's responsibilities.

A5 PROBLEM DEFINITION/BACKGROUND

The Double Bayou watershed is located on the Upper Texas Gulf Coast and is part of the Galveston Bay watershed. Situated in the eastern portion of the Lower Galveston Bay, it is comprised of two main subwatersheds; East Fork and West Fork, which are also the primary waterways in the watershed. The Double Bayou watershed drains directly into the Trinity Bay system and ultimately into Galveston Bay. The majority (93%) of the watershed lies within Chambers County, Texas. The remaining 7% of the watershed is located in Liberty County, Texas. The Double Bayou watershed drains 98 square miles of predominantly rural and agricultural landscape. However, several residential centers are located in the watershed.

Since 2009, GTRI has worked with the USGS and Shead Conservation Solutions with funding from GBEP/TCEQ, through the American Recovery and Reinvestment Act of 2009 (ARRA), to develop a watershed characterization for Double Bayou. The watershed characterization project includes establishing a baseline set of data, identifying data gaps, developing and initiating a Data Monitoring Plan and QAPP, and initial stakeholder work.

Since 2012, GTRI has worked with the USGS with funding from TSSWCB/EPA and GBEP/TCEQ to develop a Watershed Protection Plan (WPP) for Double Bayou. Through the WPP process, stakeholders in the Double Bayou watershed including community leaders, elected officials, landowners, nonprofit organizations, and representatives of relevant local, state, and federal agencies met through a serious of larger stakeholder meetings and smaller workgroup meetings to collaborate on the development of the WPP. Water quality was monitored on both the East and West Forks throughout the WPP process, and stakeholders were informed about results of the water quality monitoring and analysis. Working with the stakeholders, ideas for water quality management measures were discussed and analyzed by the three main workgroups (Ag/Wildlife/Feral Hog, Recreation/Hunting and WWTF/Septic) for inclusion in the Double Bayou WPP.

Implementation of the Double Bayou WPP supports the goals and actions outlined in the Water and Sediment Quality (WSQ) Action Plan and the NPS Action Plan of the Galveston Bay Comprehensive Conservation and Management Plan (CCMP), the Galveston Bay Plan 2nd edition.. Specifically, the Double Bayou WPP satisfies the following CCMP actions:

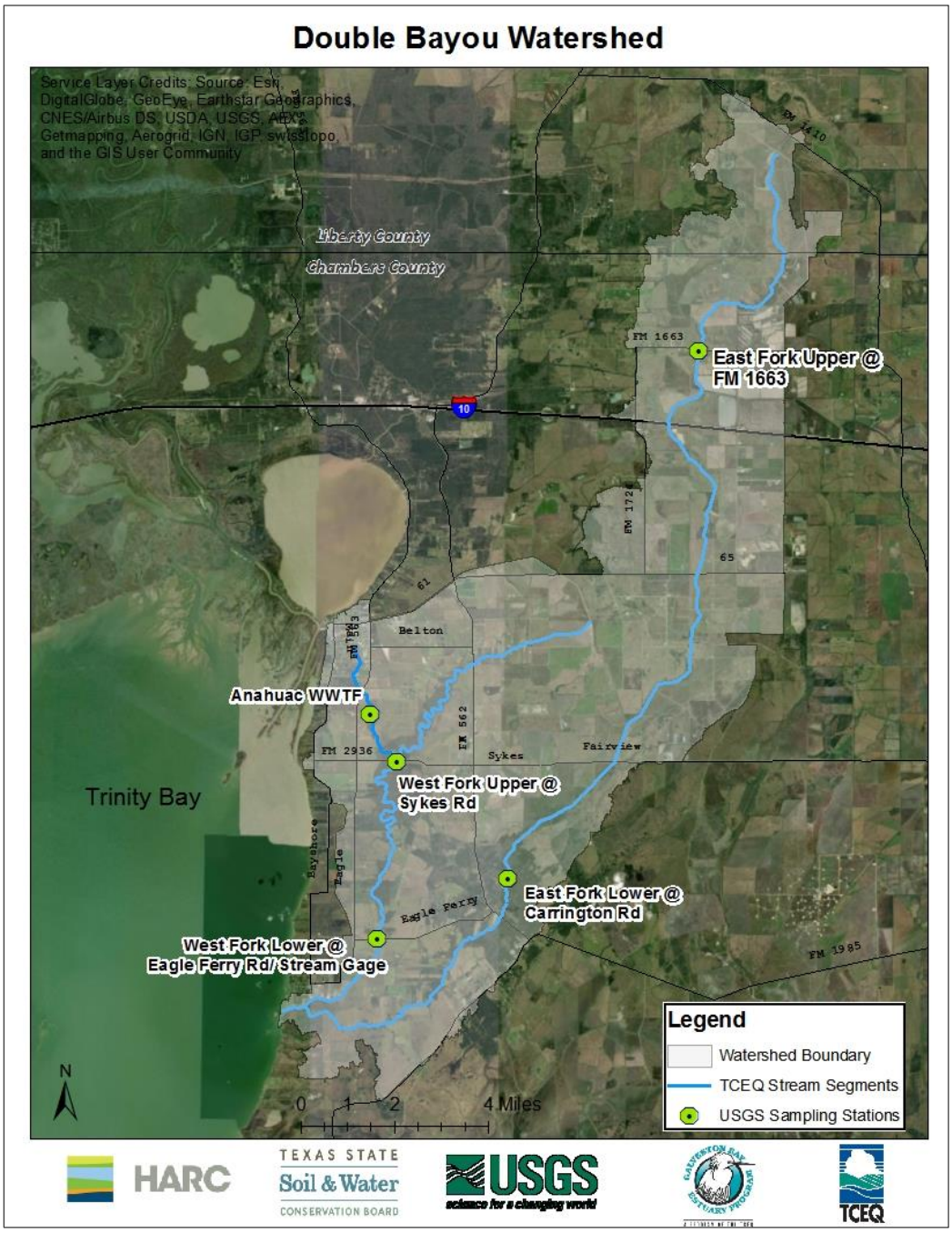
- NPS-1: Support Watershed-Based Plan Development and Implementation
- NPS-2 Support Nonpoint Source Education and Outreach Campaigns
- NPS-3 Implement NPS Best Management Practices
- NPS-4 Host Nonpoint Source Workshops

The Double Bayou Watershed Protection Plan (http://www.doublebayou.org/wpp-document/) was approved by stakeholders and accepted by the EPA in July 2016. This project is warranted to provide for water quality data collection efforts, maintaining stakeholder efforts and beginning implementation of the WPP. Maintaining an effective monitoring program will provide critical water quality data that will be used to judge the effectiveness of WPP implementation efforts and serve as a tool to quantitatively measure water quality restoration. This effort will continue

maintenance of the project website. Continuing stakeholder facilitation is critical to effectively bridging the gap between projects that developed the Double Bayou WPP and beginning WPP implementation efforts. In December 2016, the Double Bayou Watershed Protection Plan project received the Our Great Region Diligence Award from the Houston Galveston Area Council's (H-GAC) Our Great Region Awards, which recognize outstanding projects in the region that advance the goals and strategies of the Houston-Galveston region.

This project will also leverage other activities in the watershed. Through TSSWCB project #16-04 "Implementing Agricultural Nonpoint Source Components of the Cedar Bayou and Double Bayou Watershed Protection Plans" implementation of WQMPs identified in the Double Bayou WPP is underway. Water quality monitoring will be critical in helping determine the effectiveness of these management measures. A 2017 study funded by the Galveston Bay Estuary Program will begin a Bacteria Source Tracking (BST) throughout Galveston Bay; five sites were selected for analysis and Double Bayou is one of these site. Results from both of these endeavors would be used in the project to help guide the implementation of the voluntary management measures described in the stakeholder-approved and EPA-accepted Double Bayou WPP.

Figure A5.2- Double Bayou Watershed and Sampling Locations



A6 PROJECT/TASK DESCRIPTION

The goal of this project is to begin implementation of the Double Bayou WPP. The implementation process will involve implementation of targeted water quality education and outreach management measures outlined in the Double Bayou WPP, implementation of targeted water quality monitoring, further data analysis, and communicating the results to the stakeholders. Through this project, the Double Bayou Watershed Partnership will be crucial in implementing the WPP. The Partnership will serve as the participatory mechanism for interested stakeholders during this process.

Using water quality monitoring results, a targeted water quality monitoring plan will be developed. The targeted water quality monitoring plan will provide sufficient data for analysis. The targeted water quality monitoring plan will further define water quality problems noted in the watershed protection plan.

The USGS will conduct water quality data monitoring. USGS will conduct routine ambient monitoring at 4 mainstem sites once every other month, collecting field, conventional, flow, and bacteria parameter groups. USGS will include routine ambient monitoring at 1 WWTF site once per quarter, for an additional 8 samples. USGS will conduct biased-flow monitoring at 4 mainstem sites plus the WWTF site, during 2 storm events during the sampling period, collecting field, conventional, flow, and bacteria parameter groups. USGS will deploy one 24-hour multi-parameter sonde measuring field parameters during the TCEQ Index Period of each year (total of two deployments) to sample 24-hour dissolved oxygen concentrations. The USGS will also provide technical support including input for the QAPP and sampling plans.

Using data collected from the targeted water quality monitoring plan, GTRI will develop assessment methodologies capable of identifying spatial and temporal changes in water quality. GTRI will conduct analysis of patterns in water quality to determine if beginning implementation strategies are having an impact. Data results and analyses will be developed into outreach materials and presented to the stakeholders for discussion.

Table A6.1 - QAPP Milestones

TASK	PROJECT MILESTONES	AGENCY	START	END
2.1	Develop QAPP for review by USEPA.	GTRI, USGS	M1	M6
2.2	GTRI will implement the approved QAPP. GTRI will submit revisions and necessary amendments to the QAPP as needed	TSSWCB, GTRI, USGS	M7	M48

TASK	PROJECT MILESTONES	AGENCY	START	END
3.1	USGS will conduct routine ambient monitoring at 4 mainstem sites once every other month, collecting field, conventional, flow, and bacteria parameter groups. USGS will include routine ambient monitoring at 1 WWTF site once per quarter, for an additional 8 samples.	USGS	M8	M48
3.2	USGS will conduct biased-flow monitoring at 4 mainstem sites plus the WWTF site, during 2 storm events during the sampling period, collecting field, conventional, flow, and bacteria parameter groups.	USGS	M8	M48
3.3	USGS will deploy one 24-hour multi-parameter sonde measuring field parameters during the TCEQ Index Period of each year (total of two deployments); 24-hour dissolved oxygen concentrations will be sampled.	USGS	M8	M48

A7 QUALITY OBJECTIVES AND CRITERIA

The goal of this project is to generate data of known and acceptable quality for surface water quality to support the implementation of the Double Bayou WPP by monitoring ongoing water quality status and trends. The targeted water quality monitoring plan will further define water quality problems noted in the watershed characterization process, assess critical and possible sources, and analyze data trends.

The purpose of collecting routine ambient monitoring is to conduct water quality assessments in accordance with TCEQ's Guidance for Assessing and Reporting Surface Water Quality in Texas, as well as to support water quality status and changes and stakeholder decision-making.

The purpose of collecting biased-flow (storm flow) monitoring is to support the hydrologic characterization of the bayous as well as water quality status and changes and stakeholder decision-making.

The purpose of effluent monitoring is to characterize possible point source contributions (such as WWTF) in the watershed.

24-hour DO monitoring is measured to determine compliance with aquatic life use designations and support biological assessment, as well as aid with short-term temporal fluctuation analyses.

As part of coordination between TSSWCB and GTRI, GTRI will provide water quality data to TSSWCB for inclusion in TCEQ's SWQMIS. Routine water quality monitoring is needed for conducting water quality assessments in accordance with TCEQ's *Guidance for Assessing and Reporting Surface Water Quality in Texas*.

The measurement performance specifications to support the project objectives for a minimum data set are specified in Table A7.1 and A7.2 and in the text following. The measurement performance specifications in Table A7.1 apply for the data collected under this QAPP only. The representative data collected during this project will be submitted to SWQMIS via the TSSWCB.

Table A7.1 - Measurement Performance Specifications for Water Quality

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	Lab Reporting Limit (RL)	RECOVERY AT RLs	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
Field Parameters (Water Column)										
pH	Standard units	water	EPA 150.1 and TCEQ SOP, V1	00400	NA*	NA	NA	NA	NA	Field
Temperature	° C	water	EPA 170.1 and TCEQ SOP, V1	00010	NA*	NA	NA	NA	NA	Field
Conductivity	uS/cm	water	EPA 120.1 and TCEQ SOP, V1	00094	NA*	NA	NA	NA	NA	Field
DO	mg/L	water	EPA 360.1 and TCEQ SOP, V1	00300	NA*	NA	NA	NA	NA	Field
Turbidity	FNU	water	EPA 180.1 and TCEQ SOP, V1		NA*	NA	NA	NA	NA	Field
Salinity	ppt	water	[8] TCEQ SOP, V1	00480	NA*	NA	NA	NA	NA	Field
Flow	cfs	water	[8] TCEQ SOP, V1	00061	NA*	NA	NA	NA	NA	Field
Flow measurement method	1-gage 2-electric 3-mechanical 4-weir/flume 5-doppler	water	[8] TCEQ SOP, V1	89835	NA*	NA	NA	NA	NA	Field
Flow severity	1-no flow, 2-low, 3-normal, 4-flood, 5-high, 6-dry	water	[8] TCEQ SOP, V1	01351	NA*	NA	NA	NA	NA	Field
Depth of Waterbody	meters	water	[8] TCEQ SOP, V1	82903	NA*	NA	NA	NA	NA	Field
24-Hour Field Parameters										
Avg. 24-hour DO	mg/L	water	[8] TCEQ SOP, V1	89857	NA*	NA	NA	NA	NA	Field
Min. 24-hour DO	mg/L	water	[8] TCEQ SOP, V1	89855	NA*	NA	NA	NA	NA	Field
Max. 24-hour DO	mg/L	water	[8] TCEQ SOP, V1	89856	NA*	NA	NA	NA	NA	Field
No. of 24-hour DO measurements	# meas.	NA	[8] TCEQ SOP, V1	89858	NA*	NA	NA	NA	NA	Field
24-Hr Avg. water Temperature	Degrees Celsius	water	[8] TCEQ SOP, V1	00209	NA	NA	NA	NA	NA	Field

Max Daily water Temperature	Degrees Celsius	water	[8] TCEQ SOP, V1	00210	NA	NA	NA	NA	NA	Field
Min Daily water Temperature	Degrees Celsius	water	[8] TCEQ SOP, V1	00211	NA	NA	NA	NA	NA	Field
# water temp measurements during 24-Hrs.	# meas.	NA	[8] TCEQ SOP, V1	00221	NA	NA	NA	NA	NA	Field
24-Hr Avg. Spec Conductance	uS/cm	water	[8] TCEQ SOP, V1	00212	NA	NA	NA	NA	NA	Field
Max Spec Conductance	uS/cm	water	[8] TCEQ SOP, V1	00213	NA	NA	NA	NA	NA	Field
Min Spec Conductance	uS/cm	water	[8] TCEQ SOP, V1	00214	NA	NA	NA	NA	NA	Field
# Spec Conductance measurements during 24-Hrs.	# meas.	NA	[8] TCEQ SOP, V1	00222	NA	NA	NA	NA	NA	Field
Max Daily pH	Standard units	water	[8] TCEQ SOP, V1	00215	NA	NA	NA	NA	NA	Field
Min Daily pH	Standard units	water	[8] TCEQ SOP, V1	00216	NA	NA	NA	NA	NA	Field
# pH measurements during 24-Hrs.	# meas.	NA	[8] TCEQ SOP, V1	00223	NA	NA	NA	NA	NA	Field
24-Hr Avg. Turbidity	FNU	water	[8] TCEQ SOP, V1	--	NA*	NA	NA	NA	NA	Field
Max Turbidity	FNU	water	[8] TCEQ SOP, V1	--	NA*	NA	NA	NA	NA	Field
Min Turbidity	FNU	water	[8] TCEQ SOP, V1	--	NA*	NA	NA	NA	NA	Field
# Turbidity measurements in 24-Hrs.	# meas.	water	[8] TCEQ SOP, V1	--	NA*	NA	NA	NA	NA	Field
24-Hr Avg. Salinity	ppt	water	[8] TCEQ SOP, V1	00218	NA*	NA	NA	NA	NA	Field
Max Salinity	ppt	water	[8] TCEQ SOP, V1	00217	NA*	NA	NA	NA	NA	Field
Min Salinity	ppt	water	[8] TCEQ SOP, V1	00219	NA*	NA	NA	NA	NA	Field
# Salinity measurements in 24-Hrs.	# meas.	water	[8] TCEQ SOP, V1	00220	NA*	NA	NA	NA	NA	Field

* Reporting to be consistent with SWQM guidance and based on measurement capability. References located on page 59.

Table A7.2 - Data Quality Objectives for Laboratory Parameters (in Water)

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	Reporting Limit (RL)	RECOVERY at AWRL (% rec)*	PRECISION (RPD of LCS/LCS dup)	BIAS (% rec of LCS)*	Lab
Conventional, Bacteriological, and Pesticide Parameters (Water)										
NH_3-N (filtered)	mg/L	Water	[6] I252290	00608	0.1	0.01	75-125	10	80-120	USGS - NWQL
NH_3-N (unfiltered)	mg/L	Water	[2] EPA 350.1***	00610	0.1	0.02	75-125	10	80-120	USGS - NWQL
Enterococcus	MPN /100 mL	Water	[4] Enterolert	31701	1.0****	1.0	NA	0.16 **	NA	NWDLS
E. coli	MPN /100 mL	water	[4] SM 9223-B	31699	1.0	1.0	NA	0.16 **	NA	NWDLS
E. coli Colilert, IDEXX, Holding time	hours	water	[4] SM 9223-B	31704	NA	NA	NA	NA	NA	NWDLS
NO_3-N + NO_2-N	mg/L	Water	[2] EPA 353.2***	00631	0.05	0.04	75-125	10	80-120	USGS - NWQL
Phosphorous, total	mg/L	Water	[5] I461091	00665	0.06	0.02	75-125	10	80-120	USGS - NWQL
Phosphorous, orthophosphate	mg/L	Water	[6] I260190	00671	0.04	0.004	75-125	10	80-120	USGS - NWQL
TKN	mg/L	Water	[6] I451591	00625	0.2	0.10	75-125	10	80-120	USGS - NWQL
Chloride	mg/L	Water	USGS-I-2057-85***	00940	5	0.02	75-125	10	80-120	USGS - NWQL
Sulfate	mg/L	Water	USGS-I-2057-85	00945	5	0.02	75-125	10	80-120	USGS - NWQL
TSS	mg/L	Water	[1] USGS-I-3765-89***	00530	5	15	75-125	15	NA	USGS - NWQL

* Reporting to be consistent with SWQM guidance and based on measurement capability.

** Based on a range statistic as described in Standard Methods, 23rd Edition, Section 9020-B, Quality Assurance/Quality Control - Intralaboratory Quality Control Guidelines.

*** USGS-NWQL is not NELAP accredited for methods EPA 350.1, EPA 353.2, I-2057-85 (Chloride), and I-3765-89 (TSS).

**** Only results for dilutions of 1:10 or greater will be reported to TCEQ for inclusion in SWQMIS.

References located on page 62.

Ambient Water Reporting Limits (AWRLs)
The AWRL establishes the reporting specification at or below which data for a parameter must be reported to be compared with freshwater screening criteria. The AWRLs specified in Table A7.1 are the program-defined reporting specifications for each analyte. A full listing of AWRLs can be found at https://www.tceq.texas.gov/assets/public/waterquality/crp/QA/awrlmaster.pdf. The limit of quantitation is the minimum level, concentration, or quantity of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. Laboratory Measurement Quality Control Requirements and Acceptability Criteria are provided in Section B5.

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

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 laboratory control samples in the sample matrix (e.g. deionized water, sand, commercially available tissue) or 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.

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

Representativeness
Samples must be collected that are representative of spatial components that influence conditions in the East and West Forks of Double Bayou. Site selection for this study captures various land uses and inputs from the watershed. For this, water quality monitoring and discrete sampling will be performed at sites along both the East and West Forks of Double Bayou.

In order to collect samples representative of temporal components that influence conditions in the stream, monitoring and water sampling will be conducted over a variety of flow conditions, and at least every other month at each site over a range of three-month seasonal periods. Discrete samples will be collected routinely, as well as during targeted storm events.

Comparability

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

Completeness

The completeness of the data is basically a relationship of how much of the data 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.

A8 SPECIAL TRAINING/CERTIFICATION

Due to qualifications of the staff, no specialized training will be required.

Measurement of stream flow using an Acoustic Doppler Current Profiler (ADCP) may be necessary – use of the ADCP requires a 5-day class that splits evenly between classroom instruction and hands-on application of basic principles. The class is taught by USGS Office of Surface Water instructors. Successful completion of the class is mandatory within the USGS for use of the ADCP in stream flow data collection. Further information on measuring discharge with acoustic Doppler current profiles can be found in Mueller and others (2013[12]).

A9 DOCUMENTS AND RECORDS

Records produced by this project will consist of the results of data collection, data monitoring and data analysis. Progress reports on data processing and analysis will be submitted monthly. Data validation and QA checks will be conducted by the GTRI PM, GTRI GIS Analyst, and GTRI Software Engineer. Copies of data documentation generated by GTRI project personnel and agency metadata will be stored on the server and backed up to a tape drive on a bi-weekly basis. GTRI will ensure against catastrophic loss of data (e.g. physical damage/data loss due to fire or storm damage) by storing data backups offsite at a secure location per data backup procedures implemented by the GTRI Information Technology (IT) Department.

All data reports, including GIS data reports, summaries, and other project documentation will be retained in a specially designated folder on the server. Only GTRI project staff will have access to these password-protected project files and documentation. All electronically backed up information which will include all data reports, summaries, and other project documentation will be retained by the GTRI PM for one year after completion of the project. At the end of that one-year period, all backup discs, data reports, including GIS data reports, summaries and documentation will be transferred to the TSSWCB PM who will retain the backup materials for a minimum of ten years.

The data report and web-based products will be organized according to data type (water quality, land use, etc.). Contributing agency programs, their quality assurance procedures, the parameters for which values are obtained, and associated metadata will be described (see Section B9).

Quarterly progress reports will be produced electronically for the TSSWCB and will note activities conducted in connection with audits of the water quality monitoring program, items or areas identified as potential problems, and any variations or supplements to the QAPP. Corrective Action Reports (CAR) will be utilized when necessary (Appendix C). CARs will be maintained in an accessible location for reference at GTRI. CARs that result in any changes or variations from the QAPP will be made known to pertinent project personnel and documented in an update or amendment to the QAPP when appropriate.

Individuals listed in Section A3 will be notified of approval of the most current copy of the QAPP by the GTRI PM. The GTRI PM will make the most recent version of the QAPP available to all entities listed in Section A3 of this QAPP. Current copies of the QAPP will be kept on file for all individuals on the distribution list.

The final assessment data report will be produced electronically and as a hard copy, and all files used to produce the report will be saved electronically by GTRI for at least five years and will be available for transfer to the TSSWCB PM.

The documents that describe, specify, report, or certify activities are listed in Table A9.1. Water-quality data will be submitted by USGS to GTRI in spreadsheet format. In addition, hard copies of the field sheets used for sampling and a Data Review Checklist will be submitted to GTRI.

Table A9.1 - Project Quality Assurance Documents and Records

Document/Record	Location	Retention	Form
QAPP, amendments, and appendices	GTRI/USGS	7 years	Electronic/Paper
QAPP distribution documentation	GTRI	7 years	Electronic/Paper
Field notebooks or field data sheets	USGS	7 years	Paper
Field equipment calibration/maintenance logs	USGS	7 years	Paper
Chain of custody records	USGS	7 years	Paper
Field SOPs	USGS	7 years	Paper/Electronic
Laboratory sample reception logs	USGS/NWDLS	7 years	Paper
Laboratory QA manuals	USGS/NWDLS	≥10 years	Paper/Electronic
Laboratory SOPs	USGS/NWDLS	≥10 years	Paper/Electronic
Laboratory internal/external standards	USGS/NWDLS	7 years	Paper
Laboratory instrument performance	USGS/NWDLS	7 years	Paper
Laboratory initial demonstration of capability	USGS/NWDLS	7 years	Paper
Laboratory procedures	USGS/NWDLS	≥10 years	Paper/Electronic
Instrument raw data files	USGS/NWDLS	7 years	Electronic
Instrument readings/printouts	USGS/NWDLS	7 years	Paper
Laboratory data reports	USGS/NWDLS	10 years	Electronic/Paper
Laboratory data verification for integrity, precision, accuracy and validation	USGS/NWDLS	7 years	Paper
Laboratory equipment maintenance logs	USGS/NWDLS	7 years	Paper
Laboratory calibration records	USGS/NWDLS	7 years	Electronic
Laboratory corrective action documentation	USGS/NWDLS	7 years	Paper
USGS data base verification	USGS	7 years	Electronic
Quality control verification/validation	GTRI/USGS	7 years	Paper
Progress report/final report/data	GTRI	7 years	Paper/Electronic
Training records	GTRI/USGS	≥10 years	Paper/Electronic
Corrective Action Documentation	GTRI/USGS	7 years	Paper/Electronic
All Backup Information	GTRI	1 year	Electronic

The TSSWCB may elect to take possession of documents/records as stated in Table A9.1 at the conclusion of the specified retention period.

Laboratory Test Reports

Data reports from the laboratory will report the test results clearly and accurately. The test report will include the information necessary for the interpretation and validation of data and will include the following:

- title of report and unique identifiers on each page
- name and address of the laboratory
- name and address of the client
- a clear identification of the sample(s) analyzed
- identification of samples that did not meet QA requirements and why (e.g., holding times exceeded)
- date and time of sample receipt

- identification of method used
- sample results
- field split results (as applicable)
- clearly identified subcontract laboratory results (as applicable)
- a name and title of person accepting responsibility for the report
- quality control results to include LCS sample results (% recovery), LCS duplicate results (%RPD), equipment, trip, and field blank results (as applicable), and RL confirmation (% recovery)
- notification of QC failures or deviations from requirements that may affect the quality of results as necessary for verification and validation of data.

Two laboratories perform analyses for this study. The USGS NWQL performs all chemical analyses of water. At the NWQL, project-specific LCS sample results are provided with organics, but inorganic LCS sample results are handled somewhat differently. These results are compared to established criteria. Relevant LCS data are entered into control charts.

Test/data reports from the laboratory must document the test results clearly and accurately. Routine data reports should be consistent with the NELAP standards (Section 5.5.10) and include the information necessary for the interpretation and validation of data. The requirements for reporting data and the procedures are provided.

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. If the entire QAPP is current and valid, the document may be reissued by certifying that the plan is current and including a new copy of the signed approval page. The approved version of the QAPP shall remain in effect until revised versions have been approved only if the revised version is submitted for approval before the approved version expires. If the entire QAPP is current, valid, and accurately reflects the project goals and the organization's policy, the annual re-issuance may be done by a certification that the plan is current. This will be accomplished by submitting a cover letter stating the status of the QAPP and a copy of new, signed approval pages for the QAPP.

QAPP Amendments
Amendments to the QAPP should be approved prior to implementation in order to reflect changes in project organization, tasks, schedules, objectives and methods, to address deficiencies and non-conformance, improve operational efficiency and to accommodate unique or unanticipated circumstances. Requests for amendments are directed from the GTRI PM to the TSSWCB PM in writing. They are effective immediately upon approval by the TSSWCB PM and QAO, or their designees, and the EPA Project Officer.

Justifications, summaries, and details of the amendment will be documented and distributed to all persons on the QAPP distribution list under the direction of the GTRI PM. Amendments will be reviewed, approved, and incorporated into the next revision of the QAPP.

B1 SAMPLING PROCESS DESIGN

Sample Design Rationale
The sample design rationale is based on the intent of the study to characterize water quality in the East and West Forks of the Double Bayou watershed through systematic monitoring. Measurement of water-quality parameters and constituents to describe stream quality will be used to investigate natural conditions (including low dissolved oxygen) as well as potential impact from anthropogenic stresses.

All samples will be collected with methods as established in TCEQ SWQM Procedures Manual (2012) and will be completed by the USGS. Water discharge measurements will be obtained from multiple depths at the time of sampling.

Site Selection Criteria
A total of four sites were selected for this project; two sites on the West Fork Double Bayou with one of those sites being located in an area of tidal influence, and two sites located on the East Fork Double Bayou with one of those sites being located in an area of tidal influence and the other site being located in the northern most part of the watershed. The locations of all sites were determined after the preliminary land-use characterization study was completed by GTRI to optimize sampling efforts for both bayous. The sites were all used for sampling efforts in the development of the Double Bayou Watershed Protection Plan. The Double Bayou watershed is a smaller watershed at only 98 square miles. Balancing the limitations faced by scope of project with the desire to monitor everything, everywhere, all the time, it was determined that 4 sites plus one WWTF effluent site would best strike the required balance. The sample design rationale focused on the upstream/downstream approach and was developed with the idea that information can be extended from a few sites to a general representation of the watershed's response as a whole.

This data collection effort involves systematic monitoring of hydrologic conditions and stream quality at four sites in the East and West Forks of Double Bayou. To this end, some general guidelines were followed when selecting sample sites, as identified below. Overall consideration is given to accessibility and safety. All monitoring activities have been developed with coordination with GTRI and with the TSSWCB.

1. Monitoring sites are representative of in-stream water quality and hydrology during the study period. Where possible, sites are representative of typical land use.
2. Monitoring sites are spaced throughout the watershed to allow assessment of progressive changes in water quality along the entire reach of the stream. Sites that have historical water-quality or biological data were considered in order to provide continuity and a longer period-of-record for comparisons.
3. Location of sites attempt to bracket the effects of point sources on water quality and aquatic biota. Specifically, site selection places one site upstream and one site downstream of a Wastewater Treatment Facilities (WWTF).
4. Monitoring sites were chosen based on accessibility and safety. When possible, sites were

selected where it is possible to collect flow measurements and water samples during the entire range of hydrologic conditions.

Sampling Regime

USGS will conduct routine ambient monitoring (RT) at 4 mainstem sites. Each monitoring event will include field, conventional, flow and bacteria parameter groups. The sampling period extends over 24 months. Spatial and seasonal variation will be captured in these snapshots of watershed water quality. Currently, routine ambient monitoring is conducted once per quarter year at one station by TCEQ (10657; field, conventional, and bacteria parameters only) and at two stations by the Trinity River Authority (18361, 10658; field and conventional parameters only) through the Clean Rivers Program. Sampling through this subtask will complement existing routine ambient monitoring regimes.

Field parameters are pH, temperature, specific conductance, turbidity and dissolved oxygen. Conventional parameters are suspended solids, sulfate, chloride, nitrite+nitrate nitrogen, ammonia nitrogen, total kjeldahl nitrogen, orthophosphorus, and total phosphorus. Bacteria parameters are E. coli and Enterococcus (for both tidal and above tidal sites). Flow parameters are quantitative flow collected by gage, electric, mechanical or Doppler, including severity. USGS will conduct biased-flow monitoring (BF) at 4 mainstem sites during 2 storm events over the total sampling period, collecting field, conventional, flow and bacteria parameter groups. Sampling period extends over 24 months.

USGS will conduct effluent monitoring at 1 WWTF once per quarter, collecting field, conventional, flow, bacteria, and effluent parameter groups. The sampling period extends over 24 months. WWTF data will only be used to estimate bacteria loadings from wastewater discharges and to assist TPDES permittees in improving management and operations.

USGS will conduct 24-hour DO monitoring at two times during the sampling period collecting field parameter groups. Sampling frequency will follow the Index and Critical period requirements described in TCEQ's Surface Water Quality Monitoring Procedures, Volume 1:Physical and Chemical Monitoring Methods. Two 24-hour DO sampling events will occur during the index period representing warm-weather seasons of the year, March 15–October 15. Of these two, at least one will occur during the critical period (July 1–September 30). Approximately one month will separate each 24-hour sampling event.

All samples (tidal samples will follow correct methods where indicated[7]) will be sent to the USGS National Water Quality Laboratory (NWQL) in Denver, CO for analysis except where indicated.

a. Bacteria – NWDLS
b. Nutrients (includes Nitrogen and Phosphorus)
c. Chloride
d. Sulfate
e. Total Suspended Solids

Through TSSWCB project 05-02 *FY05 Statewide NPS Pollution Management Project*, USGS installed and is operating an Index Velocity Site Gage on the West Fork of Double Bayou at Eagle Ferry Road near Anahuac, TX (USGS 08042558). Through this project, USGS will provide operation and maintenance for this real-time streamflow gage. Continuous sampling extends over 36 months.

Table B1.1 - Sampling regime with site locations and number of samples of each type.*

TCEQ Station ID	Site Description	Work plan Task	Monitor Type	Flow	Field Parameters	Conventional	Bacteria
10657	W. FK Double Bayou at Eagle Ferry Rd. nr Anahuac, TX	3	RT	14	14	14	14
18361	W. Fk Double Bayou at FM 2936 nr Anahuac, TX	3	RT	14	14	14	14
21305	E. Fk Double Bayou at Carrington Rd	3	RT	14	14	14	14
21306	E. Fk Double Bayou at FM 1663	3	RT	14	14	14	14
21307	Anahuac WWTP outflow***	3	RT	-	8	8	8
10657	W. FK Double Bayou at Eagle Ferry Rd. nr Anahuac, TX	3	BF**	2	2	2	2
18361	W. Fk Double Bayou at FM 2936 nr Anahuac, TX	3	BF	2	2	2	2
21305	E. Fk Double Bayou at Carrington Rd	3	BF	2	2	2	2
21306	E. Fk Double Bayou at FM 1663	3	BF	2	2	2	2
21307	Anahuac WWTP outflow***	3	BF	-	2	2	2

*Note that 24-hr sampling will be a total of two deployments; sites for the 24-hour sampling will be chosen from the four mainstem sites and determined based on initial water quality sampling results. The 24-hr sampling is covered under Work plan Task 3 and will include one 24-hour multi-parameter sonde deployment measuring 23 field parameters during the TCEQ Index Period (total of two deployments).

**Note that BF sampling numbers per location may have to be altered if a storm event compromises the safety of sampling at a site location.

*** The data collected from the Anahuac WWTP Outflow station will not be submitted for entry into SWQMIS.

B2 SAMPLING METHODS

Field Monitoring and Conventional Water-Quality Sampling Procedures
Field monitoring and conventional water-quality sample collection will be conducted using sampling procedures consistent with those documented in the TCEQ *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2012.(RG-415)* and *Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data (RG-416)*. Stream depth at the sampling section, as well as depth from which the sample is collected, will be documented on the field form. Appropriate QA/QC samples will be collected, in particular, field splits that will comprise a minimum of 10% of the samples. All samples will be immediately preserved and chilled upon collection, and maintained at the appropriate temperature until submitted to the respective laboratories for analysis. Container types, expected sample volumes, preservation requirements, and holding time requirements are specified in Table B2.1.

Hydrologic Monitoring
Hydrologic monitoring will be conducted using standard methods documented by the USGS (Rantz, 1982). These data will include instantaneous discharge measurements that accompany each sampling visit.

Sample Containers
Sample containers are specified in their respective method documentation as provided in Table B2.1, and can be found at the USGS NWQL web site at: http://wwwnwql.cr.usgs.gov/qas/Containers%20at%20NWQL.pdf. The QA procedures for these bottles are located at: http://wwwnwql.cr.usgs.gov/qas/QASPProceduresbyNFSSNumber.pdf sorted by National Field Supplies Services stock number and their certificates of analysis are located at: http://wwwnwql.cr.usgs.gov/qas.shtml?bottles_home.

Bottles used for indicator bacteria (*E. coli* and Enterococcus will be provided by NWDLS.

Sample bottles for all other chemical and biological analyses are obtained from the USGS National Water-Quality Laboratory (NWQL), located in Denver, CO. A representative number of sample containers are checked by the NWQL to ensure that they are acceptable for collection of water-quality samples.

Table B2.1 - Min. Sample Vol., Container Types, and Preservation & Holding Requirements

Parameter	Matrix	Container	Preservation	Sample Mass Required for Analysis	Holding Time
E. Coli**	Water	Autoclaved, amber glass bottle, thiosulfate	Ice to 4ºC	250 mL	8 hours
Enterococcus	Water	Autoclaved, amber glass bottle, thiosulfate	Ice to 4ºC	250 mL	8 hours
TSS	Water	250 mL polyethylene bottle	Ice to 4ºC	250 mL	180 days
NO_3-N + NO_2-N (filtered)	Water	125-mL brown polyethylene bottle	Ice to 4ºC	125 mL	28 days*
O-PO_4 (field filtered < 15 min.)	Water	125-mL brown polyethylene bottle	Ice to 4ºC	125 mL	28 days*
NH_3 (filtered)	Water	125-mL brown polyethylene bottle	Ice to 4ºC	125 mL	28 days*
NH_3 (unfiltered)	Water	125-mL clear polyethylene bottle	Ice to 4ºC, 1 mL of 4.5N H_2SO_4	100 mL	28 days*
Phosphorous	Water	125-mL clear polyethylene bottle	Ice to 4ºC, 1 mL of 4.5N H_2SO_4	100 mL	28 days*
TKN	Water	125-mL clear polyethylene bottle	Ice to 4ºC, 1 mL of 4.5N H_2SO_4	100 mL	28 days*
Chloride	Water	250 mL polyethylene bottle	Ice to 4ºC	50 mL	28 days
Sulfate	Water	250 mL polyethylene bottle	Ice to 4ºC	50 mL	28 days

* The USGS NWQL has a 28-day holding time for all nutrients. Documentation that differences in analytical results from samples that were analyzed within 48 hours and samples analyzed at intervals up to 30 days were not statistically significant when the sample was filtered and treated with sulfuric acid. Documentation can be accessed at: http://nwql.usgs.gov/Public/pubs/WRIR98-4118-new.pdf

** *E.coli* samples analyzed by SM 9223-B should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 6 hours, the holding time may be extended and samples must be processed as soon as possible and within 24 hours; if held over 8 hours the data would be flagged as such.

Processes to Prevent Cross-Contamination
Procedures to prevent contamination of samples as outlined in the TCEQ SWQM Procedures (2012) will be followed. Preservation procedures for nutrients, chloride, sulfate, TDS and "suspended sediment concentration" are based on USGS methods set forth in "USGS National field manual for the collection of water-quality data[11]" which is available online at: http://pubs.water.usgs.gov/twri9A. Field QC samples, as discussed in Section B5, are collected to verify that contamination of samples during collection or processing has not occurred.

Documentation of Field Sampling Activities
Documentation of USGS field activities and water-quality sample collection will be conducted as described in the TCEQ SWQM Procedures (2008) and the USGS National Field Manual (variously dated[11]).

Field sampling activities are documented on field data sheets as presented in Appendix A1. The following will be recorded for all site 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:
    - Water appearance
    - Weather
    - Biological activity
    - Unusual odors
    - 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.)
    - Watershed or in-stream activities (events impacting water quality (e.g., bridge construction, livestock watering upstream, etc.)
    - Missing parameters (i.e., when a scheduled parameter or group of parameters is not collected)

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

1. Legible writing in indelible ink with no modifications, write-overs or cross-outs;
2. Correction of errors with a single line followed by initials and the date;
3. Close-out all incomplete pages using a diagonal line with initials and the date.

Deficiencies, Nonconformances and Corrective Action Related to Sampling Requirements

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP or other applicable documents. Nonconformances are deficiencies which affect data quantity and/or 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 sampling site adjustments.

Deficiencies are documented in logbooks, on field data sheets, etc. by field or laboratory staff and reported to the correct field or laboratory supervisor or USGS Project Chief who will notify the QAO. The USGS QAO will initiate a Corrective Action Report (CAR) to document the deficiency if needed (Appendix C).

GTRI, USGS Project Chief, and USGS QAO 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 CAR will be completed accordingly and the CAR closed. If it is determined a nonconformance does exist, GTRI and the USGS Project Chief will determine the disposition of the nonconforming activity or item and necessary corrective actions(s); results of the disposition (completed Corrective Action Report) will be maintained by the USGS QAO.

Corrective Action Reports (CARs) document: root cause(s); 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 SAMPLE HANDLING AND CUSTODY

Chain-of-Custody
USGS sample handling and custody procedures will follow those outlined by Shelton (1994[10]). The purpose of sample custody is to document and maintain the integrity of all samples during collection, transportation, analysis, and reporting of analytical results.

A sample is considered to be "in custody" if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The Chain-of-Custody (COC) form is used to document sample handling during transfer from the field to the laboratory and among subcontract laboratories.

Immediately after collection and until shipment, samples are in the custody of USGS personnel. Samples are returned to the USGS Houston Water Science Center where they are processed and packed for shipment. The USGS Houston facility is secured and only accessed by a key card. Samples are usually shipped via Fed Ex the same day as collection. When this is not possible, samples are maintained at appropriate holding temperatures. Information including site ID, date and time of sampling, sampling method, and field parameters are entered into the USGS water-quality database (QWDATA), at which time a unique record number is assigned to the site visit. Water-quality samples are shipped to NWQL packed in ice in sealed containers. The NWQL is a secured laboratory on the US Federal Center in Denver, Colorado. Access to the Federal Center is controlled by guards; access to the NWQL is by key card only.

All samples are sent with Analytical Services Request (ASR) forms, which also serve as a COC. The ASR form is provided in Appendix A1 and includes the following information:

1. Date and time of collection
2. Site identification
3. Sample medium (water)
4. Number of containers
5. Preservative used or if the sample was filtered
6. Analyses required – Lab Schedule or Lab Code
7. Name of collector
8. Date of sample shipment and person who shipped sample(s)
9. Name of laboratory admitting the sample

Upon arrival, email is sent to the USGS Project Chief, documenting sample receipt and condition. This notification is maintained as part of the project records.

NWDLS laboratory's COC form is provided in Appendix B.

Sample Labeling
Pre-printed, waterproof labels that are adhesive backed and capable of being attached directly to the sample container are used. An indelible marker is used to write all information. Label information includes:

1. Station Identification Number
2. Station Name
3. Date and Time (of sample collection)
4. Sample Type (i.e., analysis to be performed)
5. Sample processing or preservation

Sample Handling
Upon collection, samples are immediately put in coolers containing ice. All samples, with the exception of suspended sediment, are maintained at 4^{o}C until analysis.

USGS sample handling and custody procedures follow NWQL Technical Memoranda. Samples and their containers are kept under the surveillance of the sampling team or in a secure storage area until transfer to the shipper's agent. The sample containers are sealed prior to delivery to the shipper. The shipper (Fed Ex) logs samples into a tracking system when taking custody. At the receiving laboratory, the laboratory carefully examines the sample container to ensure that it is intact before the shipper is released from custody of the samples.

Sample handling procedures at the NWQL are described in the NWQL QMS plan (Maloney, 2005[9]). When received at the NWQL, samples are removed from coolers, examined, sample temperature is verified, matched with the record created in Houston, logged into the Laboratory Information Management System (LIMS) database at the laboratory, labeled with a unique bar code number, and transferred to refrigerators until analysis.

All samples are sent with Analytical Services Request (ASR) forms to NWQL, which also serve as USGS COCs.

NWDLS sample handling will follow procedures as described in NWDLS AD004, Rev. 1.

Deficiencies, Nonconformances and Corrective Action Related to Chain-of-Custody
Deficiencies are defined as unauthorized deviation form procedures documented in the QAPP. Nonconformances are deficiencies which affect quality and render the data unacceptable or indeterminate. All deficiencies associated with chain-of-custody procedures as described by this QAPP are immediately reported to the USGS Project Chief. These include such items as, delays in transfer, resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples etc.

Deficiencies are documented in logbooks and field data sheets by field or laboratory staff and reported to the pertinent field or laboratory supervisor who will notify the USGS Project Chief.

The USGS Project Chief will notify the USGS QAO of the potential nonconformance. The USGS QAO will initiate the CAR to document the deficiency.

The USGS QAO, in consultation with the USGS Project Chief (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 CAR will be completed accordingly and closed. If it is determined that a nonconformance does exist, the USGS Project Chief in consultation with USGS QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by completion of a CAR, which is retained by the USGS QAO.

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. The TSSWCB will be notified of inconsistencies that affect data quality with quarterly progress reports. In addition, significant conditions (i.e., situations that, if uncorrected, could have a serious effect on safety or validity or integrity of data) will be reported to TSSWCB immediately.

B4 ANALYTICAL METHODS

The analytical methods, associated matrices, and performing laboratories are listed in Table A7.1. All analyses cited in the Table A7.1 that are performed by the USGS laboratory are approved methods that are either published by the U.S. Environmental Protection Agency (designated "EPA"), the American Society for Testing and Materials Annual Book of ASTM Standards (designated "ASTM"), in Standard Methods for the Examination of Water and Wastewater (American Public Health Association, 1998)[3] (designated "SM"), or in USGS Techniques of Water-Resources Investigations Reports, Open-File Reports, and Methods and Techniques. References for specific analytical methods are provided as footnotes to Table A7.1.

At a minimum, laboratories producing data under this QAPP are compliant with ISO/IEC Standard 17025. NWDLS and the USGS NWQL policies and procedures are in compliance with the National Environmental Laboratory Accreditation Program (NELAP) standards of 2003. Documentation of NWQL policies and procedures is found in the NWQL QMS plan (Maloney, 2005[9]).

The TCEQ has determined that analyses associated with the remark codes "holding time exceedance" or "sample received unpreserved" or "estimated value," etc. may have unacceptable measurement uncertainty associated with them. This will immediately disqualify analyses from submittal. Therefore, data with these types of problems should not be reported.

Standards Traceability
All standards used in the field and laboratory are traceable to certified reference materials. Standards preparation is fully documented, maintained, and are available online at http://wwwnwql.cr.usgs.gov/qas/QASP.pdf. Each documentation includes information concerning the standard identification, starting materials, including concentration, amount used and lot number; date prepared, expiration date and preparer's initials/signature. The reagent bottle is labeled in a way that will trace the reagent back to preparation.

Deficiencies, Nonconformances and Corrective Action Related to Analytical Methods
Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP or other applicable documents. Nonconformances are deficiencies which affect quantity and/or quality and render the data unacceptable or indeterminate. Deficiencies in field and laboratory measurement systems involve, but are not limited to such things as instrument malfunctions, failures in calibration, blank contamination, quality control samples outside QAPP-defined limits, etc.

Deficiencies are documented in logbooks and field data sheets by field or laboratory staff and reported to the pertinent field or laboratory supervisor who will notify the USGS Project Chief. The USGS Project Chief will notify the USGS QAO of the potential nonconformance. The USGS QAO will initiate the CAR to document the deficiency.

The USGS QAO, in consultation with the USGS Project Chief (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 CAR will be completed accordingly and closed. If it is determined that a nonconformance does exist, the USGS Project Chief in consultation with USGS QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by completion of a CAR, which is retained by the USGS QAO.

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. The TSSWCB will be notified of inconsistencies that affect data quality with quarterly progress reports. In addition, significant conditions (i.e., situations that, if uncorrected, could have a serious effect on safety or validity or integrity of data) will be reported to TSSWCB immediately.

B5 QUALITY CONTROL

Sampling Quality Control Requirements and Acceptability Criteria
Field quality-control samples are submitted as separate samples to the laboratory and reported accordingly, on the data reports. Table B5.1 lists QC samples for water chemistry that will be collected as part of this project.

Table B5.1 - Number and type of field quality-control samples[1]

Constituent	Number of Analyses	Method Blank	Field Blank	Field Split
E. coli	66	0	2	4
Enterococcus	66	0	2	4
TSS	66	1	2	4
Nutrients	66	1	2	4
Chloride	66	1	2	4
Sulfate	66	1	2	4

Equipment Blanks
An equipment blank tests the amount of potential contamination to water samples from equipment used to collect or process the samples. It consists of a sample of reagent water that is poured into or over a sampling device, compositing container, or filtering apparatus. Thequipment blank is collected in the same type of container as the environmental sample, preserved in the same manner and analyzed for the same parameter. The analysis of equipment blanks should yield values lower than the reporting limit, or, when target analyte concentrations are very high, blank values must be less than 5% of the lowest value of the batch, or corrective action will be implemented.

Field Blanks
Field blanks are required for water samples when collected without sample equipment (i.e., as grab samples). A field blank consists of deionized water that is taken to the field and poured into the sample container. Field blanks are not routinely required but are used to assess the contamination from field sources such as airborne materials, containers, and preservatives. The analysis of field blanks should yield values lower than the reporting limit. When target analyte concentrations are high, blank values should be less than 5% of the lowest value of the batch. Field blanks will be collected during the study to provide this information."

Field Split

[1] For chemical analyses, one equipment blank is run at the beginning of the study. If any of the analytes are above acceptable levels, appropriate measures are taken to identify the possible source(s) of the contaminants. Once these measures have been undertaken, an additional equipment blank is processed and analyzed to test their effectiveness. For biological and bacteriological analyses, periodic equipment blanks test for organic growth in the deionized water system.

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 apply to conventional samples only and are collected at a minimum frequency of 10%. The precision of field split results is calculated by relative percent difference (RPD) using the following equation:

$$RPD = (X1-X2)/((X1+X2)/2))*100$$

A 30% RPD criteria will be used to screen field split results as a possible indicator of excessive variability in the collection and analytical system. If it is determined that meaningful quantities of constituent (i.e., >AWRL) were measured and analytical variability can be eliminated as a factor, than variability in field split results will primarily be used as a trigger for discussion with field staff to ensure samples are being handled in the field correctly. Some sample results or batches of samples may be invalidated based on the examination of all extenuating information. Professional judgment during data validation will be relied upon to interpret the results and take appropriate action. The qualification (i.e., invalidation) of data will be documented on the Data Summary. Deficiencies will be addressed as specified in this section under Deficiencies, Nonconformances, and Correction Action related to Quality Control.If the RPD of the field splits exceeds 30%, the Project Chief will identify possible sources of error and corrective measures will be taken before the next sampling event.

Laboratory Measurement Quality Control Requirements and Acceptability
Analyses for chemical constituents will be performed by USGS laboratories. Because of very short holding times, bacteriological, will be performed by NWDLS Environmental Laboratory. A summary of quality control measures at the NWQL, including participation in laboratory evaluation programs, is provided in the NWQL Quality Management System manual (Maloney, 2005[9]).

Detailed laboratory QC requirements and corrective action procedures are contained within the individual laboratory quality assurance manuals (QAMs). The minimum requirements that all participants abide by are stated below. Lab QC sample results are submitted with the data report (see Section C2).

Laboratory Control Standard (LCS)
A LCS consists of a sample matrix (e.g. deionized water) free from the analyte(s) of interest spiked with verified known amounts of analyte(s). The LCS is spiked into the sample matrix at a level less than or near the mid-point of the calibration curve for each analyte. In cases of test methods with very long lists of analytes, LCSs are prepared with all the target analytes and not just a representative number.

The LCS is carried through the complete preparation and analytical process. The LCS is used to document the bias of the analytical process. The number of LCS samples can vary and is either

specified in the method or SOP. An LCS is analyzed at a minimum of one per batch of environmental samples. A batch is defined as a set of environmental samples that are prepared and/or analyzed together within the same process using the same lot of reagents.

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

The following formula is used to calculate percent recovery of LCS analyses, where %R is percent recovery; SR is the measured result; SA is the spike added:

$$\%R = SR/SA * 100$$

Analyte concentration must be within the calibration range of the methods where possible. An LCS that is determined to be within the acceptance criteria effectively establishes that the analytical system is in control and validates system performance for the samples in the associated batch. Samples analyzed along with an LCS determined to be "out of acceptance limit" are reprocessed and reanalyzed, or the data are reported with appropriate data-qualifying codes.

Performance limits and control charts are used to determine the acceptability of LCS analyses. Project control limits are specified in Table A7.1.

AWRL/Reporting Limit Verification

The laboratory reporting limit for each parameter will be at or below the AWRL. To demonstrate the ongoing ability to recover at the reporting limit, the laboratory will analyze a calibration standard (if applicable) at or below the reporting limit on each day USGS samples are analyzed. Two acceptance criteria will be met or corrective action will be implemented. First, calibrations including the standard at the reporting limit will meet the calibration requirements of the analytical method. Second, the instrument response (e.g., absorbance, peak area, etc.) for the standard at the reporting limit will be treated as a response for a sample by use of the calibration equation (e.g., regression curve, etc.) in calculating an apparent concentration of the standard. The calculated and reference concentrations for the standard will then be used to calculate percent recovery (%R) at the reporting limit using the equation:

$$\%R = CR/SCA * 100$$

where CR is the calculated result and SCA is reference concentration for the standard. Recoveries must be within 75-125% of the reference concentration.

When daily calibration is not required (e.g., EPA Method 624), or a method does not use a calibration curve to calculate results, the laboratory will analyze a check standard at the reporting limit on each day USGS samples are analyzed. The check standard does not have to be taken through sample preparation, but must be recovered within 75-125% of the reference concentration for the standard. The percent recovery of the check standard is calculated using the following equation in which %R is percent recovery, SCR is the sample result, and SCA is the reference concentration for the check standard:

$$\%R = SCR/SCA * 100$$

If the calibration (when applicable) or the recovery of the calibration or control standard is not acceptable, corrective actions (e.g., re-calibration) will be taken to meet the specifications before proceeding with analyses of USGS samples.

The NWQL uses Continuing Calibration Verification (CCV) standards as calibration checks. These standards are run at or below the AWRL for each inorganic constituent, on each day. Therefore, this information will be compiled for those days when USGS samples are analyzed and provided to the Project Chief.

Laboratory Duplicates
A laboratory duplicate is prepared in the laboratory by splitting aliquots of an LCS. Both samples are carried through the entire preparation and analytical process. LCS duplicates are used to assess precision and are performed at a rate of one per batch.

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

$$RPD = (X_1 - X_2)/\{(X_1+X_2)/2\} * 100$$

A bacteriological duplicate is considered to be a special type of laboratory duplicate and applies when bacteriological samples are run in the field as well as in the lab. 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.

Performance limits and control charts are used to determine the acceptability of duplicate analyses. Project control limits are specified in Table A7.1. The specifications for bacteriological duplicates in Table A7.1 apply to samples with concentrations >10 colonies/100mL.

Laboratory equipment blank
The NWQL prepares blank water for internal use. This is done using the in-house deionized water followed by a final ultrapure deionizing and polishing that results in ASTM Type I reagent water. Certificates of analyses and NWQL documentation of blank water is available from the laboratory web site. Blanks are included as an integral part of each set of sample analyses, in conjunction with both spikes and environmental samples. The sequence ensures that instrumentation is appropriately purged between samples. The analysis of laboratory equipment blanks should yield values less than the reporting limit. Otherwise the equipment will not be used.

Method (Equipment) Blank
A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in the sample processing and analyzed with each batch. The method blank is carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination from the analytical process. The analysis of method blanks should yield values less than the reporting level. For very high-level analyses, blank value should be less than 5% of the lowest value of the batch, or corrective action will be implemented.

Additional method specific QC requirements
Additional QC samples are run (e.g., surrogates, internal standards, continuing calibration samples, interference check samples) as specified in the methods. The requirements for these samples, their acceptance criteria, and corrective actions are method-specific.

Deficiencies, Nonconformances and Corrective Action Related to Quality Control
Deficiencies related to laboratory measurement systems include, but are not limited to, instrument malfunctions, blank contamination, quality-control sample failures, etc. Procedures the NWQL uses to ensure data quality and corrective actions are described in the NWQL Quality Management System report, Sections 2.6-2.8 (Maloney, 2005[9]). Corrective actions at the NWQL are outlined in laboratory Quality Management System manual (Maloney, 2005[9]).

Sampling QC excursions are evaluated by the USGS PM, in consultation with the USGS QAS. In that differences in field duplicate sample results are used to assess the sampling process, including environmental variability, the automatic rejection of results based on control chart limits is not practical. Therefore, some professional judgment will be relied upon in evaluating results. Rejecting sample results based on wide variability is a possibility. Blank data are scrutinized very closely. Blank values exceeding the acceptability criteria may automatically invalidate the sample, especially in cases where high blank values maybe indicative of contamination which may be causal in putting a value above the standard. Incidences of field duplicate excursions and blank contamination are noted in the quarterly report.

Deficiencies are documented in logbooks and field data sheets by field or laboratory staff and reported to the pertinent field or laboratory supervisor who will notify the USGS Project Chief. The USGS Project Chief will notify the USGS QAO of the potential nonconformance. The USGS QAO will initiate the CAR to document the deficiency.

The USGS QAO, in consultation with the USGS Project Chief (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 CAR will be completed accordingly and closed. If it is determined that a nonconformance does exist, the USGS Project Chief in consultation with USGS QAO will determine the disposition of the nonconforming activity or item and necessary corrective

action(s); results will be documented by completion of a CAR, which is retained by the USGS QAO.

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. The TSSWCB will be notified of inconsistencies that affect data quality with quarterly progress reports. In addition, significant conditions (i.e., situations that, if uncorrected, could have a serious effect on safety or validity or integrity of data) will be reported to TSSWCB immediately.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

All sampling equipment testing and maintenance requirements are detailed in the TCEQ Surface Water Quality Monitoring Procedures Volumes 1 and 2. Sampling equipment is inspected and tested upon receipt and is assured appropriate for use. Equipment records are kept on all field equipment and a supply of critical spare parts is maintained.

http://water.usgs.gov/owq/FieldManual/

http://fisp.wes.army.mil/Reports-Index.htm

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

B7 INSTRUMENT CALIBRATION AND FREQUENCY

A pre-calibration of water-quality meters will take place at the beginning of sampling each day. Post-calibration will be done at the conclusion of sampling on the same day. Both pre- and post-calibration documentation will be photocopied and included with the field form for each site sampled during that day. Post-calibration error limits and the disposition resulting from error are adhered to. Data not meeting post-error limit requirements invalidate associated data collected subsequent to the pre-calibration and are not submitted to the TSSWCB. Field equipment calibration requirements are described in the TCEQ Surface Water Quality Monitoring Procedures.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

All laboratory-related items will be inspected and accepted for use in this project by the laboratories. Acceptance criteria for such supplies and consumables, in order to satisfy the technical and quality objectives of this project, are documented in the individual laboratories QMs.

B9 NON-DIRECT MEASUREMENTS

The baseline data set employed in this project is non-direct in that they will be obtained from the agencies or organizations that made the direct measurements. Every monitoring program differs in the quantity and quality of procedural documentation, metadata, and Quality Assurance/Quality Control (QA/QC) practices. All data will be accepted from the sources, but will be subject to a validation process. Sources may include, depending on availability of data during project period, the TCEQ SWQMIS database, the National Weather Service, Trinity Bay Conservation District, USGS, Texas Department of State Health Services, EPA, and the Houston-Galveston Area Council (H-GAC). Limitations will be noted in the final report and in all web-based deliverables.

The project will make qualitative statements describing data confidence based on the existence and availability of the following documentation:

- Approved QAPP
- Established QA/QC procedures
- Agency-specific procedural documentation
- Metadata in a standard format

Data sets will fall under one of three qualitative confidence levels: HIGH, MODERATE, and LOW. It should be noted that agency data will not automatically fall in the HIGH level of confidence range, just as volunteer monitoring data will not necessarily be placed within the LOW confidence range. The confidence level will be determined based on the availability of the above documentation. Depending on the availability of that documentation, it is very possible that volunteer monitoring data could be classified as being MODERATE or even HIGH, just as the lack of that documentation could cause agency data to fall within the MODERATE or LOW confidence ranges.

Data will be designated as having a HIGH level of confidence if three to four of the following items exist and are made available:

- An approved QAPP
- Established QA/QC procedures
- Agency-specific procedural documentation
- Metadata in a standard format

Data will be designated as having a MODERATE level of confidence if two of the following items exist and are made available:

- An approved QAPP
- Established QA/QC procedures
- Agency-specific procedural documentation
- Metadata in a standard format

Data will be designated as having a LOW level of confidence if one or fewer of the following items exist and are made available:

- An approved QAPP
- Established QA/QC procedures
- Agency-specific procedural documentation
- Metadata in a standard format

B10 DATA MANAGEMENT

Data Management Process

For data processing and management, the introduction of errors and loss of data will be managed through procedures for record keeping and auditing. Documentation will describe project personnel that made changes and the time at which the changes were made. Every time a file is changed it is saved in a new version and the old version will be archived. New file names and locations will be recorded in the database documentation. Archival files will be deleted when the data updates are received from the responsible agency and the data processing cycle starts over. Periodic comparisons between recent and early versions will be used to detect problems and quality assurance training will be implemented if problems are detected.

For data monitoring and acquisition, all field forms used as part of this study are in Appendix A1.

Review procedures at the NWQL are discussed in the laboratory QMS manual (Maloney, 2005[9]). Analytical results from the NWQL (nutrients, TSS, chloride, sulfate,) are electronically transferred to the USGS NWIS database. In addition, a copy of the analytical results is sent electronically to a directory accessible from the USGS Houston Water Science Center. Each week, personnel from Houston retrieve analytical data from the directory for review by the Project Chief. Standard data checks include ion balance and comparison with historical data from that site. If any anomalies are found during review, the NWQL is notified for re-loads or clarification, if necessary. Analytical results from NWDLS are manually entered into the USGS NWIS database by project personnel. Data from field sheets used to record hydrologic data (discharge, stage) are checked and manually entered into the USGS NWIS database. Similarly, water-quality parameters that are determined during site visits (water temperature, specific conductance, dissolved oxygen, pH, etc.) are verified in the office and entered into the USGS NWIS database. All data entries are ultimately reviewed for accuracy by the Project Chief.

Continuous (24-hour) monitor data (water temperature, specific conductance, dissolved oxygen, pH) are determined at each sampling station of East and West Fork Double Bayou during 24 events. The multi-probe data are recorded electronically by a data logger. Calibration of the monitor is checked and recorded both when it is deployed, and when it is removed from the field. Data are reviewed by the USGS Project Chief for final acceptance. If values exceed calibration criteria, they are not provided.

Verified project data will be retrieved from the USGS NWIS database and provided to GTRI in electronic format. GTRI will provide the data to TSSWCB in electronic format. All data will be submitted to the GTRI and TSSWCB using standard methods. If any discrepancies are found in data that are submitted by the USGS, the Project Chief will be alerted and the extent and source of the discrepancy will be determined and corrected before re-submitting the electronic data.

Data Errors and Loss

Data errors or loss will be documented in logbooks and field data sheets by field or laboratory staff and reported to the pertinent field or laboratory supervisor who will notify the USGS Project Chief. If the USGS Project Chief deems the loss significant they will notify the USGS QAO of the potential nonconformance. The USGS QAO will initiate the CAR to document the deficiency.

The USGS QAO, in consultation with the USGS Project Chief (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 CAR will be completed accordingly and closed. If it is determined that a nonconformance does exist, the USGS Project Chief in consultation with USGS QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by completion of a CAR, which is retained by the USGS QAO.

Record Keeping and Data Storage
For data processing and management, this project is built upon the use of computing and electronic communications resources for the transfer, processing and maintenance of data. GTRI staff will manage the project's computing resources currently housed at GTRI. The project staff will coordinate with the GTRI IT Department to ensure that server and network maintenance will minimally interfere with project computing, storage, and network connectivity needs. All data for this project will be backed up to other server locations and to tape prior to any server or network maintenance.

Surface-water and water-quality data will be archived as outlined in the Texas Water Science Center quality-assurance and quality-control plan. Field data will be promptly entered into the NWIS database. Monitor data will be uploaded every time measurements are made. A total of three USGS Hydrologic technicians or Hydrologists will be involved in the record finalization process.

Data Handling, Hardware, and Software Requirements
For data processing and management, three servers with dual processors and high capacity hard drives will be used for this project. All of the other computing resource components will be employed as part of the GTRI computing network. GTRI employs security systems and software to protect the data from virus infection and tampering by unauthorized users. The GTRI IT Department and the Double Bayou Watershed staff work together to administer user rights by means of password protection to limit access to the project's data files. The data servers are equipped with writable CD drive or tape backup and an archival system to provide additional security. The data servers also have emergency power supplies.

The project will use Microsoft software packages for processing and maintaining the data: Microsoft (MS) SQL Server, Access and Excel. ArcView will be used to produce maps. SPSS, S-Plus, and Analyse-It will be used to perform statistical analyses. MS Access and SQL Server will be used as the database maintenance software packages. Web products will be created using

.HTML, .ASP, and .NET languages. Data sets processed for access by personnel not directly involved in data management or analysis will be provided with read-only permission.

For data monitoring and acquisition, analytical results from USGS laboratories will be electronically transferred to the USGS NWIS database. Analytical results from NWDLS will be provided to the USGS in a hardcopy format.

Electronic Data

Data will be submitted electronically to the TCEQ Data Management and Analysis Team for inclusion in SWQMIS and/or project partner for review in the Event/Result file format described in the most current version of the TCEQ Data Management Reference Guide (DMRG). Until the project begins and we know the coordination schedule for sampling, lab turnaround time on each parameter, and data QC checks, an exact schedule for SWQMIS submission cannot be determined; at a minimum, annual submissions will occur. Once the schedule is in place, submissions will occur more often. A completed Data Summary (see example in Appendix D) will be submitted with each data submittal.

Table B10.1 Codes for Data Submittals

Sample Description	Tag Prefix	Submitting Entity	Collecting Entity	Monitoring Type Code
Routine monitoring to establish baseline conditions	*TX*	*TX*	*GS*	*RT*
Biased flow monitoring targets flow condition that must be present in order for the sample collection to occur	*TX*	*TX*	*GS*	*BF*
24-hour DO Monitoring	*TX*	*TX*	*GS*	*BS*

1) RT- Sampling scheduled in advance without intentionally trying to target any certain environmental condition. The sampling seeks to set a baseline for the site. Sample will be collected regardless of the conditions encountered.
2) BF - not precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample collection to occur.

C1 ASSESSMENTS AND RESPONSE ACTIONS

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

Table C1.1 - Assessments and Response Requirements

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	GTRI	Monitoring of the project status and records to ensure requirements are being fulfilled	Report to TSSWCB in Quarterly Progress Report
Monitoring Systems Audit of USGS	Dates to be determined by TSSWCB	TSSWCB	Field sampling, handling and measurement; facility review; and data management as they relate to this project	30 days to respond in writing to the TSSWCB to address corrective actions
Laboratory Inspection	Dates to be determined by TSSWCB	TSSWCB	Analytical and QC procedures employed at the USGS laboratory and the contracted laboratories	30 days to respond in writing to the TSSWCB to address corrective actions

Corrective Action

The GRTI PM is responsible for implementing and tracking corrective action resulting from audit findings outlined in the audit report. Records of audit findings and corrective actions are maintained by both GRTI and TSSWCB. Audit reports and corrective action documentation will be submitted to the TSSWCB in the Quarterly Progress Report.

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

C2 REPORTS TO MANAGEMENT

The results of data audits will be included in quarterly reports to the TSSWCB PM from the GTRI PM. GTRI responses to problems detected by audits will also be summarized in the reports to management. Field water-quality data will be transmitted to the GTRI PM when data are submitted.

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

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

Monitoring Systems Audit Report and Response - GRTI will respond in writing to the TSSWCB within 30 days upon receipt of a monitoring system audit report to address corrective actions. Response written by the GRTI PM.

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

For the purposes of this document, the term verification refers to the data review processes used to determine data completeness, correctness, and compliance with technical specifications contained in applicable documents (i.e., QAPPs, SOPs, QMs, analytical methods). Validation refers to a specific review process that extends the evaluation of a data set beyond method and procedural compliance (i.e., data verification) to determine the quality of a data set specific to its intended use.

All field and laboratory data will be reviewed and verified for integrity and continuity, reasonableness, and conformance to project requirements, and then validated against the project objectives and measurement performance specifications which are listed in Section A7. Only those data which are supported by appropriate quality control data and meet the measurement performance specifications defined for this project will be considered acceptable, and will be reported.

The procedures for verification and validation of data are described in Section D2 below. The USGS Project Chief is responsible for ensuring that field data are properly reviewed, verified, and submitted in the required format to the project database. Laboratory managers are responsible for ensuring that laboratory data are reviewed, verified, and submitted to the USGS Project Chief.

Data validation will be the focus. The GTRI Data Analyst will review all data sets received and validate the values according to the process described below. The sampling and analytical methodology, quality assurance procedures and associated metadata will be obtained, when available, from agency programs contributing data. Data quality will be described (see to Section B9).

If a data error is suspected (e.g. the concentration of a water quality parameter appears to be exceptionally high), the GTRI PI will contact the source agency to verify the data in question. If the data cannot be verified, they will be filtered from the database and not included in analyses. If the data are verified by the source agency, the data will be included in analyses. Regardless of outcome, the action will be noted in the database documentation.

D2 VERIFICATION AND VALIDATION METHODS

For data acquisition, data will be reviewed and validated in a stepwise process to exclude from the analysis all values of questionable sampling location, sampling date, sampling method and value. The first step is to eliminate values that cannot be precisely identified as to the time the sample or information was collected. Values that cannot be precisely located to a latitude and longitude or landmark in the Double Bayou watershed will also be removed. The distribution of values for a particular parameter and method will be reviewed to question the validity of outliers.

Extreme values will be excluded if it is determined that it is physically or biologically impossible for the parameter to arrive at that value. Outliers that pass the test of impossibility, but are still an order of magnitude or one standard deviation greater or less than the next closest value will be referred to the submitting agency for determination of inclusion or exclusion.

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 and verification 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 personnel are listed in the first two sections of Table D2.1, respectively. The data to be verified (Table D2.1) are evaluated against project specifications and are checked for errors, especially errors in transcription, calculations, and data input. Data from original field notes will be compared with electronic data to ensure correctness. Potential outliers are identified by graphical examination for unreasonable data, or identified using computer-based software imbedded in the USGS NWIS database (ADAPS and QWDATA). If a question arises or an error or potential outlier is identified, the manager of the task responsible for generating the data is contacted to resolve the issue. Issues that can be corrected are corrected and documented electronically or by initialing and dating the associated paperwork. 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. The USGS Project Chief is responsible for validating that the verified data meet the measurement performance criteria. Field and laboratory review, 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. Data review, verification, and validation tasks to be performed on the data set include, but are not limited to, the confirmation of lab 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.

Table D2.1 - Data Review Tasks

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

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 the TCEQ in SWQMIS for the use in the development of the biennial *Texas Integrated Report for Clean Water Act Sections 305 (b) and 303(d)* and WPP development as appropriate. Data which do not meet requirements will not be submitted to SWQMIS nor will be considered appropriate for any of the uses noted above.

References

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Appendix A. USGS Field Forms

9-275-x	07/08/2009	U.S. Department of The Interior U.S. Geological Survey	Meas. No.	
Station Number			Comp. by	
		ADV Discharge Measurement Notes	Checked by	

Station Name					
Date	, 20_____	Party			
Width	Area	Velocity	SNR	Gage Height	Discharge

Method	# Sections	Gage Height Change	
		in hrs.	

Manufacturer	Model	Serial No.	Firmware	Software

Data File	Std Velocity Profile	ADV Clock Sync'd	Diagnostic Test
	Y or **N** or Uncertain	**Y** at _____ or **N**	**Y** or **N**

Measured Water Temp	ADV Water Temp	Weather / Air Temp	Wind Speed / Dir.
°F / C at	°F / C at	°F / C	

Gage Readings

Time	**S**tart **E**nd	Primary Reference				
Weighted MGH						
GH corrections						
Correct MGH						

Rod Offset	
Pressure Sensor Calibrated?	
Y or **N**	
Rating number	
Percent from rating	
Indicated shift	
Rain gage	
Serviced / Calibrated	
Salinity	
ppt at	
Checkbar found	
Checkbar Changed to	
at	

Wading, ice, upstr., downstr., side bridge		ft., mi. upstr., downstr. of gage
Measurement rated	excellent (2%), good (5%), fair (8%), poor (>8%)	based on following conditions
Flow		
Cross section		
Control		

Gage operating	Y or N	Record removed	Y or N	Filename	
Battery voltage	V	Intakes/Orifice cleaned/purged			
Bubble-gage psi	Tank		Line		Bubble rate / min
Extreme-GH indicators:	Max		Min		CSG Checked Y or N
HWM on stick		Ref elev.		HWM elevation	
GH of zero flow = GH		- depth at control		= ft,	Uncertainty ±
Remarks					

	Sheet No.		of		sheets

Attach ASR and WatList

USGS science for a changing world

U. S. GEOLOGICAL SURVEY SURFACE-WATER QUALITY FIELD NOTES

Station No. _____

NWIS Record No. _____

Station No. _____ Station Name _____ Field ID _____

Sample Date _____ Mean Sample Time _____ Time Datum _____ (eg. EST, EDT, UTC) End Date _____ End Time _____

*Sample Medium: WS WSQ OAQ *Sample Type: 9 (regular) 7 (replicate) 2 (blank) 1 (spike) _____

*Sample Purpose (71999): 10 (routine) 15 (NAWQA) 20 (NASQAN) 25 (NMN) 30 (Benchmark) _____

*see last page for additional codes

*Purpose of Site Visit (50280): 1001 (fixed-frequency SW) 1003 (extreme high flow SW) 1004 (extreme low flow SW) 1098 (NAWQA QC) _____

QC Samples Collected? Y N Blank Replicate Spike Other_____

Project No. _____ Project Name_____

Sampling Team _____ Team Lead Signature _____ Date _____

START TIME _____ GAGE HT _____ TIME _____ GHT _____ TIME _____ GHT _____ TIME _____ GHT _____ END TIME _____ GHT _____

FIELD MEASUREMENTS

Property	Parm Code	Method Code (http://water.usgs.gov/usgs/owq/Forms/Fieldmeasurement_parametersmethods.doc)	Result	Units	Remark Code	Value Qualifier	Null Value Qualifier	NWIS Result-Level Comments
Gage Height	00065			ft				
Discharge, instantaneous	00061			cfs				
Temperature, Air	00020	THM04 (Thermistor) THM05 (Thermometer)		°C				
Temperature, Water	00010	THM01 (Thermistor)		°C				
Specific Conductance	00095	SC001 (Contacting Sensor)		µS/cm				
Dissolved Oxygen	00300	LUMIN (Luminescent) MEMBR (Amperometric) SPC10 (Spectrophotometric)		mg/L				
Barometric Pressure	00025	BAROM (Barometer)		mm Hg				
pH	00400	PROBE (Electrode)		units				
Alkalinity, filtrd, incr. Alkalinity, filtrd, Gran	39086 29802	TT061 (Digital Titrator) TT062 (Buret) TT056 (Digital Titrator) TT057 (Buret)		mg/L				
Carbonate, filtrd, incr. Carbonate, filtrd, Gran	00452 63788	ASM01 (Digital Titrator) ASM02 (Buret) ASM03 (Digital Titrator) ASM04 (Buret)		mg/L				
Bicarbonate, filtrd, incr. Bicarbonate, filtrd, Gran	00453 63786	ASM01 (Digital Titrator) ASM02 (Buret) ASM03 (Digital Titrator) ASM04 (Buret)		mg/L				
Hydroxide, filtrd, incr. Hydroxide, filtrd, Gran	71834 29800	ASM01 (Digital Titrator) ASM02 (Buret) ASM03 (Digital Titrator) ASM04 (Buret)		mg/L				
Turbidity [see attachment for codes and units]								

SAMPLING INFORMATION

Parameter	Pcode	Value	Information
Sampler Type	84164	*see last page for proper codes— consider type of sampler and material*	Sampler ID:
Sampling Method	82398	10 EWI; 20 EDI; 30 single vertical; 40 multiple vertical; other _____	**BAG SAMPLER EFFICIENCY TEST**
Sampler bottle/bag material	84182	Plastic Bag (11) Teflon® Bag(12) Glass Bottle(20) Plastic Bottle (21) Teflon® Bottle (22) other (30)	Test / Duration Sampler Collected Water (seconds) / Sample Volume Collected (milliliters)
Sampler Nozzle material	72219	plastic (2) Teflon® (3) Brass (1)	1
Sampler Nozzle Diameter	72220	3/16" (3) 1/4" (4) 5/16" (5)	2
Sampler Transit Rate	50015	feet/second	3
Velocity to Calculate Isokinetic transit rate	72196	feet/second	Mean (72217) (72218)
Depth to Calculate Isokinetic transit rate	72195	feet	Bag Sampler Efficiency % *(See last page)*
Splitter Type	84171	*See last page for codes* _____	Splitter ID:
Hydrologic Condition	N/A	A Not Determined; 4 Stable, low stage; 5 Falling stage; 6 Stable, high stage; 7 Peak stage; 8 Rising stage; 9 Stable, normal stage	
Observations [Codes: 0=none; 1=mild; 2=moderate; 3=serious; 4=extreme]		Oil-grease (01300) ___ Detergent suds (01305) ___ Floating garbage (01320) ___ Floating algae mats (01325) ___ Floating debris (01345) ___ Turbidity (01350) ___ Atm. Odor (01330) ___ Fish kill (01340) ___ Gas Bubbles (01310) ___ Sewage Solids (01335) ___ Floating Vegetation (84178) ___ Ice Cover(01355) ___	

COMPILED BY: _____ **CHECKED BY:** _____ **LOGGED INTO NWIS BY:** _____

Station No. _____

SAMPLING CONDITIONS

Stream width (0004): _____ ft mi Left bank _____ Right bank _____ft Ice cover _____% Ave. ice thickness _____ in.

Number of Sampling points (00063): ____

Stations on cross-section (distance from LEFT RIGHT bank)____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

Sampling location: wading cableway boat bridge upstream downstream side of bridge _____ ft mi above below gage _____

Sampling site: pool riffle open channel braided backwater Bottom: bedrock rock cobble gravel sand silt concrete other _____

Stream color: brown green blue gray clear other _____ Stream mixing: well-mixed stratified poorly-mixed unknown other_____

Weather (00041) _____

wind speed (00035) _____ mph *temperature*- very cold cool warm hot

No. days since last rainfall event (72053) _____

Observations:

Sample Comments (for NWIS; 300 characters max.):

LABORATORY INFORMATION *Sample Set ID* _____

SAMPLES COLLECTED (check all that apply):

Nutrients: ___WCA ___FCC ___FCCVT ___FCA Major cations: ___FA ___RA Major anions: ___FU

Trace elements: ___FA ___RA ___CU Mercury: ___FAM ___RAM ___Wis. Hg Lab Lab pH/SC/ANC: ___RU

Organics: ____GCC filtered __ unfiltered __ ___BGC ___C18 ___ Kansas OGRG Lab _____PEST ____PHARM ____HUN ____HFL

VOC: _____GCV (____ vials) Suspended solids: ___SUSO Turbidity: ___TBY Methylene Blue Active Substances: ___MBAS Color: ___RCB

Carbon: ___TPCN filter1-vol filtered_____mL filter2-vol filtered_____mL filter3-vol filtered_____mL ___DOC ___TOC

Stable isotopes: ___FUS ___RUS Radio-chemicals: ___FUR ___RUR ___SUR ___FAR ___RAR __CUR

___BOD ___COD Chlorophyll: ____ CHL Algae: ____ Invertebrates: ___IQE ___IQL ___IQM ___IRE Fish tissue: ___TBI

Ultraviolet Absorbing Substances: ___UAS

Other:_____ (Lab_____) Other:_____ (Lab_____) Other:_____ (Lab_____)

Other:_____ (Lab_____) Other:_____ (Lab_____) Other:_____ (Lab_____)

Suspended sediment: ____ CONC. S/F SIZE [No. bottles _____]

Microbiology: _____ (Lab_____) Date shipped: _____

Date sediment sample shipped: _____ Sediment Lab: _____

Comments:

_____

Date shipped:_____ Laboratory _____ Date shipped_____ Laboratory_____

Date shipped:_____ Laboratory _____ Date shipped_____ Laboratory_____

****Notify the NWQL in advance if shipping potentially hazardous samples—phone 1-866-ASK-NWQL or email LabLogin@usgs.gov**

Calibrated by:_____ Location:_____ Station No. _____
Date:_____ Time:_____

METER CALIBRATIONS and FIELD MEASUREMENTS

TEMPERATURE Meter make/model _____ S/N _____ Thermistor S/N _____ Thermometer ID _____

Calibration criteria: ± 0.2 °C for thermistors | Local Meter

Lab Tested against NIST Thermometer/Thermistor? Y N Date: _____ ±_____ °C

Measurement Location: SINGLE POINT AT _____ ft DEEP STREAMSIDE _____ FT FROM LEFT RIGHT BANK VERTICAL AVG/MEDIAN OF _____ PTS

Field Readings # 1 _____ #2 _____ #3 _____ #4 _____ #5 _____ **MEDIAN**:_____ **ºC** Method Code _____ Remark ___ ___ Qualifier __

SPECIFIC CONDUCTANCE Meter MAKE/MODEL _____ S/N _____ Sensor ID _____

Sample: CONE SPLITTER CHURN SPLITTER SINGLE POINT AT _____ ft DEEP VERTICAL AVG. OF _____ POINTS

LOCAL METER ID:_____ AUTO TEMP COMPENSATED METER? Y N CORRECTION FACTOR APPLIES? Y N CORRECTION FAC-

Std Value µS/cm	Std Temp	SC Before Adj.	SC After Adj.	Vendor Lot No.	NWIS Parameter Code (see last page)	NWIS* Lot No.	Expiration Date

Calibration Criteria: ± 5 % for SC ≤100 µS/cm or 3% for SC >100 µS/cm ***NWIS Lot Numbers are available at: http://wwwnwql.cr.usgs.gov/qas.shtml?ConductivityStds_home**

Field readings #1_____ #2_____ #3_____ #4_____ #5 _____ **MEDIAN: _____ µS/cm** Method Code _____ Remark ___ ___ Qualifier ___ ___

DISSOLVED OXYGEN Meter MAKE/MODEL _____ S/N _____

Sensor Type: Amperometric Luminescent Spectrophotometer Sensor ID _____Local Meter ID_____

Calibration Method: Air-Saturated Water Water-Saturated Air

Sample: SINGLE POINT AT _____ ft DEEP VERTICAL AVG. OF _____ POINTS BOD BOTTLE OTHER_____ Stirrer Used? Y N

Calibration Temperature °C	Barometric Pressure mm Hg	DO Table Reading mg/L	Salinity Correc-tion Factor	DO Before Adjustment mg/L	DO After Adjust-ment mg/L

Zero DO Check _____mg/lL Adj. to _____ mg/L Date: _____

Thermister Check? Y N Date_____

Barometer Calibrated? N Y Date: _____ Time: _____

Phase Degrees/Slope/Gain/Scale Factor (100%)_____(Zero)_____

Calibration Criteria: ± 0.2 mg/L **DO saturation _____ %**

Field readings #1_____ #2_____ #3_____ #4_____ #5 _____ **MEDIAN: _____ mg/L** Method Code _____ Remark ___ ___ Qualifier ____

pH Meter MAKE/MODEL _____ S/N _____ Electrode ID _____ Type: GEL LIQUID OTHER _____

Sample: FILTERED UNFILTERED CONE CHURN SPLITTER SINGLE POINT AT _____ ft DEEP VERTICAL AVG. OF ___ POINTS

pH BUFFER	BUFFER TEMP	THEO-RETICAL pH FROM TABLE	pH BEFORE ADJ.	pH AFTER ADJ.	SLOPE	MILLI-VOLTS
pH 7						
pH ___						
CHECK pH ___						

pH Buffer	Vendor Lot No.	NWIS* Lot No.	Expiration Date
pH 7 (99173)			
pH 10 (99171)			
pH 4 (99172)			

Calibration Criteria: ± 0.1 pH units, ± 0.3 if SC <75us/cm ***NWIS Lot Numbers are available at: http://wwwnwql.cr.usgs.gov/qas.shtml?Buffers_home**
Millivolts: pH 7 –10 t0 +10 , pH4 +165 to +195 mV, pH 10 –165 to –195 mV
Slope Acceptance Criteria: 95% to 102%

Field Readings #1_____ #2_____ #3_____ #4_____ #5 _____ **MEDIAN: _____ Units** Remark ___ ___ Qualifier ___

Station No. _____

TURBIDITY Meter make/model _____ S/N _____ Type: turbidimeter submersible spectrophotometer

Sample: pump discharge line flow-thru chamber single point at _____ ft blw LSD MSL MP Sensor ID _____

Sample: Collection Time: _____ Measurement Time: _____ Measurement: In-situ/On-site Vehicle Office lab NWQL Other _____

Sample diluted? Y N Vol. of dilution water _____ mL Sample volume _____ mL

	Lot Number or Date Prepared	Expiration Date	Concentration _____ (units)	Calibration Temperature °C	Initial instrument reading	Reading after adjustment
Stock Turbidity Standard						
Zero Standard *(DIW)*						
Standard 1						
Standard 2						
Standard 3						

TURBIDITY VALUE = ***A*** x (***B***+***C***) / ***C***
where:
A= TURBIDITY VALUE IN DILUTED SAMPLE
B= VOLUME OF DILUTION WATER, mL
C= SAMPLE VOLUME, mL

Calibration Criteria:
≤ 100 Turbidity units ± 0.5 turbidity units or ± 5% of the measured Value, whichever Is greater
> 100 Turbidity units ± 10%

Field Readings #1 _____ #2 _____ #3 _____ #4 _____ #5 _____

MEDIAN _____ **Parameter Code** _____ FNU NTU NTRU FNMU FNRU FAU FBU AU METHOD CODE _____ Remark ___ ___ Qualifier ___ __

CROSS SECTION NOTES Barometric pressure = _____ mm Hg

Station	ft from left bank (00009) or ft from right bank (72103)	Time	Gage ht ft (00065)	Depth to Bottom at this station ft (81093)	Depth of measure -ment ft (00003)	Temp °C (00010) THM01	SC µS/cm (00095) SC001	DO mg/L (00300) (Method Code)	DO sat %	pH units (00400) PROBE	Turbidity _____ (_____) (Method Code)	Chl A Units (_____)	NWIS Record No.
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													

NOTES:

ALKALINITY/ANC

Beginning H_2O temp. _____ °C
Specific Conductance_____µS/cm

pH	ΔpH	Vol acid DC or mL	ΔVol acid DC or mL	ΔpH / ΔVol acid

End H_2O temp. _____ °C
Specific Conductance_____µS/cm

Beginning H_2O temp. _____ °C
Specific Conductance_____µS/cm

pH	ΔpH	Vol acid DC or mL	ΔVol acid DC or mL	ΔpH / ΔVol acid

End H_2O temp. _____ °C
Specific Conductance_____µS/cm

Go to the Alkalinity Calculator for a complete listing of reporting rules, parameter codes, method codes, etc:
http://or.water.usgs.gov/alk

FIRST TITRATION

Date _____ Initials _____
Begin time_____ End time_____
Alkalinity/ANC _____ mg/L* as $CaCO_3$
Bicarbonate _____mg/L* as HCO_3^-
Carbonate _____mg/L* as CO_3^{2-}
Hydroxide _____mg/L* as OH^-
Acid: 1.6N 0.16N 0.01639N Other:_____
Acid Lot No. _____Expiration Date _____
Correction factor: 1.01 _____
Acid Delivery: Digital Counter Buret
Sample Volume: _____mL Filtered Unfiltered
Method: Inflection Point Gran
Stirring Method: Magnetic Manual

SECOND TITRATION

Date _____ Initials _____
Begin time_____ End time_____
Alkalinity/ANC _____ mg/L* as $CaCO_3$
Bicarbonate _____mg/L* as HCO_3^-
Carbonate _____mg/L* as CO_3^{2-}
Hydroxide _____mg/L* as OH^-
Acid: 1.6N 0.16N 0.01639N Other:_____
Acid Lot No. _____Expiration Date _____
Correction factor: 1.01 _____
Acid Delivery: Digital Counter Buret
Sample Volume: _____mL Filtered Unfiltered
Method: Inflection Point Gran
Stirring Method: Magnetic Manual

Alkalinity/ANC pH Meter Calibration

Meter make/model:	S/N
Calibration Location:	
Electrode No.	
Electrode type GEL LIQUID	

	pH 7	pH ____
BUFFER TEMPERATURE		
THEORETICAL FROM TABLE		
pH BEFORE ADJUSTMENT		
pH AFTER ADJUSTMENT		
SLOPE		
MILLIVOLTS		
MANUFACTURER LOT NUMBER		
NWIS LOT NUMBER		

Field titration by:_____

Checked by:_____

Station No. _____

QUALITY-CONTROL INFORMATION

PRESERVATIVE, BLANK WATER and SPIKE NWIS LOT NUMBERS

NWIS lot numbers are available at: http://wwwnwql.cr.usgs.gov/qas.shtml?nfssqa_certificates

Description	Parameter Code	Expiration Date	Manufacturer Lot Number	NWIS Lot Number
4.5N H_2SO_4 (NUTRIENTS AND DOC)	99156			
7.5N-7.7N HNO_3 (METALS&CATIONS)	99159			
6N HCl (Mercury)	99158			
1:1 HCl (VOC)	99157			
18N H_2SO_4 (COD and Phenol)	99155			
Inorganic Blank Water	99200			
Organic Blank Water	99202			
VOC/Organic Blank Water	99204			
Spike	99104			

FILTER LOT NUMBERS

Filter descriptions with parameter codes require NWIS LOT NUMBERS available at http://wwwnwql.cr.usgs.gov/qas.shtml?filters_home

Filter Type	Pore Size (microns)	Manufacturer's Lot Number	Parameter Code	NWIS Lot Numer
Capsule	0.45		99206	
Disc	0.45		99206	
142 mm GFF (organics)	0.70			
Syringe (organics)	0.70		99207	
25 mm GFF (organic carbon)	0.70			
142 mm membrane (inorganics)	0.45			

QC SAMPLES

Sample Type	NWIS Record No.	Sample Type	NWIS Record No.	Sample Type	NWIS Record No.
Equip Blank _____	_____	Sequential _____	_____	Trip Blank _____	_____
Field Blank _____	_____	Spike _____	_____	Other _____	_____
Split _____	_____	Concurrent _____	_____	Other _____	_____

NWQL Schedules/lab codes (QC Samples) _____ _____ _____ _____ _____ _____

COMMENTS:_____

(Circle appropriate selections)

99100 Blank-solution type
10 Inorganic grade (distilled/deionized)
40 Pesticide grade (OK for organics and organic carbon)
50 Volatile-organic grade (OK for VOCs, organics, and organic carbon)
200 Other

99101 Source of blank water
10 NWQL
40 NIST
55 Wisconsin Mercury Lab
140 EMD Chemicals
150 Ricca Chemical Company
200 Other

99105 Replicate-sample type
10 Concurrent
20 Sequential
30 Split
40 Split-Concurrent
50 Split-Sequential
200 Other

99102 Blank-sample type
1 Source Solution
30 Trip
40 Sampler
50 Splitter
80 Equipment (done in non-field environment)
90 Ambient
100 Field
200 Other

99111 QC sample associated with this environmental sample
1 No associated QA data
10 Blank
30 Replicate Sample
40 Spike sample
110 Cross-section information stored
100 More than one type of QA sample
200 Other

A complete list of fixed-value codes can be found online at:
http://wwwnwis.er.usgs.gov/currentdocs/index.html

99106 Spike-sample type
10 Field
20 Lab

99107 Spike-solution source
10 NWQL

99108 Spike-solution volume, mL _____

99112 Purpose, Topical QC data
1 Routine QC (non-topical)
10 Topical for high bias (contamination)
20 Topical for low bias (recovery)
100 Topical for variability (field equip)
110 Topical for variability (field collection)
120 Topical for variability (field personnel)
130 Topical for variability (field processing)
140 Topical for variability (shipping&handling)
200 Topical for variability (lab)
900 Other topical QC purpose

–

REFERENCE LIST FOR CODES USED ON THIS FORM

The complete list of fixed-value codes can be found online at: http://wwwnwis.er.usgs.gov/currentdocs/index.html

Sample Medium Codes
- WS Surface water
- WSQ Quality-control sample (Replicate, Spike)
- OAQ Blank

Sample Type Code
- 9 Regular
- 7 Replicate
- 2 Blank
- 1 Spike
- 3 Reference
- B Other QA
- H Composite

71999 Sample Purpose
- 10 Routine
- 15 NAWQA
- 20 NASQAN
- 25 National Monitoring Network
- 30 Benchmark
- 40 SW Network
- 60 Lowflow Network
- 70 Highflow Network
- 110 Seepage Study
- 180 Cross-Section Variation

Time Datum Codes

Time Zone	Std Time Code	UTC Offset (hours)	Daylight Time Code	UTC Offset (hours)
Hawaii-Aleutian	HST	-10	HDT	-9
Alaska	AKST	-9	AKDT	-8
Pacific	PST	-8	PDT	-7
Mountain	MST	-7	MDT	-6
Central	CST	-6	CDT	-5
Eastern	EST	-5	EDT	-4
Atlantic	AST	-4	ADT	-3

Value Qualifiers
- e see field comment
- f sample field preparation problem
- k counts outside the acceptable range

Null-value Qualifiers
- e required equipment not functional or available
- f sample discarded; improper filter used
- o insufficient amount of sample
- p sample discarded; improper preservation
- q sample discarded; holding time exceeded
- r sample ruined in preparation

Bag Sampler Intake Efficiency (IE)

$$IE = K \times \frac{V/T}{Vs}$$

IE=Intake Efficiency
T=Mean Duration Sampler Collected Water (P72217)
V=Mean Sample Volume Collected (P72218)
Vs=Mean Stream Velocity (P72196)
K = 0.1841 for 3/16" nozzle
K = 0.1036 for 1/4" nozzle
K = 0.0663 for 5/16" nozzle

82398 Sampling Method
- 10 Equal Width Increment (EWI)
- 15 Multiple Verticals, non-isokinetic, equal widths and transit rate
- 20 Equal Discharge Increment (EDI)
- 25 Timed Sampling Interval
- 30 Single Vertical
- 40 Multiple Verticals
- 50 Point Sample
- 55 Composite, multi-point samples
- 70 Grab Sample (Dip)
- 8030 Grab Sample At Water-Supply Tap

84164 Sampler Type
- 100 Van Dorn Sampler
- 110 Sewage Sampler
- 125 Kemmerer Bottle
- 3044 US DH-81
- 3045 US DH-81 With Teflon Cap And Nozzle
- 3047 Sampler, Frame-Type, Plastic Bottle W/Reynolds Oven Bag
- 3048 Sampler, Frame-Type, Teflon Bottle
- 3049 Sampler, Frame-Type, Plastic Bottle
- 3050 Sampler, Frame-Type, Plastic Bottle W/Teflon Collapsible Bag
- 3051 US DH-95 Teflon Bottle
- 3052 US DH-95 Plastic Bottle
- 3053 US D-95 Teflon Bottle
- 3054 US D-95 Plastic Bottle
- 3055 US D-96 Bag Sampler
- 3057 US D-99 Bag Sampler
- 3058 US DH-2 Bag Sampler
- 3060 Weighted-Bottle Sampler
- 3061 US WBH-96 Weighted-Bottle Sampler
- 3070 Grab Sample
- 3071 Open-Mouth Bottle
- 3080 VOC Hand Sampler
- 4010 Thief Sampler
- 4115 Sampler, point, automatic
- 8000 None
- 8010 Other

50280 Purpose of Site Visit
- 1001 Fixed frequency, surface-water
- 1002 Storm hydrograph, surface-water
- 1003 Extreme high flow, surface-water
- 1004 Extreme low flow, surface-water
- 1005 Diurnal, surface-water
- 1006 Synoptic, surface-water
- 1098 NAWQA surface-water quality control
- 1099 Other, surface-water
- 3001 Occurrence Survey, bed sediment or tissue
- 3002 Spatial Distribution Survey, bed sediment or tissue
- 3003 Synoptic Study, bed sediment or tissue
- 3098 Bed-sediment or tissue quality control
- 3099 Other, bed sediment or tissue

84171 Splitter type, field, code
- 10 Churn splitter, plastic, 8 liter, cooler-type spigot
- 20 Churn splitter, plastic, 14 liter, cooler-type spigot
- 30 Churn splitter, plastic, 8 liter, cubitainer-type spigot
- 40 Churn splitter, plastic, 14 liter, cubitainer-type spigot
- 50 Churn splitter, fluoropolymer, 8 liter (future development)
- 60 Churn splitter, fluoropolymer, 14 liter, US SS-1
- 70 Cone splitter, plastic
- 80 Cone splitter, fluoropolymer
- 90 Sieve, wet
- 100 Sieve, dry
- 110 Riffle splitter (Jones)
- 200 Other

NWIS Lot Number Parameter Codes* for Conductance Standards

Parameter Code	Standard Value µS/cm, KCl
99160	50
99161	100
99162	250
99163	500
99164	750
99165	1000
99166	2500
99167	5000
99168	10,000
99169	25,000
99170	50,000

Dissolved Oxygen
- AZIDE Azide-modified Winkler
- INDIGO Spectrophotometer, indigo carmine
- INDKT Field Kit, indigo carmine, visual
- LUMIN Luminscence sensor
- MEMB2 Amperometric, Membrane (DODEC)
- MEMBR Amperometric, Membrane electrode
- RHODA Field Kit, Rhodazine-D, visual
- SPC10 Spectrophotometer, Rhodazine-D
- WINKL Winkler titration

Parameter and method codes for field measurements: http://water.usgs.gov/usgs/owq/Forms.html

***NWIS Lot numbers and Certificates of Analysis:** http://wwwnwql.cr.usgs.gov/qas.shtml?nfssqa_certificates

National Field Manual: http://water.usgs.gov/owq/FieldManual/

Alkalinity Calculator, Alkalinity/ANC parameter and method codes: http://or.water.usgs.gov/alk/reporting.html

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USGS science for a changing world

U.S. GEOLOGICAL SURVEY
CONTINUOUS WATER-QUALITY MONITOR

Station No._____

Station No. _____ Station Name _____
Monitor Inspected By _____ Date _____ Watch Time _____ Time Datum _____
Gage Ht _____ (Rising, Falling, Steady, Peak) Channel Conditions _____
Monitor Make/Model _____ Monitor Serial No. _____
Field Meter Make/Model _____ Field Meter Serial No. _____
Weather Cold Cool Warm Hot Rain Mist Sleet Snow Humid Dry Cloudy Pt Cloudy Overcast Clear Windy Gusty Breeze Calm
Comments:

MONITOR FOULING CHECKS

Parameter	Before Cleaning Time _____ Recorded/ Live Monitor Reading	Before Cleaning Time _____ Field Meter Reading	After Cleaning Time _____ Recorded/ Live Monitor Reading	After Cleaning Time _____ Field Meter Reading
Temp (°C)				
pH (units)				
DO (mg/L)				
SC (µS/cm)				
Turbidity (FNU NTU NTRU FNMU FNRU FAU FBU AU) Parm Code _____ Method code _____				
Other _____				

CALIBRATION DRIFT CHECKS

TEMPERATURE Calibration Criteria: ± 1 percent or ± 0.5 °C for liquid-filled thermometers; ± 0.2 °C for thermisters	Recorded/Live Monitor Reading Time _____	Field Meter Reading Time _____	Field Meter 2-pt check Date	Field Meter 5-pt check Date

Comments:

SPECIFIC CONDUCTANCE Calibration Criteria: ± 5 percent for SC ≤ 100 µS/cm or ± 3 percent for SC >100 µS/cm				Calibration Check Time _____			Recalibration Time _____		
Standard Value	**NWIS Lot No.**	**Vendor Lot No.**	**Expiration Date**	**Standard Temp °C**	**SC Reading µS/cm**	**Error %**	**Standard Temp °C**	**SC Reading µS/cm**	**Error %**
Cell range =	**Reading in air = (should be zero)**								

Comments:

Station No._____

MAINTENANCE RECORD FOR CONTINUOUS MONITOR

Battery changed? Yes No Voltage _____volts

Sensors cleaned? Yes No Type of fouling _____

Wiper cleaned? Yes No Type of fouling _____

Sensor changed? SC YES NO Sensor ID _____

pH YES NO Sensor ID _____

DO YES NO Sensor ID _____

Turbidity YES NO Sensor ID _____

Sonde Changed? YES NO New Sonde No. _____ Old Sonde No. _____

DO Membrane changed? YES NO Date Changed: _____ Membrane allowed to relax _____ hrs

Comments:

Field Meter(s)	Make/Model	Serial No.	Correction Factor Applied?
Multi-parameter meter			None Yes No
Temperature			None Yes No
Conductivity			None Yes No
pH			None Yes No
Dissolved Oxygen			None Yes No
Turbidity (1)			None Yes No
Turbidity (2)			None Yes No
Other			None Yes No

COMMENTS/OBSERVATIONS:

Turbidity method codes are available at: http://water.usgs.gov/owq/FieldManual/Chapter6/6.7_contents.html

Inspection form (Basic form for fouling and drift) is available at:
http://sr.water.usgs.gov/qw/qwmonitors/Inspection.summary.v2.3.xls

Ultimate spreadsheet is available at: http://sr.water.usgs.gov/qw/qwmonitors/QW.Ultimate.2.3.xls

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Station No._____

CROSS-SECTION SURVEY INFORMATION

Method used to determine measurement locations (82398): EWI (10) EDI (20) Single vertical (30) Point Sample (50) Other _____
No. of Verticals _____ Measurement Location: _____ ft upstream downstream of monitor
Stream Mixing: Excellent Good Fair Poor

Station	Time	Ft from left bank (00009) or ft from right bank (72103)	Depth to bottom at meas. loc. ft (81903)	Measure-ment depth ft (00003)	Temp °C (00010)	pH units (00400)	SC µS/cm (00095)	DO mg/L (00300)	Turbidity _____ ( )	Other _____ ( )	NWIS Record No.
Gage ht =											
At monitor											
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
At monitor											
Gage ht =											

CROSS-SECTION COMPARISON AT _____ CFS

Parameter	Cross-section median	Point value	Indicated coefficient
Water Temp	°C	°C	
pH	units	units	
SC	µS/cm	µS/cm	
DO	mg/L	mg/L	
Turbidity	_____	_____	
Other _____			

Appendix B. Laboratory Forms

NWDLS Chain of Custody Form

NWDLS
North Water District
Laboratory Services, Inc.

North Water District
Laboratory Services, Inc.
8725 Fawn Trail • The Woodlands, TX 77385
(936) 321-6060 • fax (936) 321-6061 • lab@nwdls.com

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

Project Name:

Project Locatior

Company Name: _____
Contact: _____
Address: _____
_____
Phone #: _____ Fax #: _____
P.O.#: _____

Field Sample No./ Identification	Date	Time	Grab	Comp	Container Size	Container Type	Sample Type (Liquid, Sludge, Etc.)	Preser-vation	Analysis Requested	Laboratory Remarks

Sampler: *(Signature)*	Relinquished by: *(Signature)*	Date: Time:	Received by: *(Signature)*	Date: Time:	Intact
Sampler: *(Print Name)*	Relinquished by: *(Signature)*	Date: Time:	Received by: *(Signature)*	Date: Time:	Intact
Affiliation	Relinquished by: *(Signature)*	Date: Time:	Received by: *(Signature)*	Date: Time:	Intact
pH Meter_____ Tech. _____	Sampler Remarks		Received for laboratory: *(Signature)*	Date: Time:	Paid

date/ time	slope	buffers
		4 7 10

Appendix C. Corrective Action Report

Corrective Action Report
CAR #:_____

Date:_____ Area/Location:_____

Reported by:_____ Activity:_____

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

Possible causes:
_____
_____
_____

Recommended Corrective Actions:
_____
_____
_____

CAR routed to:_____
Received by:_____

Corrective Actions taken:
_____
_____
_____
_____

Has problem been corrected?: YES NO

Immediate Supervisor:_____

Program Manager:_____

GTRI Quality Assurance Officer:_____

TSSWCB Quality Assurance Officer:_____

Appendix D. Data Summary Report

Data Summary

Data Information

Data Source: _____

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 TSSWCB or TCEQ; and**
- **Other discrepancies.**

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Data Manager: _____

Date: _____