Kathleen Hartnett White, *Chairman*
Larry R. Soward, *Commissioner*
H. S. Buddy Garcia, *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

October 3, 2007

Dr. James Miertschin
James Miertschin and Associates
5524 Bee Cave Road, Suite D4
Austin, Texas 78746

Re: Lake Houston Watershed Area Bacteria TMDL Project – Segment Numbers: 1002, 1003, 1004, 1008, 1008B, 1009, 1010, and 1011 Quality Assurance Project Plan (QAPP)

Dear Dr. Miertschin:

The above named QAPP has been approved. The original QAPP and signature pages are enclosed as documentation of approval

In accordance with the terms of the QAPP, **please ensure that copies of this document and any subsequent amendments are distributed to each sub-tier participant as noted in Section A3 of the QAPP.** This approval letter must be available for review during a monitoring systems audit.

Should you have questions, please contact me at (512) 239-0425.

Sincerely,

Kyle Girten
Quality Assurance Specialist

enclosure

cc: Sharon Coleman, Senior Quality Assurance Specialist, MC 176
Casey Johnson, Project Manager, MC 203

Lake Houston Watershed Area Bacteria TMDL Project
Segment Numbers: 1002, 1003, 1004, 1008, 1008B, 1009, 1010, and 1011
Quality Assurance Project Plan
Revision 0

Date submitted to TCEQ: 9/26/2007

USEPA QTRAK#

James Miertschin & Associates, Inc.
Post Office Box 162305
Austin, Texas 78716-2305
jm@jmaenv.com

Total Maximum Daily Load Program
Chief Engineer's Office, Water Programs
Texas Commission on Environmental Quality
P.O. Box 13087, MC - 203
Austin, Texas 78711-3087

This QAPP is effective for a period of one year from approval date.

Questions concerning this QAPP should be directed to:
James Miertschin & Associates, Inc.
Austin, TX

A1 APPROVAL PAGE

Texas Commission on Environmental Quality
Chief Engineer's Office, Water Programs

10/1/07
Faith Hambleton, Program Manager — Date
Total Maximum Daily Load Program

10/1/07
Casey Johnson, Project Manager — Date
Total Maximum Daily Load Program

Office of Compliance and Enforcement
Compliance Support Division

10/1/07
Stephen Stubbs, Manager — Date
Quality Assurance Program

10/1/07
Kyle Girten, Quality Assurance Specialist — Date
Quality Assurance Program

Monitoring Operations Division

10/2/07
David Manis, Manager — Date
Data Management and Quality Assurance Section

James Miertschin & Associates, Inc.

26SEP07
James Miertschin PhD, PE, Project Manager — Date
James Miertschin & Associates, Inc.

9-26-07
Al Capps, Quality Assurance Officer — Date
James Miertschin & Associates, Inc.

Note: The JMA Quality Assurance Officer will secure written documentation (such as the letter in Appendix G) from each sub-tier project participant (e.g., subcontractors, other units of government, laboratories) stating the organization's awareness of and commitment to requirements contained in this quality assurance project plan and any amendments or revisions of

this plan. The JMA Quality Assurance Officer will maintain the documentation as part of the project's quality assurance records, and will ensure that the document is available for review. **Copies will also be submitted as deliverables to the TMDL Project Manager within 30 days of QAPP approval.**

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APPENDIX F: DATA REVIEW CHECKLIST
APPENDIX G: EXAMPLE LETTER

A3 DISTRIBUTION LIST

Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Chief Engineer's Office
Water Programs
Casey Johnson, TMDL Project Manager
MC-203
(512) 239-1505

Office of Compliance and Enforcement
Compliance Support Division
Kyle Girten, Quality Assurance Specialist
MC-176
(512) 239-0425

Monitoring Operations Division
David Manis, Manager
Data Management and Quality Assurance
MC-165
(512) 239-5853

TCEQ Field Operations Division
Monica Harris, Water Program Manager
MC-174
(512) 239-6266

Linda Broach, Region 12 TMDL Staff
MC-R12
(713) 767-3579

James Miertschin & Associates, Inc.
PO Box 162305, Austin, Texas 78746
James Miertschin, PhD, PE, Project Manager
(512)-327-2708

Al Capps, Quality Assurance Officer
(512)-327-2708

Steve Grychka, Laboratory Supervisor
North Water District Laboratory Services, Inc.
(936) 321-6060

Steve Grychka, Laboratory QA Officer
North Water District Laboratory Services, Inc.
(936)321-6060

Thierry Tamers
MST Project Manager
Source Molecular Corporation, Inc.
4989 SW 74th Court
Miami, FL 33155
(786) 268-8363

U.S. EPA Region 6
1445 Ross Avenue
Suite # 1200
Mail Code: 6WQAT
Dallas, TX 75202-2733
Donna Miller, Chief
(214)-665-8093

Note: The JMA Quality Assurance Officer will provide copies of this project plan and any amendments or revisions of this plan to each sub-tier project participant, e.g., subcontractors, other units of government, laboratories. The JMA Quality Assurance Officer will document receipt of the plan by sub-tier participants and maintain this documentation as part of the project's quality assurance records. This documentation will be available for review and will also be submitted to the TMDL Project Manager within 30 days of QAPP approval.

List of Acronyms

AWRL	Ambient Water Reporting Limit
BOD5	5-day Biochemical Oxygen Demand
CAR	Corrective Action Report
CBOD	Carbonaceous Biochemical Oxygen Demand
CFU	Colony-Forming Unit of Bacteria
COC	Chain of Custody
COD	Chemical Oxygen Demand
CRP	Clean Rivers Program
CWA	Clean Water Act
DM&QA	Data Management & Quality Assurance
DMRG	Data Management Reference Guide
DOC	Demonstration of Capability
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
EPA	Environmental Protection Agency
FOD	Field Operations Division
GPS	Global Positioning System
ISO/IEC	International Standard Organization/International Electrotechnical Commission
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
LOD	Limit of Detection
LOQ	Limit of Quantification
MS	Matrix Spike
MDMA	Monitoring Data Management and Analysis
MPN	Most Probable Number
NPS	Nonpoint Source
NWDLS	North Water District Laboratory Services, Inc.
QA/QC	Quality Assurance/Quality Control
QAO	Quality Assurance Officer
QAM	Quality Assurance Manual (or Manager)
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
QAS	Quality Assurance Specialist
QMP	Quality Management Plan
qPCR	Quantification Polymerase Chain Reaction
RPD	Relative Percent Difference
SMI	Source Molecular Corporation, Inc.
SOP	Standard Operating Procedure
SWQM	Surface Water Quality Monitoring
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TCEQ	Texas Commission on Environmental Quality
TOC	Total Organic Carbon
SWQMIS	Surface Water Quality Monitoring Information System

List of Acronyms Continued

TSS	Total Suspended Solids
TSWQS	Texas Surface Water Quality Standards
USGS	United States Geological Survey
VOA	Volatile Organic Analyses

A4 PROJECT/TASK ORGANIZATION

TCEQ Chief Engineer's Office
Water Programs

Faith Hambleton
TMDL Program Manager
Responsible for managing the TCEQ TMDL Program. Oversees the development of QA guidance for the TMDL Team to be sure it is within pertinent frameworks of the TCEQ. Reviews and/or approves all TMDL Projects, QA audits, QAPPs, agency QMPs, corrective action reports, work plans, and contracts. Enforces corrective action where QA protocols are not met. Ensures TCEQ TMDL personnel are fully trained and TMDL projects are adequately staffed.

Casey Johnson
TMDL Project Manager
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 the JMA Project Team and the TCEQ. Tracks and reviews deliverables to ensure that tasks in the work plan are completed as specified in the contract. Reviews and approves QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TCEQ participants. Responsible for verifying that the QAPP is followed by the JMA Project Team. Notifies the TCEQ QAS and TMDL Program Manager of significant project nonconformance and corrective actions taken as documented in quarterly progress reports from JMA Project Team Project Manager.

Kerry Niemann
TMDL Data Manager
The TMDL Data Manager tracks and validates data generated by TMDL projects and associates all applicable incoming data with a Project and QAPP in SWQMIS. Responsibilities include receiving data (Event/Results Files) and review checklists from TMDL Project Managers, and loading data sets into SWQMIS. The SWQMIS data loader identifies invalid stations, invalid parameter codes, outliers, and orphans. Deficiencies are provided to Project Managers via a SWQMIS Data Loading Validator Report. The TMDL Data Manager ensures data deficiencies are corrected before data sets are accepted by SWQMIS and loaded.

TCEQ Compliance Support Division

Kyle Girten
TMDL Quality Assurance Specialist
Assists the TCEQ TMDL Project Manager on QA-related issues. Coordinates reviews and approvals of QAPPs and amendments or revisions. Conveys QA problems to appropriate TCEQ management. Monitors implementation of corrective actions. Coordinates and conducts audits.

TCEQ Monitoring Operations Division

Data Management and Quality Assurance
Data Manager
Reviews QAPP for valid surface water quality monitoring stations, checks validity of parameter, submitting entity codes, collecting entity codes, monitoring type codes, and tag prefixes to ensures that data will be reported following the *Surface Water Quality Monitoring Data Management Reference Guide (DMRG)*, 2007 or most current version. Analyzes SWQMIS to identify Level 1 data validation inconsistencies and reports any findings to TMDL Project Managers or TMDL Data Managers as appropriate. Serves as Monitoring Operations data management customer service representative for the TMDL Project Manager. Provides training to the TMDL Data Manager and TMDL Project Manager to ensure proper data submittal. Reviews and approves QAPPs.

TCEQ Field Operations Division

Linda Broach
TCEQ Region 12 TMDL Staff
Assists in the development of the project's water quality monitoring plan as appropriate. Ensures that the water quality monitoring plan in Appendix B adequately represents the local water quality conditions that may account for the observed impairment by corresponding with respective FOD Regional Field Staff. Works with the TMDL Project Manager to resolve problems with water quality monitoring. Maintains contact with TCEQ Project Manager to ensure coordination of issues.

James Miertschin & Associates, Inc.

James Miertschin, PhD, PE
JMA Project Manager
The JMA Project Manager is responsible for ensuring that tasks and other requirements in the contract are executed on time and with the quality assurance/quality control requirements in the system as defined by the contract and in the project QAPP; assessing the quality of subcontractor/participant work; submitting accurate and timely deliverables to the TCEQ TMDL Project Manager; and coordinating attendance at conference calls, training, meetings, and related project activities with the TCEQ. Responsible for verifying that the QAPP is distributed and followed by the JMA (including all subcontractors) and that the project is producing data of known and acceptable quality. Responsible for ensuring adequate training and supervision of all activities involved in generating analytical and field data, including the facilitation of audits and the implementation, documentation, verification and reporting of corrective actions.

Al Capps
JMA Quality Assurance Officer
Responsible for coordinating development and implementation of JMA's QA program. Responsible for writing and maintaining QAPPs and monitoring its implementation. Responsible for maintaining records of QAPP distribution, including appendices and amendments. Ensures the data collected for the project is of known and acceptable quality and adheres to the specifications of the QAPP. Responsible for maintaining written records of sub-

tier commitment to requirements specified in this QAPP. Responsible for identifying, receiving, and maintaining project quality assurance records. Responsible for compiling and submitting the QA report. Responsible for coordinating with the TCEQ QAS to resolve QA-related issues. Notifies the JMA Project Manager and TCEQ Project Manager of particular circumstances which may adversely affect the quality of data. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Conducts assessments of participating organizations during the life of the project as noted in Section C1. Implements or ensures implementation of corrective actions needed to resolve nonconformance noted during assessments.

Steve Grychka
North Water District Laboratory Services, Inc.
JMA Project Team Laboratory Manager
Responsible for supervision of laboratory personnel involved in generating analytical data for the project. Responsible for ensuring that laboratory personnel involved in generating analytical data have adequate training and a thorough knowledge of the QAPP and all SOPs specific to the analyses or task performed and/or supervised. Responsible for oversight of all laboratory operations 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.

Steve Grychka
North Water District Laboratory Services, Inc.
JMA Project Team Laboratory Quality Assurance Officer
Monitors the implementation of the QAM/QAP within the laboratory to ensure complete compliance with project data quality objectives as defined by the contract and in the QAPP. Conducts in-house audits to ensure compliance with written SOPs and to identify potential problems. Responsible for supervising and verifying all aspects of the QA/QC in the laboratory. Performs validation and verification of data before the report is sent to the primary contractor. Ensures that all QA reviews are conducted in a timely manner from real-time review at the bench during analysis to final pass-off of data to the QA Officer.

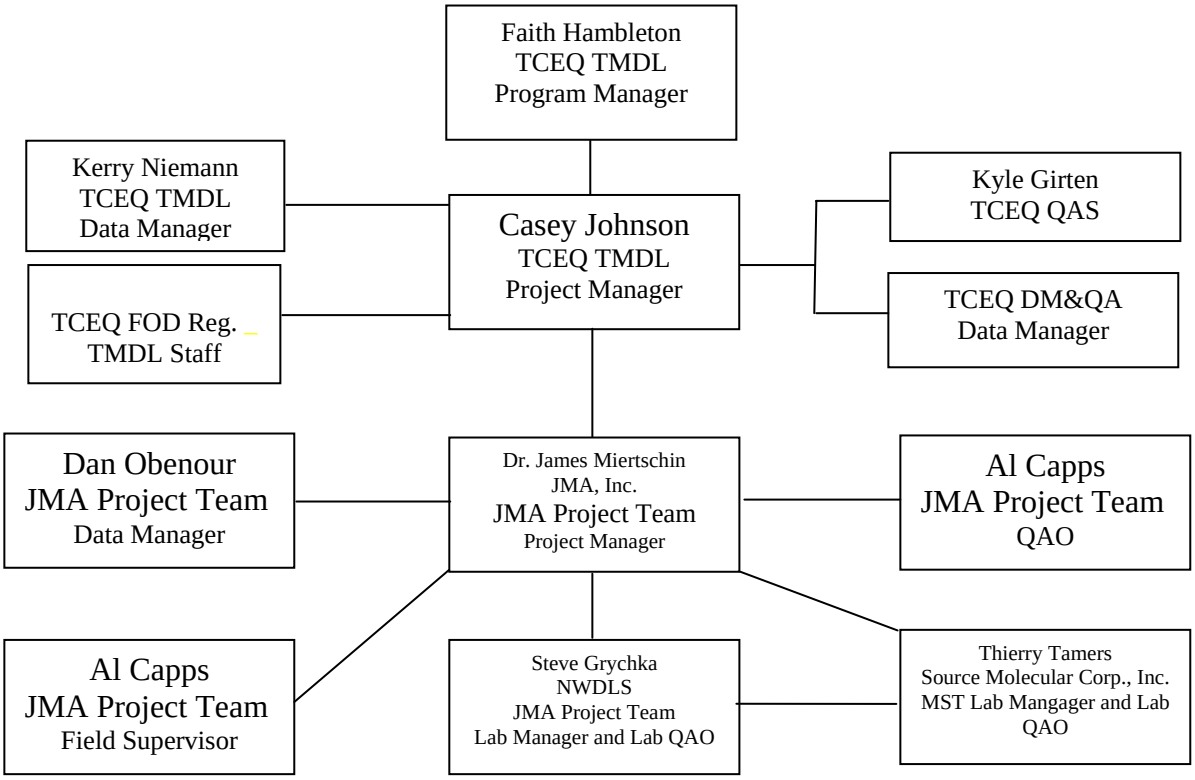
Thierry Tamers
Source Molecular Corporation, Inc.
JMA Project Team Microbial Source Tracking Laboratory Manager
Responsible for supervision of laboratory personnel involved in generating MST data for the project. Responsible for ensuring that laboratory personnel involved in generating analytical data have adequate training and a thorough knowledge of the QAPP and all SOPs specific to the analyses or task performed and/or supervised. Responsible for oversight of all laboratory operations 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.

Thierry Tamers
Source Molecular Corporation, Inc.
JMA Project Team Microbial Source Tracking Laboratory Quality Assurance Officer
Monitors the implementation of the QAM/QAP within the laboratory to ensure complete compliance with project data quality objectives as defined by the contract and in the QAPP. Conducts in-house audits to ensure compliance with written SOPs and to identify potential problems. Responsible for supervising and verifying all aspects of the QA/QC in the laboratory. Performs validation and verification of data before the report is sent to the primary contractor. Ensures that all QA reviews are conducted in a timely manner from real-time review at the bench during analysis to final pass-off of data to the QA Officer.

Dan Obenour
JMA Data Manager
Responsible for the acquisition, verification, and transfer of data to the TCEQ TMDL Project Manager. Oversees data management for the project. Performs data quality assurances prior to transfer of data to TCEQ in the format specified in the SWQM Data Management Reference Guide (2003) or most recent version. Ensures that the data review checklist is completed and data is submitted with appropriate codes. Provides the point of contact for the TCEQ TMDL Project Manager to resolve issues related to the data and assumes responsibility for the correction of any data errors.

Al Capps
JMA Project Team Field Supervisor
Responsible for supervising all aspects of the sampling and measurement of surface waters and other parameters in the field. Responsible for the collection of water samples and field data measurements in a timely manner that meet the quality objectives specified in Section A7 (Table A7.1), as well as the requirements of Sections B1 through B8. Responsible for field scheduling, staffing, and ensuring that staff is appropriately trained. When monitoring activities include TCEQ entities the field supervisor shall coordinate with the TCEQ Project Manager. Reports status, problems, and progress to JMA Project Manager.

Figure A4.1 Organization Chart



A5 PROBLEM DEFINITION/BACKGROUND

Section 303(d) of the Federal Clean Water Act and U.S. Environmental Protection Agency (EPA) regulation 40 CFR 130.7 require states to identify water bodies that do not meet, or are not expected to meet, applicable water quality standards. The compilation of subject water bodies is known as the 303(d) list. Each state must assign priorities to water bodies on the list, in order to schedule development of total maximum daily loads (TMDLs). The TMDL is an allocation of point and nonpoint source pollutant loadings that will enable the water body to meet water quality standards.

The TCEQ selected several waterbodies in the Lake Houston watershed for assessment of water quality. The waterbodies were placed on the 303(d) list for elevated levels of *E. coli* bacteria.

The subject waterbodies on the year 2006 303(d) list are included in Table 5.1:

Table 5.1: Impaired Water Bodies

Segment Number	Water Body Name
1002	Lake Houston
1003	East Fork San Jacinto
1004	West Fork San Jacinto
1004	Crystal Creek
1004	Stewarts Creek
1008	Spring Creek
1008B	Upper Panther Branch
1008	Willow Creek
1009	Cypress Creek
1009	Faulkey Gully
1009	Spring Gully
1009	Little Cypress Creek
1010	Caney Creek
1011	Peach Creek

These impaired segments are located roughly north and northwest of the Houston area. The watersheds include portions of Harris, Montgomery, Waller, Grimes, San Jacinto, and Liberty counties.

This QAPP addresses the monitoring program for the TMDL project. Refer to Appendix A Work Plan for detailed information regarding the background for Segments found in Table 5.1, including the results of prior monitoring and rationale for conducting current monitoring for the segments listed above. The purpose of the QAPP is to clearly delineate the tasks, management structure, and policies which will be used to implement the QA requirements necessary to document the reliability and validity of environmental data. The QAPP is reviewed by the TCEQ to help ensure that data generated for the purposes described above are scientifically valid and legally defensible. This process will insure that all data submitted to the Surface Water Quality Monitoring Information System (SWQMIS) database have been collected and analyzed in a way that guarantees its reliability and therefore can be used in TMDL development, stream standards modifications, permit decisions, and water quality assessments.

A6 PROJECT/TASK DESCRIPTION

The work to be performed and the products to be produced are described in the project work plan (see Appendix A). Maps of the monitoring sites and a monitoring table listing sites, parameters, and monitoring dates are also provided in Appendix A.

QAPP Revision

Until the work described is completed, this QAPP shall be revised as necessary and reissued annually on the anniversary date, or revised and reissued within 120 days of significant changes, whichever is sooner. The last approved versions of QAPPs shall remain in effect until revised versions have been fully approved; the revision must be submitted to the TCEQ for approval before the last approved version has expired. If the entire QAPP is current, valid, and accurately

reflects the project goals and the organization's policy, the annual re-issuance may be done by a certification that the plan is current. This can be accomplished by submitting a cover letter stating the status of the QAPP and a copy of new, signed approval pages for the QAPP.

Amendments

Amendments to the QAPP may be necessary to reflect changes in project organization, tasks, schedules, objectives and methods; address deficiencies and nonconformances; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Requests for amendments are directed from the JMA Project Manager to the TCEQ TMDL Project Manager in writing using the TMDL QAPP Amendment form. The changes are effective immediately upon approval by the TCEQ TMDL Project Manager and Quality Assurance Specialist, or their designees, and the EPA Project Officer (if applicable). Amendments to the QAPP and the reasons for the changes will be documented, and copies of the approved QAPP Amendment form will be distributed to all individuals on the QAPP distribution list by the JMA Project Team QAO.

Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process or within 120 days of the initial approval in cases of significant changes.

A7 QUALITY OBJECTIVES AND CRITERIA

The project objective is to collect data that complies with TCEQ's *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data* for surface water quality monitoring programs, and which may be used to support decisions related to TMDL development, stream standards modifications, permit decisions, and water quality assessments. The measurement performance specifications to support the project objective are specified in Table A7.1.

The QAPP is reviewed by the TCEQ to help ensure that data generated for the purposes described herein are scientifically valid and legally defensible. This review process will also help ensure that data submitted to the SWQMIS database have been collected and analyzed in a way that guarantees its reliability.

Only data collected that have a valid TCEQ parameter code assigned in Table A7.1 will be stored in SWQMIS. Any parameter listed in Table A7.1 that does not have a valid TCEQ parameter code assigned will not be stored in SWQMIS.

Table A7.1 - Measurement Performance Specifications

PARAMETER	UNITS	METHOD	PARAMETER CODES	AWRL	Lab Limit of Detection	Recovery at Lab Limit of Detection	PRECISION (RPD of LCS/LCSD)	BIAS (% Rec. LCS/LCSD mean)	Laboratory Performing Analysis
Field Parameters									
Conductivity	uS/cm	EPA 120.1and TCEQ SOP v1	00094	NA	NA	NA	NA	NA	field
Temperature	◦ C	EPA 170.1and TCEQ SOP v1	00010	NA	NA	NA	NA	NA	field
Flow	cfs	TCEQ SOP v1	00061	NA	NA	NA	NA	NA	field
Chlorine Residual	mg/L	SM 4500-Cl G and TCEQ SOP v1	50060	0.10	NA	NA	NA	NA	field
PARAMETER	**UNITS**	**METHOD**	**PARAMETER CODES**	**AWRL**	**Lab Limit of Detection**	**Recovery at Lab Limit of Detection**	**PRECISION (RPD of LCS/LCSD)**	**BIAS (% Rec. LCS/LCSD mean)**	**Laboratory Performing Analysis**
Conventional Parameters									
E. coli	CFU/100 mL	SM 9213D	31648***	1.0	1.0	NA	3.27*∑Rlog/n*	NA	NWDLS
E. Coli	CFU/100 mL	EPA Method 1603**	31648***	1.0	1.0	NA	3.27*∑Rlog/n*	NA	NWDLS
E. Coli	CFU/100 mL	SM 9222-D+SM9222-G	31700	1.0	1.0	NA	3.27*∑Rlog/n*	NA	NWDLS
E. coli, IDEXX Colilert	MPN/100 mL	SM 9223B	31699	1.0	1.0	NA	0.5*	NA	NWDLS
E. Coli	CFU/100 g	SM 9123D; EPA Method 1603**; SM 922-D+SM922-G; SM 9223B	31702	1.0	1.0	NA	3.27*∑Rlog/n*; 0.5*	NA	SMI

*Based on range statistic as described in Standard Methods, 20th Edition, Section 9020-B, "QA/QC - Intralaboratory QC Guidelines."

**EPA Method 1603 EPA/821/R-02/023. September 2002. Escherichia coli in Water by Membrane Filtration Using Modified membrane-Thermotolerant Escherichia coli Agar (modified mTEC.). Web link to EPA Method 1603: http://epa.gov/waterscience/methods/biological/1603escherichiacoli.pdf

*** New parameter codes will be requested prior to data submittal

Note: Multiple methods for E. coli analyses are listed so that JMA has the flexibility to choose a method of analysis based on available sample collection media, lab analytical capability, etc. EPA Method 1603 will be the preferred method of *E. Coli* analysis. If EPA Method 1603 is unavailable, SM 9223B, SM922-D+SM922-G, or SM 9213D will be used in decreasing order of preference.

References for Table A7.1:

United States Environmental Protection Agency (USEPA), "Methods for Chemical Analysis of Water and Wastes," Manual #EPA-600-4-79-020

American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), "Standard Methods for the Examination of Water and Wastewater," 20th Edition, 1998 (NOTE: The 21st edition may be cited if it becomes available).

TCEQ, 2003 (RG-415). *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue,* (December 2003).

Ambient Water Reporting Limits and Laboratory Reporting Limits

The laboratory will not perform Ambient Water Reporting Limits (AWRL) verification for *E. coli* tests. The AWRL for *E. coli* would nominally be 1 colony/100 ml. However, the actual reporting limit may vary from sample to sample depending upon the organism density and the dilutions employed for each sample.

Precision

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

Laboratory precision is assessed by comparing replicate analyses of laboratory control samples in the sample matrix (e.g. deionized water, sediment, commercially available tissue) or sample/duplicate pairs in the case of bacteria analysis. Precision results are compared against measured performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for precision are defined in Table A7.1

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.

Bias

Bias cannot be directly measured for bacterial samples. Bias will be assessed through the analysis of positive and negative controls.

Representativeness

Much of the data collected under the TMDL Program will be considered representative of ambient water quality conditions. This data will be coded with the Monitoring Type Code BF in Appendix A, Tables 3-1 to 3-18. BF reflects samples that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for sample to be taken.

Representativeness is a measure of how accurately a monitoring program reflects the actual water quality conditions. The representativeness of the data is dependent on 1) the sampling locations, 2) the number of samples collected, 3) the number of years and seasons when sampling is performed, 4) the number of depths sampled, and 5) the sampling procedures. Site selection and sampling of all pertinent media and use of only approved analytical methods will assure that the measurement data represents the conditions at the site.

The goal for meeting total representation of the water body is tempered by the availability of time and funding. Representativeness will be measured with the completion of samples collected in accordance with the approved QAPP and sampling plan.

Comparability

Confidence in the comparability of data sets from this project and those for similar uses is based on the commitment of project staff to use only approved sampling and analysis methods and QA/QC protocols in accordance with quality system requirements and as described in this QAPP. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for significant figures, and by reporting data in a standard format as specified in the *Data Management Plan* (Appendix E), SWQM DMRG, and other data reporting forms included in this QAPP.

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(s) that 90% data completion is achieved.

A8 SPECIAL TRAINING/CERTIFICATION

Field personnel will receive training in proper sampling and field analysis. Before actual sampling or field analysis occurs, they will demonstrate to the JMA Project Team QA Officer their ability to properly calibrate field equipment and perform field sampling and analysis procedures. Training will be documented and retained in the JMA Project Team personnel file and be available during a monitoring systems audit.

Contractors and subcontractors must ensure that laboratories analyzing samples under this QAPP meet the requirements contained in section 5.4.4 of the NELAC standards (concerning Review of Requests, Tenders, and Contracts). Laboratory analysts have a combination of experience, education, and training to demonstrate knowledge of their function.

Global Positioning System (GPS) training and certification are required in accordance with TCEQ Operating Policies 8.12: Global Positioning System. Certification can be obtained by: 1) completing an agency training class, 2) completing a suitable training class offered by an outside vendor, or 3) by providing documentation of sufficient GPS expertise and experience.

A9 DOCUMENTS AND RECORDS

The document and records that describe, specify, report, or certify activities, requirements, procedures, or results for this project and the items and materials that furnish objective evidence of the quality of items or activities are listed.

Table A9.1 Project Documents and Records

Document/Record	Location	Retention	Form
QAPP, amendments, and appendices	JMA, Inc.	5 years	Paper
QAPP distribution documentation	JMA, Inc.	5 years	Paper
Field notebooks or field data sheets	JMA, Inc.	5 years	Paper
Field equipment calibration/maintenance logs	JMA, Inc.	5 years	Paper
Chain of custody records	JMA, Inc.	5 years	Paper
Field SOPs	JMA, Inc.	5 years	Paper
Field corrective action documentation	JMA, Inc.	5 years	Paper
Bacteriological field sample logs	JMA, Inc.	5 years	Paper
Media/incubation logs	NWDLS	5 years	Paper
Laboratory sample reception logs	NWDLS	5 years	Paper
Laboratory QA manuals	NWDLS	5 years	Paper
Laboratory SOPs	NWDLS	5 years	Paper
Laboratory internal/external standards	NWDLS	5 years	Paper
Instrument raw data files	NWDLS	5 years	Electronic*
Instrument readings/printouts	NWDLS	5 years	Paper
Laboratory data reports	JMA, Inc.	5 years	Paper
Laboratory data verification for integrity, Precision, and validation	NWDLS	5 years	Paper
Laboratory equipment maintenance logs	NWDLS	5 years	Paper
Laboratory calibration records	NWDLS	5 years	Electronic*
Laboratory corrective action documentation	NWDLS	5 years	Paper
JMA, Inc. data verification/validation	JMA, Inc.	5 years	Paper/Electronic*
TMDL data files	JMA, Inc./TCEQ	3 years	Paper/Electronic*
Progress report/final report/data	JMA, Inc./TCEQ.	3 years	Paper/Electronic*

*Electronic files should be ASCII (DOS) pipe delimited text files. The file format is described in the SWQM DMRG.

The TCEQ may elect to take possession of records at the conclusion of the specified retention period. Laboratory Records must be retained in accordance with the NELAC standards (NELAC standards Section 5.4.12) after July 1, 2008.

Laboratory Data Reports

Test/data reports from the laboratory must document the test results clearly and accurately. Routine data reports should be consistent with the NELAC 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.

The test report will include the information necessary for the interpretation and validation of data and will include the following:

- project/report title
- 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 (i.e., holding times exceeded)
- date of sample receipt
- narrative information on QC failures or deviations from requirements that may affect the quality of results.
- sample results
- units of measure
- sample matrix
- dry weight or wet weight (as applicable)
- station information
- date of collection
- sample depth
- LOQ and LOD, and qualification of results outside the working range (if applicable)
- Certification of NELAC compliance on a result by result basis

Electronic Data

The JMA Project Team will use the electronic data reporting formats included in the most recent version of the SWQM Data Management Reference Guide. A completed data review checklist (see Appendix F) will accompany each set of electronic data.

References

TCEQ, 2007, (or most recent version). *Surface Water Quality Monitoring Data Management Reference Guide*. (March 2007)
http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wdma/dmrg_index.html

TCEQ, 2003 (or most recent version). *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediments and Tissue* (March 2003)

TCEQ, 2006. Program *Guidance & Reference Guide FY 2007-2008*, Texas Clean Rivers Program.

Warning: When references are made to documents that are not attached to the QAPP, the Project Manager/QAO of the Lead Organization should assume responsibility for compliance of the documentation with the procedures and requirements set forth in the QAPP.

B1 SAMPLING PROCESS DESIGN

See Appendix A for sampling process design and monitoring schedule associated with data collected under this QAPP.

B2 SAMPLING METHODS

The JMA Project Team will follow the field sampling procedures documented for field and biological parameters documented in TCEQ Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue (December 2003) and the TCEQ Receiving Water Assessment Procedures Manual (TCEQ, 1999b). Water samples will be collected directly in sterile polyurethane and/or glass bottles or Whirlpak bags for bacterial analysis, or they may be collected with decontaminated buckets or dippers and transferred to the sample container. Additional procedures for field sampling outlined in this section reflect specific requirements for sampling under the TMDL Project and/or provide additional clarification.

Field Sampling Procedures

The JMA Project Team will follow the field sampling procedures documented in the TCEQ *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (2003) and *Volume 2: Methods for Collecting and analyzing Biological Community and Habitat Data* (2005). Additional procedures for field sampling outlined in this section reflect specific requirements for sampling under this TMDL Project and/or provide additional clarification. These additional procedures must be consistent with TCEQ field sampling procedures.

Sample Volume, Container Types, Minimum Sample Volume, Preservation Requirements, and Holding Time Requirements.

Table B2.1 Field Sampling and Handling Procedures

Parameter	Matrix	Container	Preservation	Sample Volume	Holding Time
Temperature (probe)	Water	N/A	N/A	N/A	N/A
Conductivity (probe)	Water	N/A	N/A	N/A	N/A
Flow	Water	N/A	N/A	N/A	N/A
Residual Chlorine	Water	N/A	N/A	N/A	N/A
E. Coli	Water	Polyurethane or glass bottle, or Whirlpak bag	4º C, dark, sodium thiosulfate[1]	100-250 mL	6+2 hrs[2]
E. coli, IDEXX Colilert	Water	Polyurethane or glass bottle, or Whirlpak bags	4º C, dark, sodium thiosulfate[1]	400 mL	6+2 hrs[2]
E. coli	Sed.	Polyurethane or glass bottle, or Whirlpak bags	4º C, dark, sodium thiosulfate[1]	100-250 ml	6+2 hrs[2]

[1] Sodium thiosulfate will be used if residual chlorine is suspected to be present
[2] This holding time represents 6 field hours and 2 lab hours

Sample Containers

Sample containers are purchased pre-cleaned and pre-sterilized for bacteriological samples. Either polyurethane or glass bottles or Whirlpak bags are used for bacteriological samples. Sterilized bottles may be purchased with a sodium thisulfate tablet added to each. This dechlorination agent then is present in case the collected sample contains residual chlorine. Alternatively, a 1% sodium thiosulfate tablet will be added if residual chlorine is suspected to be present.

Processes to Prevent Cross Contamination

The TCEQ *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (2003) outlines the necessary steps to prevent cross-contamination of samples. These may include direct collection into sample containers, when possible. Field QC samples as discussed in Section B5 are collected to verify that cross-contamination has not occurred.

Documentation of Field Sampling Activities

Field sampling activities are documented on field data sheets as presented in Appendix C. Flow work sheets, multi-probe calibration records, and records of bacteria analyses (if applicable) are part of the field data record. For all visits, station ID, location, sampling time, sampling date, sampling depth, preservatives added to samples and sample collector's name/signature are recorded. Values for all measured field parameters are also recorded. Detailed observational data are recorded including water appearance, weather, biological activity, stream uses, unusual

odors, specific sample information, missing parameters (items that were to have been sampled that day, but weren't), days since last significant rainfall, and flow severity.

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, waterproof ink with no modifications, write-overs or cross-outs;
2. Correction of errors with a single line followed by an initial and date;
3. Close-outs on incomplete pages with an initialed and dated diagonal line.

Deviations from Sampling Method Requirements or Sample Design, and Corrective Action

Examples of deviations from sampling method requirements or sample design include but are not limited to such things as inadequate sample volume due to spillage or container leaks, failure to preserve samples appropriately, contamination of a sample bottle during collection, storage temperature and holding time exceedance, sampling at the wrong site, etc. Any deviations will invalidate resulting data and may require corrective action. Corrective action may include for samples to be discarded and re-collected. It is the responsibility of the JMA Project Manager, in consultation with the JMA QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the TMDL Project Manager both verbally and in writing in the project progress reports and by completion of a corrective action report (CAR).

Corrective Action Reports document: root cause(s); programmatic impact(s); specific corrective action(s) to address any deviations; 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 project 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 TCEQ immediately both verbally and in writing.

B3 SAMPLE HANDLING AND CUSTODY

Chain-of -Custody

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

A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The COC form is used to document sample handling during transfer from the field to the laboratory and among contractors. The list of items below is included on the COC form (See Appendix D for sample form).

1. Date and time of sample collection, shipping and receiving
2. Site identification
3. Sample matrix
4. Number of containers
5. Preservative used or if the sample was filtered
6. Analyses required
7. Name of collector
8. Custody transfer signatures and dates and time of transfer
9. Name of laboratory admitting the sample
10. Bill of lading *(if applicable)*

Sample Labeling

Samples are labeled on the container with an indelible, waterproof marker. Label information includes the site identification, the date and time of sampling, sample type (e.g., conventional water parameters, organics), the preservative added if applicable.

Sample Handling

EC analysis in water

Sterile polyurethane or glass bottles or Whirlpak bags will be used to collect the *E. coli* samples. If residual chloride is suspected to be present sodium thiosulfate tablets will be used in the sampling containers. Samples will be sealed and carried in ice chests from the point of collection to the laboratory or delivered by a laboratory representative. The laboratory data manager will receive a copy of the COC and will log in the samples at the laboratory including both time of collection and time of reception of each sample, as well as the temperature measured from a temperature blank. If the temperature exceeds 4 C, the lab will document if wet ice is present. If ice is present, the temperature could be attributed to a short hold time that did not allow the samples to cool to 4º C. Samples will be acceptable if they were placed on ice immediately after collection and remain on wet ice upon receipt by the laboratory. Sample preparation will be initiated within eight hours after the sample is collected. To insure that the holding time criterion is met, the laboratory data manager will receive a copy of the COC and will log in the samples at the laboratory including both time of collection and time of reception of each sample.

EC analysis in sediment

Sterile polyurethane or glass bottles or Whirlpak bags will be used to collect sediment samples. Samples will be sealed and carried in ice chests from the point of collection to NWDLS, or a representative from the lab will meet the sampling crew in the field and deliver the samples to the lab. The laboratory data manager will receive a copy of the COC and will log in the samples at the laboratory including both time of collection and time of reception of each sample, as well as the temperature measured from the temperature blank. The indirect enumeration of microorganisms from a sediment sample will involve transferring the organisms from the sample into a water phase. The sediment-to-water transference will start as soon as possible after the

samples are logged in at the laboratory but in all cases in less than eight hours after sample collection.

Failures in Chain-of-Custody and Corrective Action

All failures associated with chain-of-custody procedures as described in this QAPP are immediately reported to the JMA Project Manager. 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. The JMA Project Manager in consultation with the JMA QAO will determine if the procedural violation may have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data validity will invalidate data and the sampling event should be repeated. The resolution of the situation will be reported to the TCEQ TMDL Project Manager in the project progress report. Corrective action reports will be prepared by the JMA QAO and submitted to TCEQ TMDL Project Manager along with project progress report.

Corrective Action Reports (CARs) document: root cause(s); programmatic impact(s); specific corrective action(s) to address any deviations; 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 project 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 TCEQ immediately both verbally and in writing.

B4 ANALYTICAL METHODS

The analytical methods are listed in Table A7.1 of Section A7. Procedures for laboratory analysis will be in accordance with the most recently published edition of *Standard Methods for the Examination of Water and Wastewater*, the latest version of the TCEQ *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (2003), *Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data* (2005), 40 CFR 136, or other reliable procedures acceptable to TCEQ.

Laboratories collecting data under this QAPP are, at a minimum, compliant with ISO/IEC Guide 25 and will be NELAC accredited by July 1, 2008. Copies of laboratory SOPs are retained by the JMA Project Team and are available for review by the TCEQ. Laboratory SOPs are consistent with EPA requirements as specified in the method.

Standards Traceability

All standards used in the field and laboratory are traceable to certified reference materials. Standards preparation is fully documented and maintained in a standards log book. 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 or signature. The reagent bottle will be labeled in a way that will trace the reagent back to preparation.

Analytical Method Modification

Only data generated using approved analytical methodologies as specified in this QAPP will be submitted to the TCEQ. Requests for method modifications will be documented on form TCEQ-10364, the *TCEQ Application for Analytical Method Modification*, and submitted for approval to the TCEQ Quality Assurance Section. Work will only begin after the modified procedures have been approved.

Failures in Measurement Systems and Corrective Actions

Failures in field and laboratory measurement systems involve, but are not limited to such things as instrument malfunctions, failures in calibration, blank contamination, quality control samples outside QAPP defined limits, etc. In many cases, the field technician or lab analyst will be able to correct the problem. If the problem is resolvable by the field technician or lab analyst, then they will document the problem on the field data sheet or laboratory record and complete the analysis. If the problem is not resolvable, then it is conveyed to the JMA Laboratory Supervisor, who will make the determination and notify the JMA QAO. If the analytical system failure may compromise the sample results, the resulting data will not be reported to the TCEQ as part of this study. The nature and disposition of the problem is reported on the data report which is sent to the JMA Project Manager. The JMA Project Manager will include this information in the CAR and submit with the Progress Report which is sent to the TCEQ TMDL Project Manager.

Corrective Action Reports document: root cause(s); programmatic impact(s); specific corrective action(s) to address any deviations; 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 project 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 TCEQ immediately both verbally and in writing.

B5 QUALITY CONTROL

Sampling Quality Control Requirements and Acceptability Criteria

The minimum Field QC Requirements are outlined in the *TCEQ Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (2003) and *Volume 2: Methods for Collecting and analyzing Biological Community and Habitat Data* (2005). Specific requirements are outlined below. Field QC samples are reported with the laboratory data report (See Section A9 and C2).

<u>Field splits</u> - A field split is a single sample subdivided by field staff immediately following collection and submitted to the laboratory as two separate, identified samples according to procedures specified in the *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 on a 10% basis or one per batch, whichever is greater.

The precision of field split results is calculated by relative percent difference (RPD) using the following equation:

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

For bacteria, the logarithms of the actual counts are used in this formula. Field splits will be collected at a frequency of 10% or greater.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Detailed laboratory QC requirements are contained within each individual method and laboratory quality assurance manuals (QAMs). The minimum requirements that all participants abide by are stated below. Lab QC sample results are reported with the laboratory data report (see Section C2 and A9).

Laboratory duplicate - Laboratory duplicates are used to assess precision. A laboratory duplicate is prepared by splitting aliquots of a single sample (or a matrix spike or a laboratory control standard) in the laboratory. Both samples are carried through the entire preparation and analytical process. Laboratory duplicates are run at a rate of one per batch. Acceptability criteria are outlined in Table A7.1 of Section A7.

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 laboratory. 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. Precision limits for bacteriological analyses are defined in Table A7.1 and applies to samples with concentrations >10 org/100 ml.

Method 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 laboratory's reporting limit. 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.

Control Cultures – Each new lot of modified mTEC media is tested with positive control cultures (known *E. coli*) to verify that it supports growth of *E. coli*, and negative control cultures (known non-*E. coli* bacteria) to ensure the selectivity of the media.

Colony Verification – For initial test of analyst capability, and with each new batch of media, ten red or magenta presumed *E. coli* colonies from one or more completed tests are verified as *E. coli* through procedures described in this method.

Failures in Quality Control and Corrective Action

Sampling QC excursions are evaluated by the JMA Project Manager, in consultation with the JMA QAO. In that differences in sample results are used to assess the entire sampling process, including environmental variability, the arbitrary rejection of results based on pre-determined limits is not practical. Therefore, the professional judgment of the JMA Project Manager and QAO will be relied upon in evaluating results. Rejecting sample results based on wide variability is a possibility. Notations of field split excursions and blank contamination are noted in the quarterly report and the final QC Report.

Corrective action will involve identification of the cause of the failure where possible. Response actions will typically include re-analysis of questionable samples. In some cases, a site may have to be re-sampled to achieve project goals.

Laboratory measurement quality control failures are evaluated by the laboratory staff. The disposition of such failures and conveyance to the TCEQ is discussed in Section B4 under Failures in Measurement Systems and Corrective Actions.

Corrective Action Reports document: root cause(s); programmatic impact(s); specific corrective action(s) to address any deviations; 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 project 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 TCEQ immediately both verbally and in writing.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

All sampling equipment testing and maintenance requirements are detailed in the TCEQ *Surface Water Quality Monitoring Procedures*. 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 by the JMA Field Supervisor, or designee.

All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory QAM(s). Instruments requiring daily or in-use testing may include, but are not limited to, water baths, ovens, autoclaves, incubators, refrigerators, and laboratory pure water. Critical spare parts for essential equipment are maintained to prevent downtime. Testing and maintenance records are available for inspection by the TCEQ. The JMA Project Manager assumes responsibility for compliance of the QAM Quality Assurance Management Plan from the laboratory with the QAPP requirements.

B7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Field equipment calibration requirements are contained in the TCEQ *Surface Water Quality Monitoring Procedures*. Post calibration error limits and the disposition resulting from error are adhered to. Data not meeting post-error limit requirements invalidates associated data collected subsequent to the pre-calibration and are not submitted to the TCEQ.

Detailed laboratory calibrations are contained within the QAM(s). The laboratory QAM identifies all tools, gauges, instruments, and other sampling, measuring, and test equipment used for data collection activities affecting quality that must be controlled and, at specified periods, calibrated to maintain bias within specified limits. Calibration records are maintained, are traceable to the instrument, and are available for inspection by the TCEQ. Equipment requiring periodic calibrations includes, but is not limited to, thermometers, pH meters, balances, incubators, turbidity meters, and analytical instruments.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

All new batches of field and laboratory supplies are inspected and tested before use to ensure that they are adequate and not contaminated. Acceptance criteria are detailed in supplier's purchasing manual. The laboratory QAM provides additional details on the acceptance requirements for laboratory supplies and consumables.

B9 NON-DIRECT MEASUREMENTS

Only data collected directly under this QAPP will be submitted to the SWQMIS database. Sampling conducted by the TCEQ, the USGS, Texas Clean Rivers Program partners, and Texas Watch quality-assured volunteer monitors is not covered under this QAPP and will not be reported to the TCEQ Data Manager by the JMA. However, data collected by the above organizations that meet the data quality objectives of this project may be useful in satisfying the data and informational needs of the TMDL. The collection and qualification of the TCEQ and USGS data are addressed in the TCEQ Surface Water Quality Monitoring QAPP. The collection and qualification of the Texas CRP data are addressed in the Texas Clean Rivers Program QAPP. The collection and qualification of the Texas Watch volunteer monitoring data are addressed in the Southwest Texas State University Texas Watch QAPP.

B10 DATA MANAGEMENT

Data Management Protocols are addressed in the Data Management Plan which is in Appendix E of this document.

References

TCEQ, 2007, (or most recent version). *Surface Water Quality Monitoring Data Management Reference Guide*. (March 2007)
http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wdma/dmrg_index.html

TCEQ, 2003 (or most recent version). *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediments and Tissue* (March 2003).

TCEQ, 1999c. *Receiving Water Assessment Procedures Manual*, GI-253 (June 1999).

Warning: When references are made to documents that are not attached to the QAPP, the Project Manager/QAO of JMA should assume responsibility for compliance of the documentation with the procedures and requirements set forth in the QAPP.

C1 ASSESSMENTS AND RESPONSE ACTIONS

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

Table C1.1 Assessments and Response Actions

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	JMA Project Manager	Monitoring of the project status and records to ensure requirements are being fulfilled. Monitoring and review of contract laboratory performance and data quality	Report to TCEQ in Quarterly Report. Ensure project requirements are being fulfilled.
Laboratory Inspections	Dates to be determined by the TCEQ lab inspector	TCEQ Laboratory Inspector	Analytical and quality control procedures employed at the laboratory and the contract laboratory	30 days to respond in writing to the TCEQ to address corrective actions
	Annually	NWDLS QAO		Implements corrective action. Inspection Report will be available for review by TCEQ
Monitoring Systems Audit	Dates to be determined by TCEQ	TCEQ QAS	Field sampling, handling and measurement; facility review; and data management as they relate to the TMDL Project	30 days to respond in writing to the TCEQ to address corrective actions
	Annually	JMA QAO		Report sent to TCEQ Project Manager. Resolves any deficiencies.

Corrective Action

The JMA Project Manager is responsible for implementing and tracking corrective action procedures as a result of audit findings. Records of audit findings and corrective actions are maintained by the TCEQ Project Manager and JMA Quality Assurance Officer. Corrective action documentation will be submitted to the TCEQ TMDL Project Manager with the progress report.

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

C2 REPORTS TO MANAGEMENT

Laboratory Data Reports

Laboratory data reports contain the results of all specified QC measures listed in section B5, including but not limited to laboratory blanks and laboratory duplicates. This information is reviewed by the JMA QAO and compared to the pre-specified acceptance criteria to determine acceptability of data before forwarding to the JMA Project Manager. This information is available for inspection by the TCEQ.

Reports to TCEQ Project Management

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

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

Monitoring Systems Review Audit Report and Response - Following any audit performed by the JMA, a report of findings, recommendations and responses are sent to the TCEQ project manager in the quarterly/monthly progress report.

Reports by TCEQ Project Management

Contractor Evaluation - The JMA is evaluated in a Contractor Evaluation by the TCEQ annually for compliance with administrative and programmatic standards. Results of the evaluation are submitted to the TCEQ Financial Administration Division, Procurements and Contracts Section.

D1 DATA REVIEW, VERIFICATION AND VALIDATION

For the purposes of this document, verification refers to the processes taken to determine compliance of data with project requirements, including documentation and technical criteria. Validation means those processes taken independently of the data-generation processes to determine the usability of data for its intended use(s). Integrity means the processes taken to assure that no falsified data will be reported.

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

The procedures for verification and validation of data are described in Section D2, below. The JMA Field Supervisor is responsible for ensuring that field data are properly reviewed and verified for integrity. The Laboratory Supervisor is responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and accuracy, and reviewed for integrity. The JMA Data Manager will be responsible for ensuring that all data are properly reviewed and verified, and submitted in the required format as described in the latest version of the SWQM Data Management Reference Guide to the TCEQ Project Manager. Finally, the JMA Project Manager, with the concurrence of the JMA QAO, are responsible for validating that all data to be reported meet the objectives of the project and are suitable for reporting to TCEQ.

D2 VERIFICATION AND VALIDATION METHODS

All field and laboratory data will be reviewed, verified and validated to ensure they conform to project specifications and meet the conditions of end use as described in Section A7. The staff and management of the respective field, laboratory, and data management tasks are responsible for the integrity, validation and verification of the data each task generates or handles throughout each process. The field and laboratory tasks ensure the verification of raw data, electronically generated data, and data on chain-of-custody forms and hard copy output from instruments.

Verification, validation and integrity review of data will be performed using self-assessments and peer review, as appropriate to the project task, followed by technical review by the manager of the task. The data to be verified (listed by task in Table D2.1) are evaluated against project specifications (Section A7) and are checked for errors, especially errors in transcription, calculations, and data input. Potential outliers are identified by examination for unreasonable data, or identified using computer-based statistical software. 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 which 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 performance of these tasks is documented by completion of the data review checklist (Appendix F) by the JMA Data Manager.

The JMA Project Manager and QAO are each responsible for validating that the verified data are scientifically valid, legally defensible, of known precision, accuracy, integrity, meet the data quality objectives of the project, and are reportable to TCEQ. One element of the validation process involves evaluating the data again for anomalies. The JMA QAO or Project Manager may designate other experienced water quality experts familiar with the water bodies under investigation to perform this evaluation. Any suspected errors or anomalous data must be addressed by the manager of the task associated with the data, before data validation can be completed.

A second element of the validation process is consideration of any findings identified during the monitoring systems audit conducted by the JMA QAO or TCEQ QAS assigned to the project. Any issues requiring corrective action must be addressed, and the potential impact of these issues on previously collected data will be assessed. Finally, the JMA Project Manager, with the concurrence of the QAO validates that the data meet the data quality objectives of the project and are suitable for reporting to TCEQ.

Table D2.1 Data Verification Procedures

Tasks	**Responsible Entity/Individual**
Field Data Review	
Field data reviewed for conformance with data collection procedures, sample handling and chain of custody, analytical and QC requirements	JMA
Post calibrations checked to ensure compliance with error limits	JMA
Field data calculated, reduced, and transcribed correctly	JMA
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	JMA and NWDLS
Laboratory data calculated, reduced, and transcribed correctly	JMA and NWDLS
Reporting limits consistent with requirements for AWRLs	JMA and NWDLS
Analytical data documentation evaluated for consistency, reasonableness and/or improper practices	JMA and NWDLS
Analytical QC information evaluated to determine impact on individual analyses	JMA and NWDLS
All laboratory samples analyzed for all parameters	JMA and NWDLS
Data Set Review	
The test report has all required information as described in Section A9 of the QAPP	JMA
Confirmation that field and lab data have been reviewed	JMA
Data set (to include field and laboratory data) evaluated for reasonableness and if corollary data agree	JMA
Outliers confirmed and documented	JMA

Tasks	Responsible Entity/Individual
Field QC acceptable (e.g., field splits and trip, field and equipment blanks)	JMA
Sampling and analytical data gaps checked and documented	JMA
Verification and validation confirmed. Data meets conditions of end use and are reportable	JMA

D3 RECONCILIATION WITH USER REQUIREMENTS

No decisions will be made by the project team based on the data collected. These data, and data collected by other organizations (e.g., USGS, TCEQ, etc.), may be subsequently analyzed and used by the TCEQ for TMDL development, stream standards modifications, permit decisions, and water quality assessments. Data which do not meet requirements will not be submitted to the SWQMIS nor will be considered appropriate for any of the uses noted above.

APPENDIX A. WORK PLAN

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MONITORING PLAN
LAKE HOUSTON WATERSHED BACTERIA TMDLS PROJECT

Prepared For:

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1.0 INTRODUCTION

Section 303(d) of the Federal Clean Water Act and U.S. Environmental Protection Agency (EPA) regulation 40 CFR 130.7 require states to identify waterbodies that do no meet, or are not expected to meet, applicable water quality standards. The compilation of subject waterbodies is known as the 303(d) list. Each state must assign priorities to waterbodies on the list, in order to schedule development of total maximum daily loads (TMDLs). The TMDL is an allocation of point and nonpoint source pollutant loadings that will enable the waterbody to meet water quality standards.

The Texas Commission on Environmental Quality (TCEQ) is responsible for the monitoring and assessment of water quality to evaluate compliance with State water quality standards. Pursuant to the Clean Water Act, one of the areas of TCEQ responsibility is the development of the 303(d) list for Texas and subsequent development of TMDLs.

1.1 PROJECT AREAS

The TCEQ selected several waterbodies in the Lake Houston watershed for assessment of water quality. The waterbodies were placed on the 303(d) list for elevated levels of *E. coli* bacteria.

The subject waterbodies on the year 2006 303(d) list are included in table 1-1:

Table 1-1: Impaired Water Bodies

Segment Number	Water Body Name
1002	Lake Houston
1003	East Fork San Jacinto
1004	West Fork San Jacinto
1004	Crystal Creek
1004	Stewarts Creek
1008	Spring Creek
1008B	Upper Panther Branch
1008	Willow Creek
1009	Cypress Creek
1009	Faulkey Gully
1009	Spring Gully
1009	Little Cypress Creek
1010	Caney Creek
1011	Peach Creek

These impaired segments are located roughly north and northwest of the Houston area. The watersheds include portions of Harris, Montgomery, Waller, Grimes, San Jacinto, and Liberty counties.

1.2 OBJECTIVES AND SCOPE

The objective of this report is to prepare a monitoring plan for the study segments in order to provide additional water quality data for assessment purposes, provide data to support technical analysis of problems, identify potential sources of bacterial contamination, and support appropriate determination of bacterial loadings for establishment of TMDLs, as needed.

1.3 BACKGROUND DATA

An overview of the available *E. coli* data for these segments was included in the *Preliminary Data Review: Lake Houston Watershed Bacteria Impairments*, developed by James Miertschin & Associates in August, 2007. As a general statement, all of the impaired segments had monitoring stations that showed exceedance of the geometric mean criterion for *E. coli*. A summary of segments, monitoring stations, number of *E. coli* samples, and geometric means is provided in Table 1-2.

The study area segments generally have an adequate number of monitoring stations with sufficient data available to calculate geometric means of *E. coli* with confidence. On most segments, there are more than one monitoring station that demonstrate exceedance of the geometric mean criterion. But on some segments, there is only a single monitoring station that shows noncompliance. The spatial coverage of the routine monitoring stations appears to be sufficient to define the general extent of impairment for most segments, but most segments would benefit from additional spatial coverage. Preparation of preliminary load duration curves also indicates that the segments have generally good distribution of data over a range of hydrologic regimes. The *E. coli* data are adequate to quantify bacteria loads conveyed by the watercourse at the monitoring locations under different flow regimes.

All of the study segments would benefit from additional sampling that is designed to identify and quantify the sources of bacteria. A variety of sampling activities are prescribed in order to provide the data needed to better define bacteria sources and source areas. These sampling activities are described in subsequent sections.

No additional sampling is proposed in this project for Lake Houston Segment 1002. The monitoring station that indicated impairment has a large number of data points, and agency-sponsored monitoring is scheduled to continue on a frequent schedule. The additional sampling exercises proposed in this study for the major tributaries in the Lake Houston watershed are expected to provide data regarding potential sources of bacteria that enter the reservoir. If sampling crews encounter suspected sources of bacteria in the immediate vicinity of the reservoir, additional samples can be collected. Technical presentations to stakeholders during the project will provide an opportunity for the public to comment or note potential trouble spots.

Table 1-2: *E. coli* Data Summary

Segment	Sta. ID	Monitoring Station Location	Start Date	End Date	Number of Samples	*E.coli* Geomean (org/100mL)
1002, Lake Houston						
	11213	LAKE HOUSTON AT US 59	Jun-00	Jun-06	192	211
	18669	LAKE HOUSTON AT WEST LAKE HOUSTON PARKWAY	Dec-01	May-05	278	102
	18667	LAKE HOUSTON WEST FORK SAN JACINTO	Jun-00	May-05	57	92
1003, East Fork						
	17431	E FK SAN JACINTO RIV AT SH 150	Mar-02	Jul-04	11	197
	14242	E.F. SAN JACINTO RIVER AT US59	Jun-00	Apr-05	39	199
	11235	E FK SAN JACINTO R AT FM 1485	Jun-00	May-05	86	198
1004, West Fork						
	11251	W FORK SAN JACINTO R AT SH 105	Jun-00	Apr-05	41	69
	11250	W FK SAN JACINTO AT FM 2854	Oct-04	Jul-06	8	178
	16626	STEWARTS CREEK AT SH LOOP 336	Jun-00	Apr-05	91	229
	16624	W FK SAN JACINTO RIV AT SH 242	Jun-00	Apr-05	41	170
	16635	CRYSTAL CREEK AT SH 242	Jun-00	Apr-05	89	164
1008, Spring Creek						
	11323	SPRING CREEK AT DECKER PRAIRIE	Jan-02	May-05	41	346
	11314	SPRING CREEK AT SH 249	Jun-00	Apr-05	39	351
	17489	SPRING CREEK AT KUYKENDAHL RD	Jan-02	May-05	42	432
	11185	WILLOW CREEK AT GOSLING ROAD	Jan-02	May-05	41	483
	11313	SPRING CREEK BRIDGE AT IH45	Jun-00	Apr-05	40	271
	11312	SPRING CREEK AT RILEY FUZZEL RD	Dec-01	May-05	42	370
1008B, Panther Branch System (Spring Creek)						
	16629	UPB UPSTREAM OF WWTP 2 OUTFALL	Oct-02	Jul-05	12	141
	16630	UPB DOWNSTREAM OF WWTP 2	Oct-02	Jul-05	12	200
1008C, Lower Panther Branch System						
	16627	L PANTHER BR OF SAWDUST RD	Oct-02	Jul-05	12	177
	16628	L PANTHER BR DOWNSTREAM WWTP 1	Oct-02	Jul-05	12	179
1008E, Bear Branch System						
	16631	BEAR BRANCH AT RESEARCH FOREST	Mar-99	Jul-05	18	202
1008F, Lake Woodlands						
	16484	LK WOODLANDS AT NORTH END	Oct-02	Jul-05	12	53
	16483	LK WOODLANDS AT MID POINT	Oct-02	Jul-05	12	39
	16481	LK WOODLANDS AT WESTERN REACH	Oct-02	Jul-05	12	67
	16482	LK WOODLANDS AT SOUTH END	Oct-02	Jul-05	12	65
1009, Cypress Creek						
	11333	CYPRESS CREEK AT HOUSE HAHL ROAD	Jan-02	May-05	41	291
	14159	LITTLE CYPRESS CREEK AT KLUGE RD	Jan-02	May-05	41	589
	11332	CYPRESS CREEK AT GRANT ROAD	Jan-01	May-06	61	405
	17496	FAULKEY GULLY AT LAKEWOOD FOREST DR	Jan-02	May-05	42	555
	11331	CYPRESS CREEK AT SH 249	Jun-00	Apr-05	41	573
	11330	CYPRESS CK AT STEUBNER AIRLINE	Jan-02	May-05	42	642
	17481	SPRING GULLY AT SPRING CREEK OAK	Jan-02	May-05	42	597
	11328	CYPRESS CREEK AT IH 45	Jun-00	May-05	100	533
	11324	CYPRESS CREEK AT CYPRESSWOOD DR	Jan-02	Jun-06	22	470
1010, Caney Creek						
	14241	CANEY CREEK AT SH 105	Jun-00	Apr-05	45	264
	11335	CANEY CREEK UPSTRM OF FM 2090	Dec-02	Jun-04	9	119
	11334	CANEY CREEK AT FM 1485	Jun-00	May-06	101	196
1011, Peach Creek						
	11338	PEACH CREEK AT SH 105	Dec-02	Jun-04	9	86
	16625	PEACH CREEK AT OLD HWY 105	Jun-00	Apr-05	41	118
	11337	PEACH CREEK AT FM 2090	Dec-02	Jun-04	9	141
	11336	PEACH CREEK AT FM 1485	Jun-00	May-05	93	236
	17746	PEACH CREEK AT LAKE HOUSTON SP	Oct-03	Jul-06	10	189

2.0 STATION SELECTION

In order to achieve the desired objectives several stations have been identified in each of the impaired study segments in this monitoring plan. The project's monitoring activities include the following major activities, each discussed in more detail in Section 4.0:

- Synoptic water sampling
- Spatially-intensive source sampling
- Wet-weather point source sampling

Monitoring sites were selected for the study area using a variety of criteria, including the following:

- Sites representative of in-stream conditions
- Sites selected to maximize stream spatial coverage
- Sites include documented impaired reaches
- Sites include any historical sampling stations
- Sites on major tributaries, as needed
- Sites at outfalls of selected representative wastewater treatment plants
- Sites with accessibility

The synoptic water sampling will occur at a comprehensive network of stations to characterize conditions within the mainstem, major tributaries, and wastewater treatment plant effluents on each study segment. This network of stations is described in detail in Section 3.0. Maps showing the locations of proposed monitoring locations are provided in Figures 2-1 through 2-13. The station locations are described further in Tables 3-1 through 3-13 in Section 3.0.

The spatially-intensive source sampling surveys will take place on four segments: the upper East Fork San Jacinto, Segment 1003; Stewarts Creek, Segment 1004; Willow Creek, Segment 1008; and Spring Gully, Segment 1009. On each segment, a comprehensive network of sampling stations will be visited to describe conditions on the mainstem, major tributaries, and wastewater treatment plant effluents. The network of stations is described generally in Section 3.0. The maps shown in Figure 2-1 for the East Fork San Jacinto, Figure 2-4 for Stewarts Creek, Figure 2-7 for Willow Creek, and Figure 2-10 for the Spring Gully synoptic surveys indicate some of the locations that will be sampled in the spatially-intensive source studies. Additional locations, however, will be determined in the field and are not known at the present time. For example, if a drainage outfall pipe is discovered in any portion of the segment, a sample will be collected.

The wet-weather point source sampling will take place on wastewater treatment plant outfalls located in the Willow Creek (Segment 1008) watershed. This network of stations is described in Section 3.0. The map shown in Figure 2-7 for the Willow Creek synoptic survey shows the locations of all permitted point sources discharging to the segment.

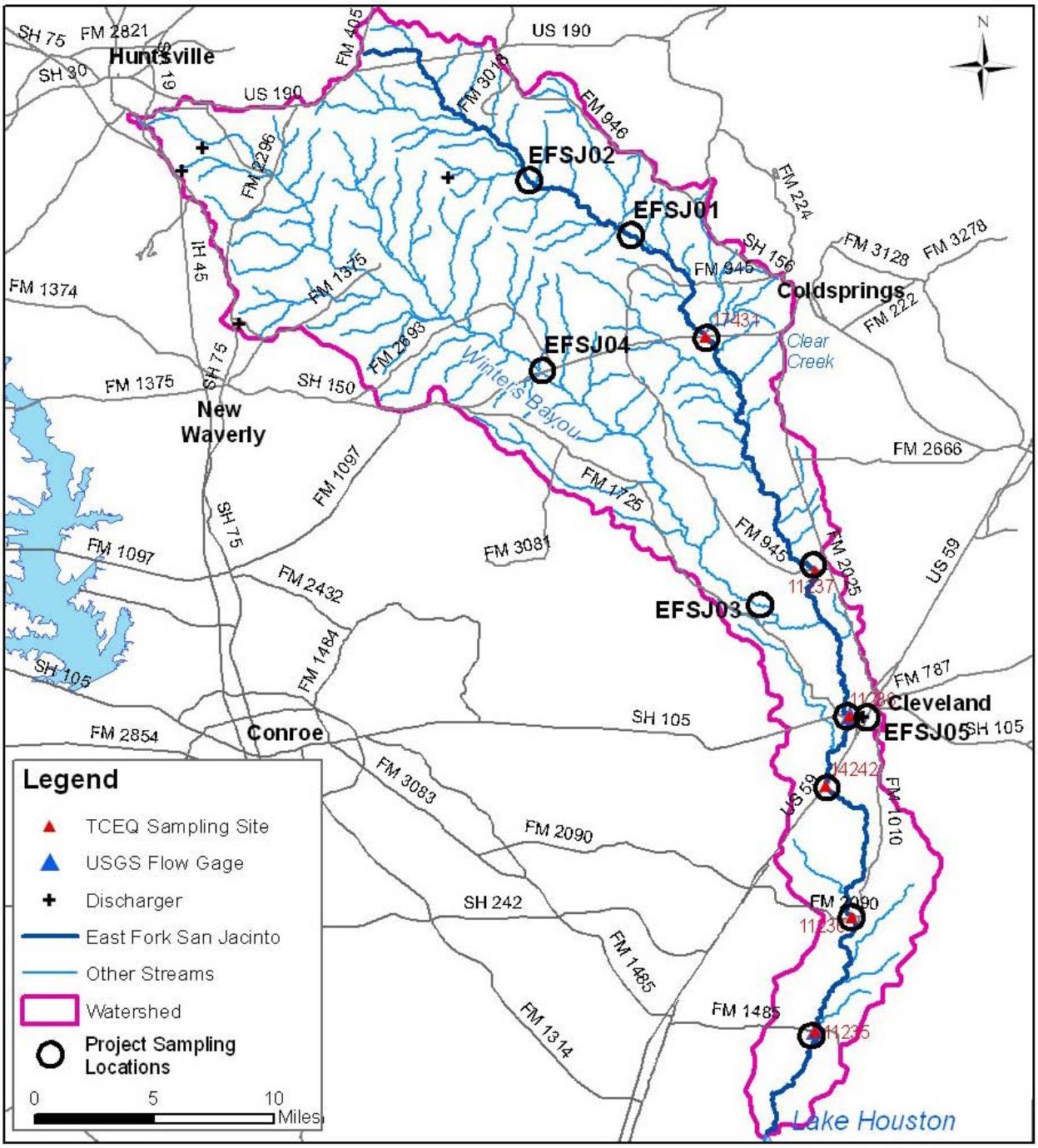

Figure 2-1: Sampling Stations for East Fork San Jacinto River, Segment 1003

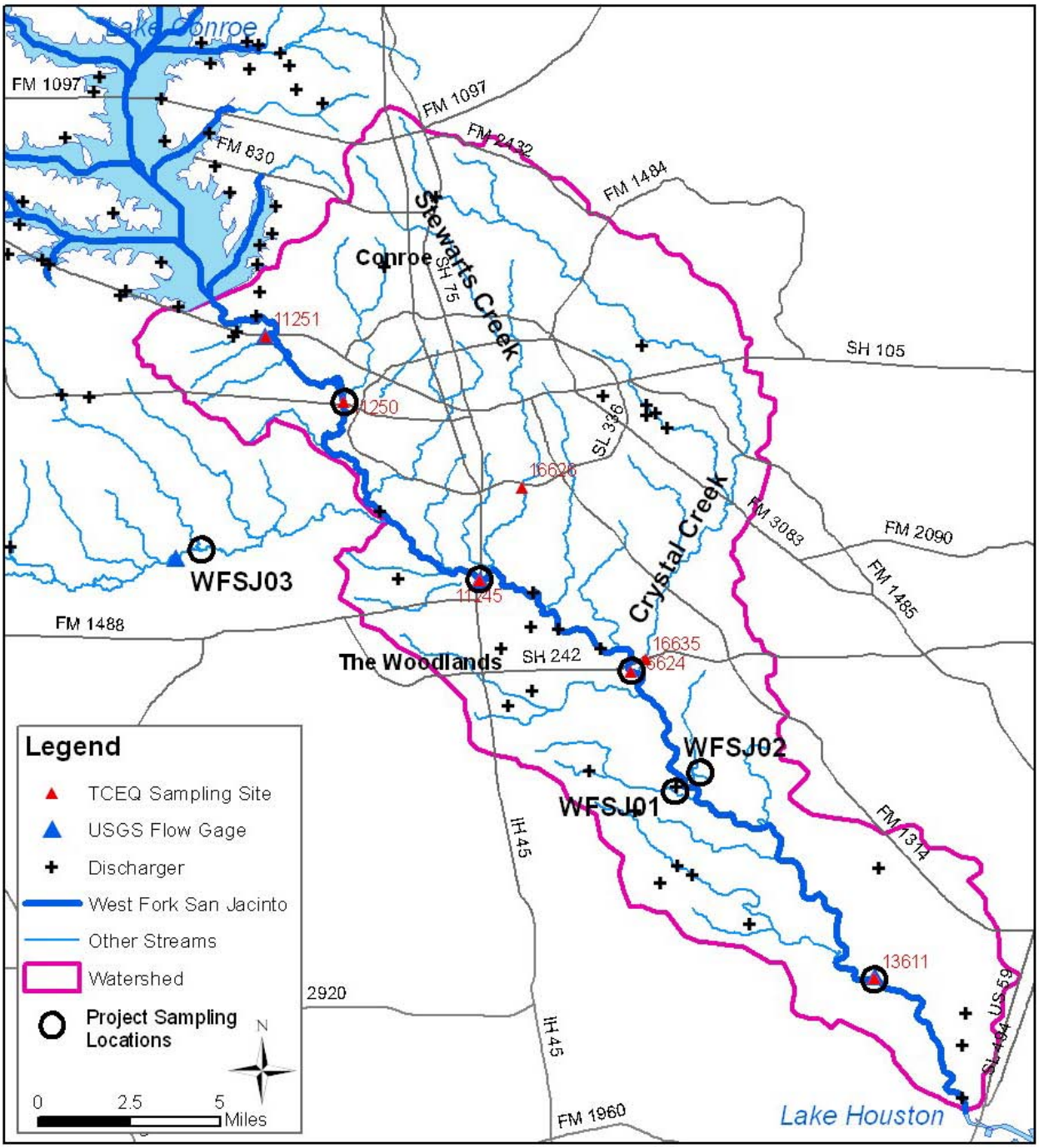

Figure 2-2: Sampling Stations for West Fork San Jacinto River, Segment 1004

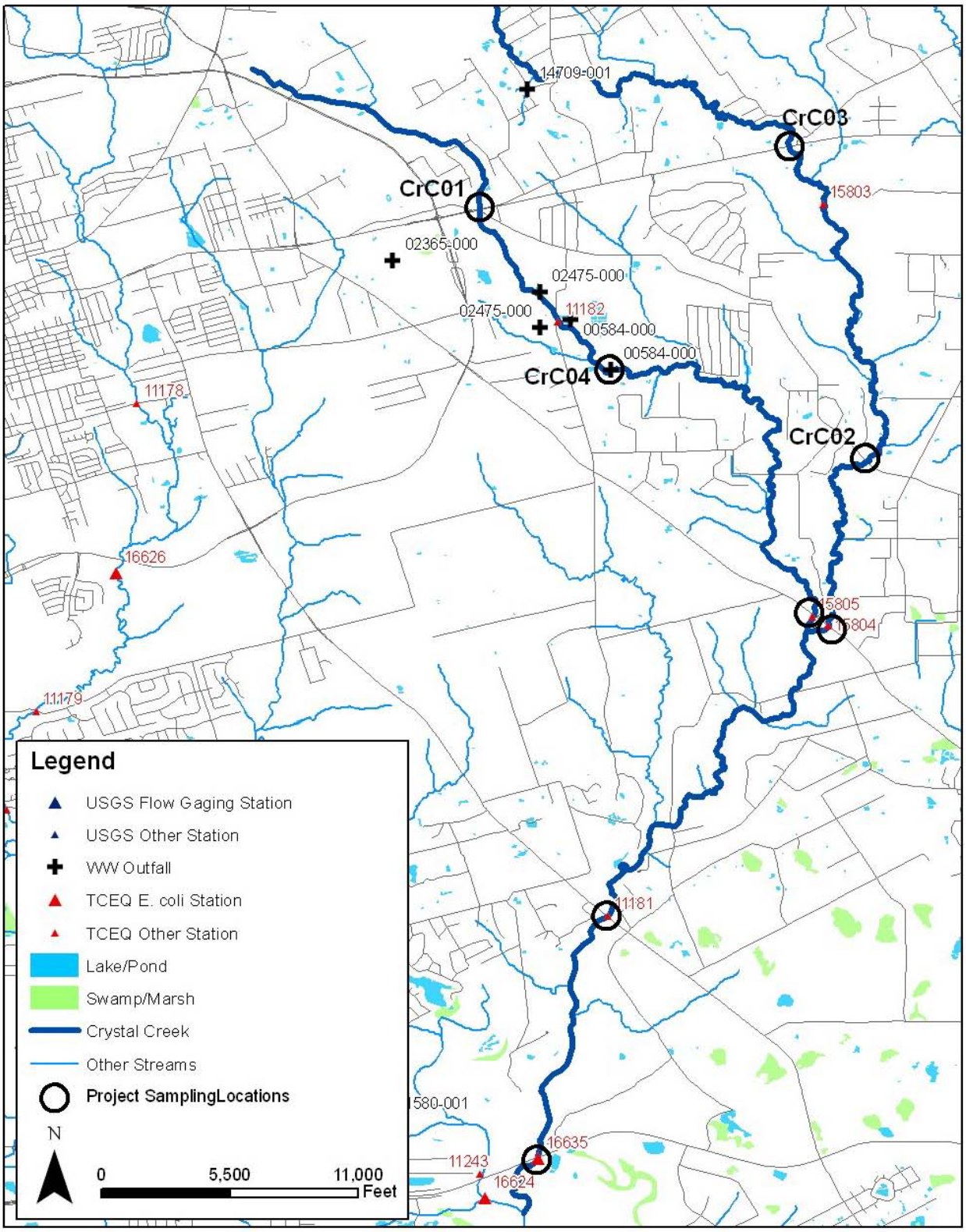

Figure 2-3: Sampling Stations for Crystal Creek, Segment 1004

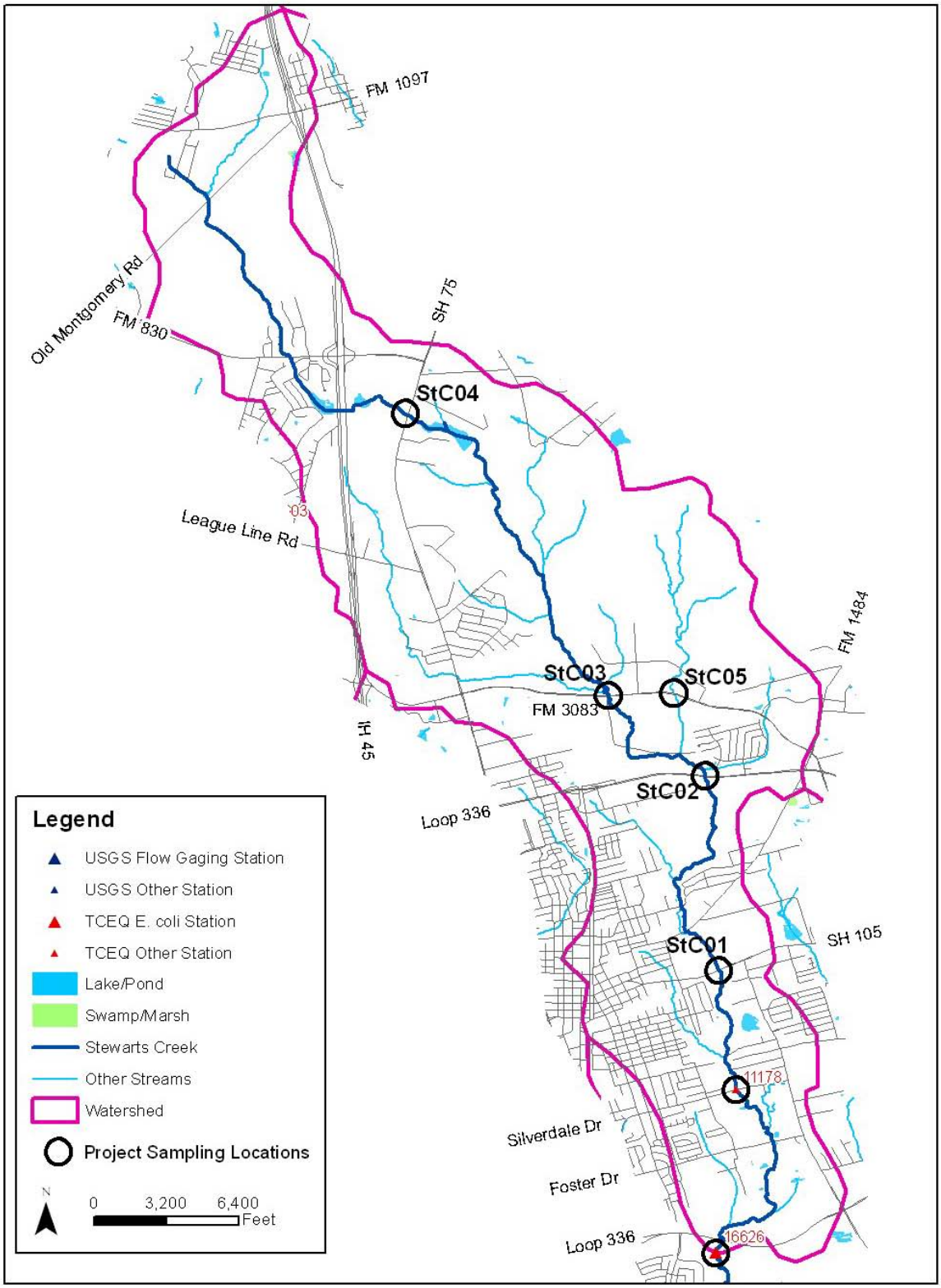

Figure 2-4: Sampling Stations for Stewarts Creek, Segment 1004

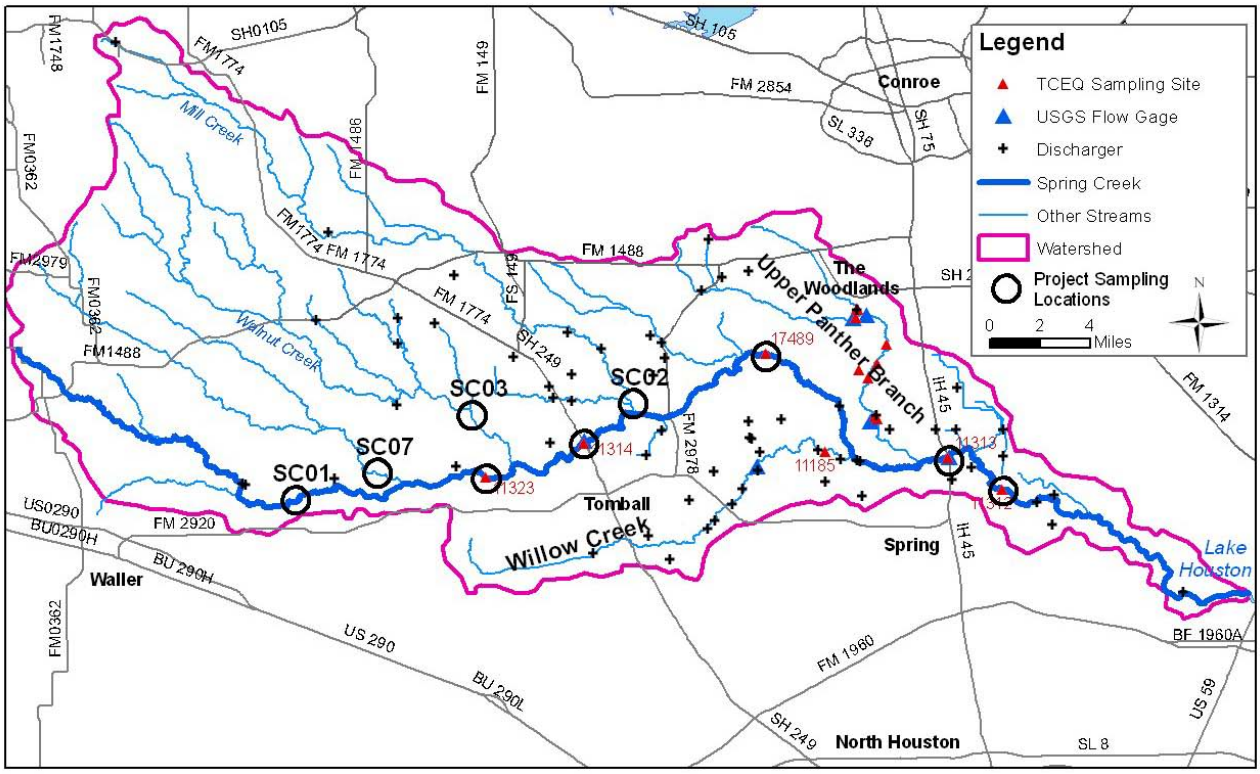

Figure 2-5: Sampling Stations for Spring Creek, Segment 1008

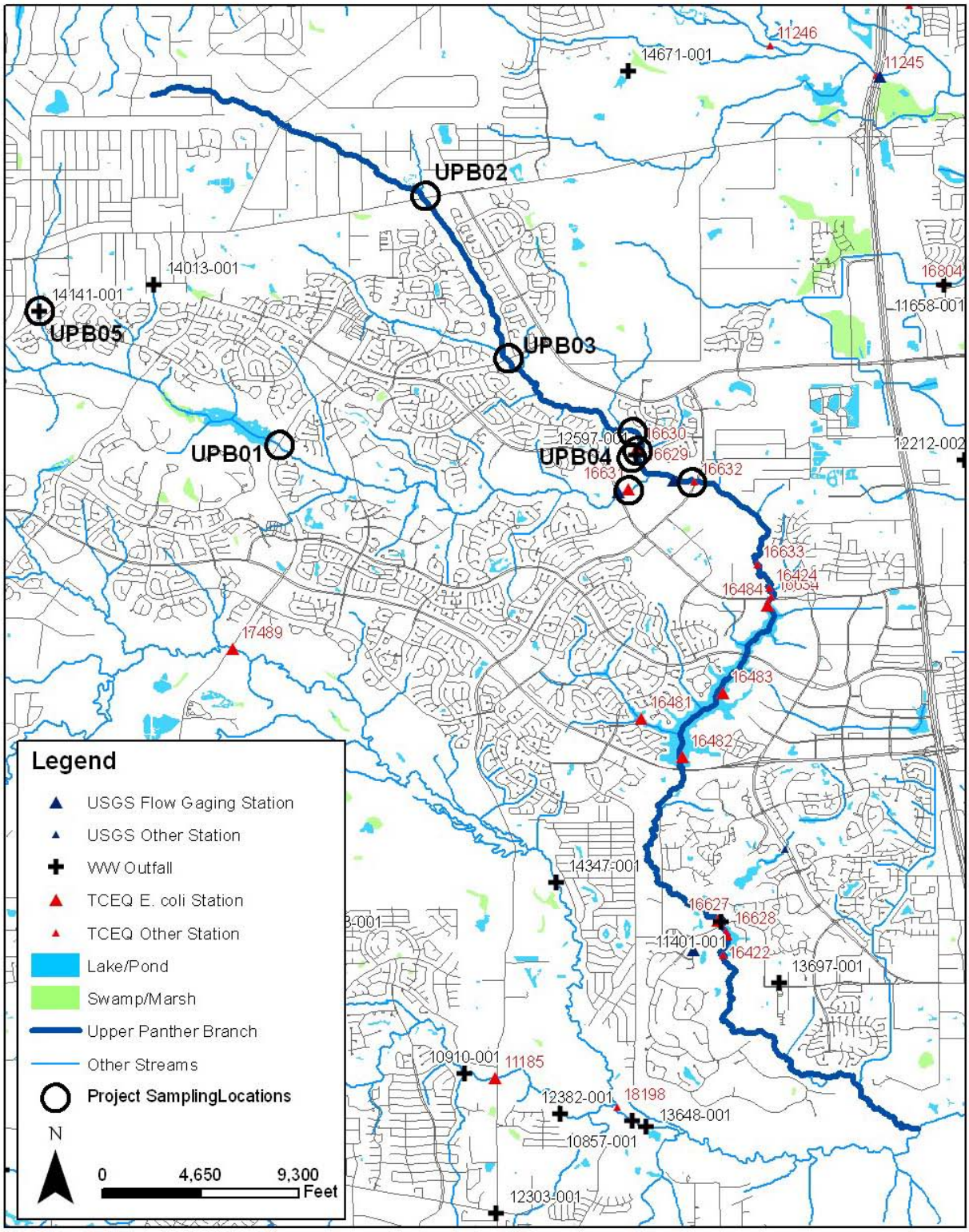

Figure 2-6: Sampling Stations for Upper Panther Branch , Segment 1008B

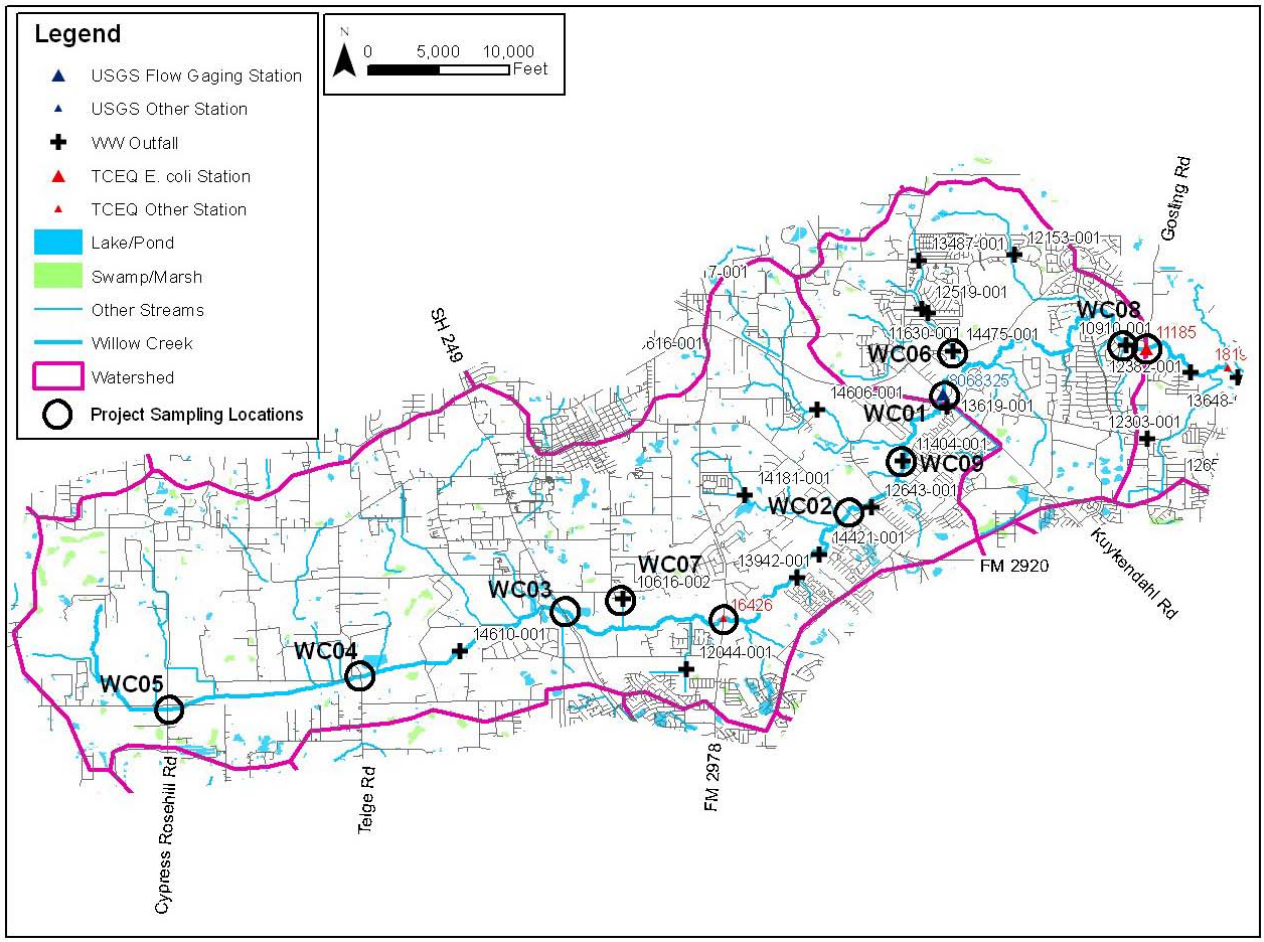

Figure 2-7: Sampling Stations for Willow Creek, Segment 1008

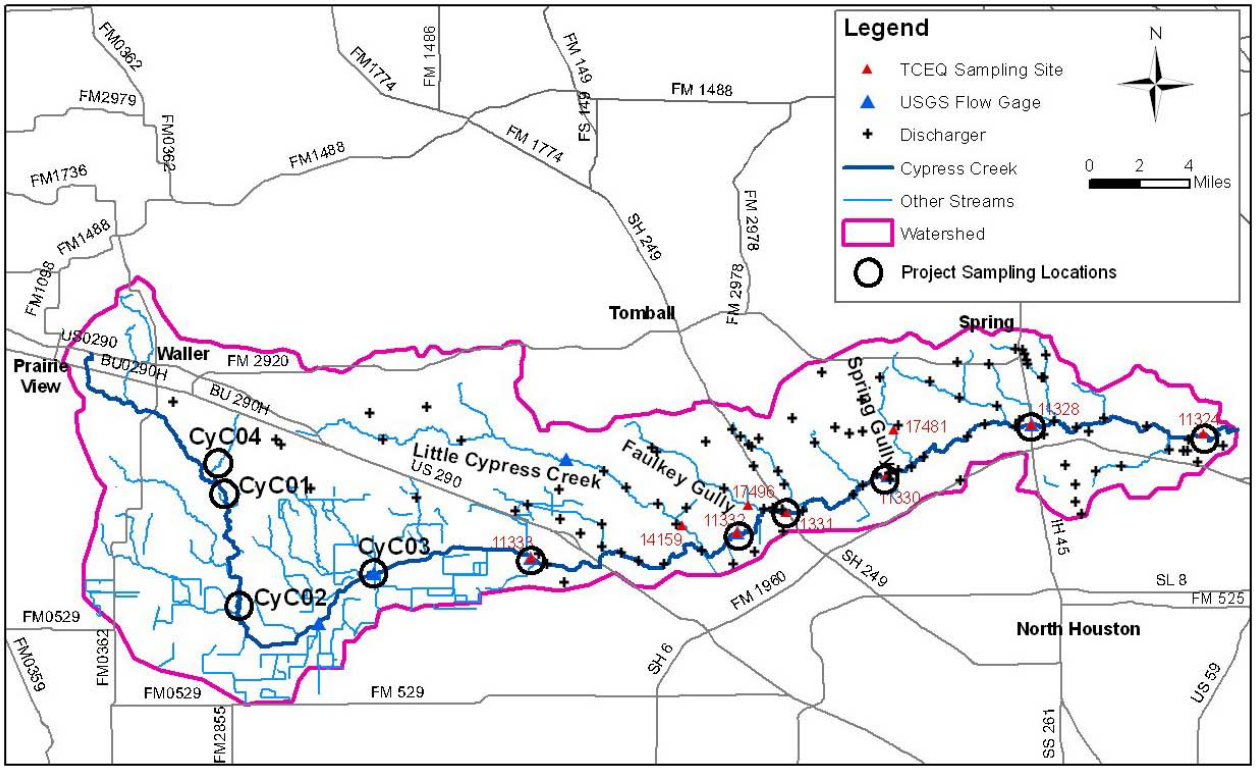

Figure 2-8: Sampling Stations for Cypress Creek, Segment 1009

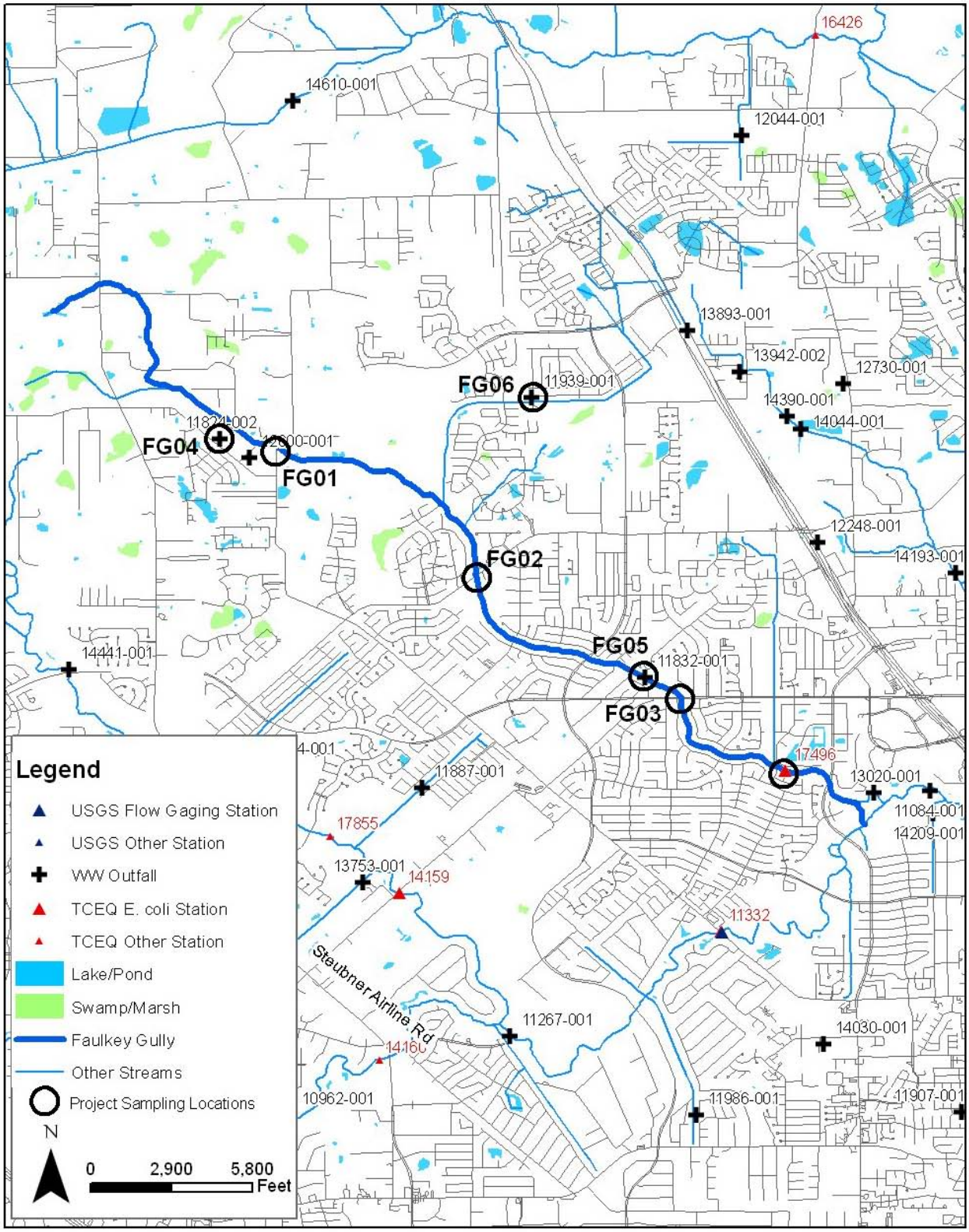

Figure 2-9: Sampling Stations for Faulkey Gully, 1009

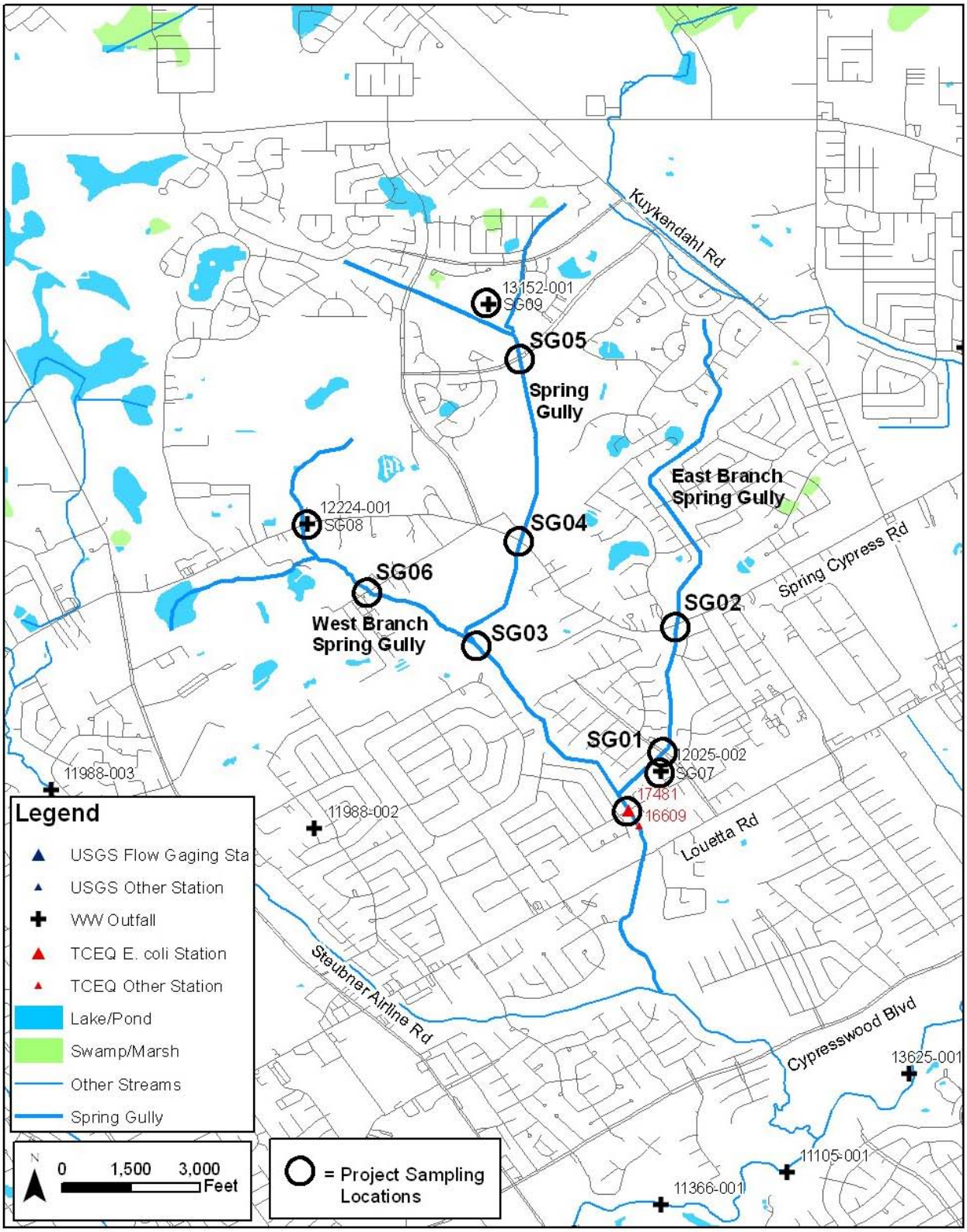

Figure 2-10: Sampling Stations for Spring Gully, 1009

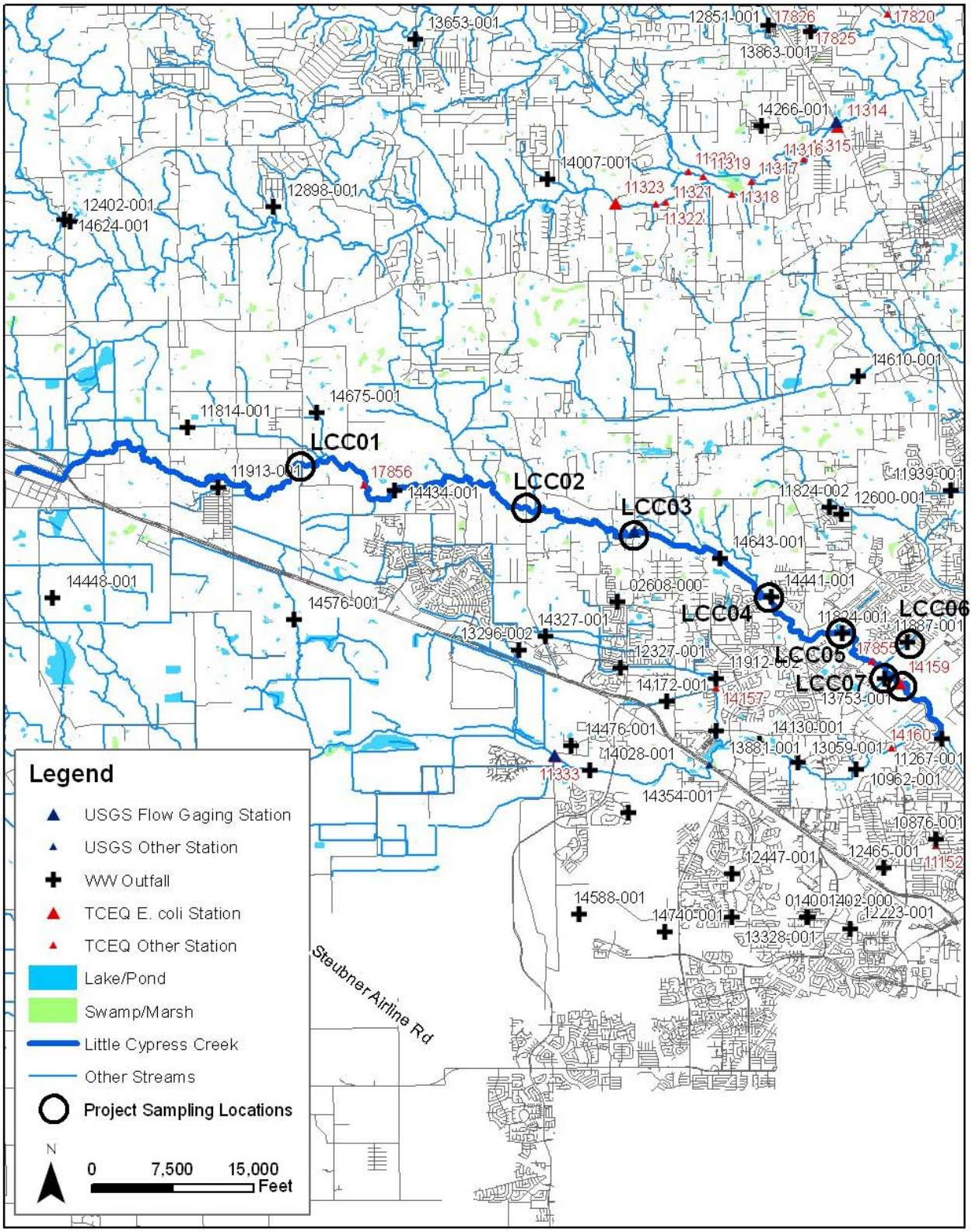

Figure 2-11: Sampling Stations for Little Cypress Creek, 1009

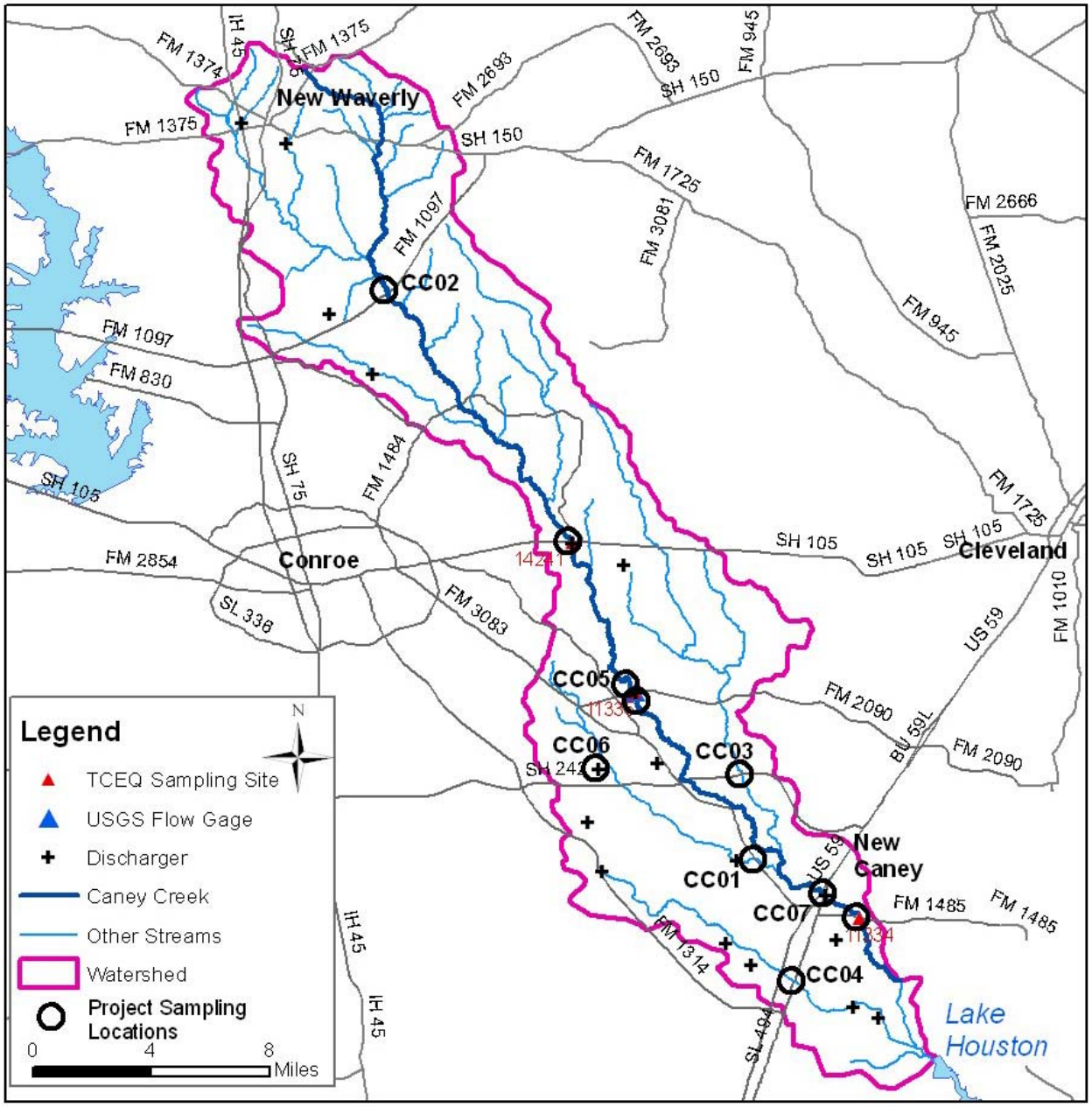

Figure 2-12: Sampling Stations for Caney Creek, 1010

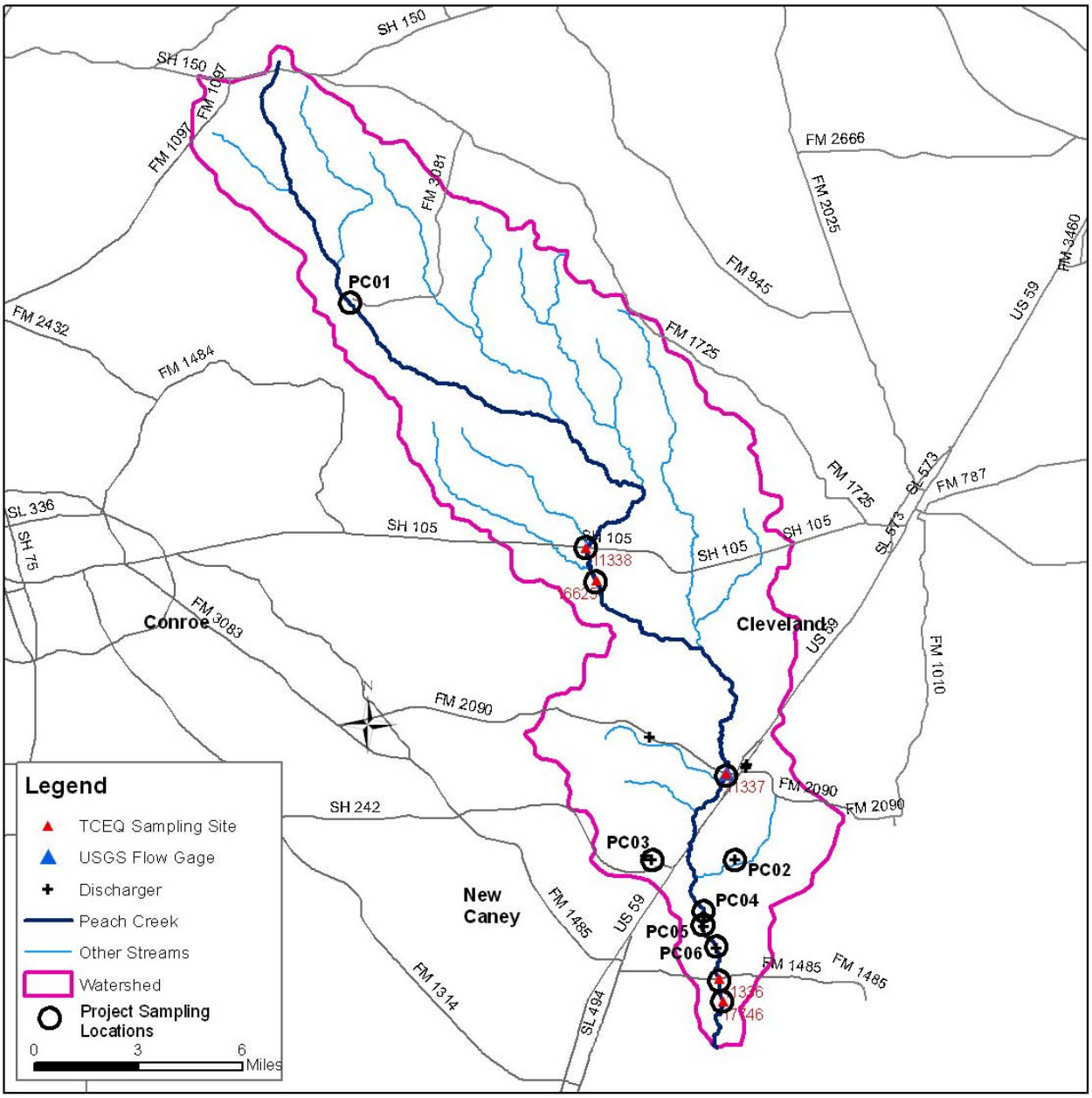

Figure 2-13: Sampling Stations for Peach Creek, 1011

3.0 MONITORING PLAN

3.1 MONITORING OBJECTIVES

There are multiple objectives embodied in the strategy for sampling. The overall objective is to conduct the monitoring activities necessary to provide:

(i) better definition of the water quality conditions on the study segments with respect to bacterial indicators,
(ii) definition of source areas or loading points that contribute to conditions in the segment,
(iii) data sufficient for estimation of loadings and support of allocation activities.

As discussed previously, sufficient bacteria data does not exist to identify and quantify the various sources of bacteria contributing to the study segments. In preparation for TMDL development, additional sampling will be completed. This additional sampling will provide data to expand available databases and will provide information to assist in estimation of bacteria source loadings. Sampling activities prescribed to provide additional data are described in a subsequent section. Additional data should also be available as sampling is conducted by local agencies at routine monitoring sites.

3.2 MONITORING ACTIVITIES

The monitoring plan for the study segments will include the following activities. All of the thirteen impaired segments will be scheduled for two Synoptic Sampling Surveys. Four of the impaired segments, East Fork San Jacinto (Segment 1003), Stewarts Creek (Segment 1004), Willow Creek (Segment 1008), and Spring Gully (Segment 1009), will be scheduled for Spatially-Intensive Source Sampling. One of the impaired segments, Willow Creek (Segment 1008) will be scheduled for Wet-Weather Point Source Sampling.

Synoptic Sampling Surveys

- Ascertain source areas, extent of impairment
- Baseflow priority
- Include full spatial extent of segment
- Routine monitoring stations and additional sites
- Include representative point sources
- Ascertain longitudinal trends in *E. coli* concentrations

The primary objective of synoptic sampling surveys would be to identify general source areas of bacteria loading to the stream system. Synoptic sampling involves the occupation of a comprehensive network of stations along the longitudinal extent of a segment, sufficient to provide spatial coverage in order to track longitudinal trends and changes in constituent concentration in an upstream to downstream direction. Major tributary and selected point source contributors (where accessible) may also be sampled. This type of monitoring will dictate that samples be collected under a specific hydrologic regime, namely, baseflow conditions. The selection of baseflow conditions is based on the fact that the study area

watercourses demonstrate impairment by bacteria indicators under baseflow conditions, as well as under high flow conditions. Sampling under baseflow conditions presents a realistic opportunity to define specific reaches of the streams, tributaries, or point sources that are contributing bacteria. In an ideal situation, additional sampling surveys would also be conducted under runoff conditions, but it is a foregone conclusion that bacteria concentrations will be elevated from land-based sources under runoff conditions. Therefore, if funding is limited, it appears that more value will be derived from baseline sampling where the potential exists to identify sources with more specificity.

Two synoptic sampling surveys will be conducted under baseflow conditions on each study segment. It is recognized that "baseflow" in these study areas may be influenced to a certain degree by the frequent rainfall patterns in the area. The general schedule for these events will most probably range from October 2007 to July 2008. Sampling activities will commence once the Quality Assurance Project Plan (QAPP) is approved by TCEQ.

Spatially-Intensive Source Studies

- Evaluate specific source locations in detail
- Baseflow conditions
- selected segments: urban
- Numerous sampling points, eg, 1000-ft intervals
- Sample pipes, outfalls, tributaries
- Test for bacteria, optical brighteners
- Extrapolate to general study area

The spatially-intensive studies will be designed to cover a relatively small watershed with numerous sampling points to better define potential sources of bacteria. Four watersheds have been selected for spatially intensive studies: the upper East Fork San Jacinto River Segment 1003, representing a largely undeveloped area; Stewarts Creek Segment 1004, representing an urbanized area without permitted wastewater treatment facility discharges; Willow Creek Segment 1008, representing both a relatively rural area with septic systems and an urbanized area with numerous permitted wastewater treatment facilities; and Spring Gully Segment 1009, representing an urbanized area with a few permitted wastewater treatment facilities. On the study watersheds, sampling personnel will travel by foot (or boat) along the study reach, pulling samples at some nominal interval, say approximately 1000-ft, or wherever a tributary or outfall pipe joins with the stream. Water samples will be tested for *E. coli* concentration. Testing for optical brighteners will also be conducted using portable instrumentation. The optical brightner data may provide an indication of the presence of domestic wastewater, with particular relevance in areas served by onsite septic treatment systems. This detailed sampling exercise will enable a high level of definition regarding actual sources that are active at the time of sampling.

Sediment Source Studies

- Evaluate sediment as a potential bacteria source
- Baseflow conditions
- Selected locations
- Sediment sampling at varying distance from stream bed

Keen interest has been expressed in past studies regarding the role of sediment as a source of bacteria in impaired waterbodies. A sediment source study will be conducted in conjunction with each Spatially-

Intensive study (upper East Fork San Jacinto, Stewarts Creek, Willow Creek, and Spring Gully) to provide additional information and data regarding this potential source of bacteria. The sediment source studies will involve collection of sediments within the stream bed and at radial distances from the edge of water. For example, at a specific station, one sample will be collected from the wet streambed sediments, one sample will be collected from the wet edge-of-water region, and dry sediment samples will be collected at distances of 1 ft, 3 ft, 10 ft, and 50 ft from the waterline. Samples will be analyzed in the laboratory by mixing a measured weight of sediment with buffered water, mixing, then determining bacteria concentrations. The bacteria data will be transformed to organism counts per unit weight (dry) of sediment. Sediment characteristics of texture and grain size will be determined. The sediment studies will be conducted on each of the four segments selected for spatially intensive sampling.

Resuspension Study

- Evaluate resuspension of bed sediments as bacteria source
- Baseflow conditions
- Selected locations
- Disturb sediment over defined area
- Track bacteria in water column over 1-2 days

The resuspension of sediments that have been previously deposited on a stream bottom is often targeted as a potential source of bacteria loadings in impaired segments. The objective of the resuspension study would be to quantify the concentration of bacteria that can be potentially released from the sediment upon disturbance, then determine the gross fate of the resuspended bacteria. Two sites have been selected for the experiment, in conjunction with Spatially-Intensive studies: Willow Creek and Spring Gully. A defined area of the streambed will be vigorously disturbed by raking, in order to resuspend the upper layer of deposited sediment. The bacteria concentration in the water column will be defined immediately after disturbance by sampling. At the time of disturbance, dye will be released as a hydrodynamic tracer. The resultant sediment plume will be tracked downstream and sampled periodically for bacteria concentration. This exercise will enable determination of the magnitude and fate of resuspended bacteria. It may be determined, for example, that the resuspended bacteria summarily die-off by settling and or ultraviolet deactivation at a typical first-order decay rate. Alternately, it may be determined that resuspended bacteria populations continue to increase with transport downstream, signaling a regrowth phenomenon.

Kinetics Study

- Evaluate regrowth of bacteria from point sources
- Baseflow conditions
- Selected locations
- In situ bacteria kinetic rates

Bacteria regrowth in the stream environment has been hypothesized in previous bacteria studies. The existence/absence of regrowth of bacteria from municipal effluent discharges has received particular attention. Special studies will be conducted at one location on Willow Creek and at one location on Spring Gully, in conjunction with Spatially-Intensive Studies, to provide additional information and data regarding this aspect of bacteria transport. Chambers of

discharged effluent, or effluent in combination with receiving water, will be set up within the stream environment, maintained intact, and tested at regular intervals for bacteria concentrations. A similar approach has been utilized in previous studies of bacteria kinetics (JMA, 2005). Regular testing of these in situ chambers will demonstrate that bacteria numbers either increase or decrease with time subsequent to discharge. Chambers can also be placed at selected distances downstream of outfalls to define kinetic properties.

Wet Weather Point Source Sampling

- Estimate point source loads under wet weather conditions
- Sample 10-30 WWTPs at outfall pipes
- Sample receiving stream at downstream monitoring station
- Estimate total event loading of bacteria from point sources
- Estimate proportion of total stream loading derived from point sources

There is often considerable debate among stakeholders regarding the contribution of bacteria from point sources under wet weather conditions. While the discharge of bacteria from point sources would normally be expected to be controlled by disinfection unit processes included in the treatment plant, problems may arise during wet weather conditions due to increased inflow to the facility. The increased inflow may impair the capabilities of the disinfection process, and in some situations, may enable solids containing bacteria to be discharged.

Sampling will be conducted on one of the impaired segments, Willow Creek Segment 1008, to determine the actual discharge bacteria concentrations from wastewater treatment plants under wet weather conditions. A representative number of plants will be selected for sampling, since it would be impractical to sample every municipal point source. The logistics of coordination with operators and owners of treatment facilities is a handicap for wet weather event sampling, since there is often very little advance warning or notification time available. Therefore, sampling of wastewater treatment plants under this exercise will be conducted at the discharge points that are accessible outside of the fenced boundaries of the facilities. For example, an outlet pipe that conveys discharged effluent to the receiving stream will be a logical, accessible point for sampling. Sampling at such outlets will provide data to define the bacteria load entering the stream, accounting for any potential concentration changes between the treatment plant and the end of the pipe. Regular sampling will also be performed at a downstream monitoring station within each watershed for comparison to the point source data. By extrapolation, the collected bacteria data should enable an estimate of the total bacteria load discharged by point sources in each watershed. This point source loading estimate can be compared directly to the corresponding loading estimate within the receiving stream measured during the same wet weather event.

Microbial Source Tracking

- Conduct sampling and testing for qPCR
- Test for human presence/absence
- Test raw wastewater samples
- Rapid turn-around of results may guide additional testing
- One baseline survey

Microbial source tracking (MST) will be utilized to provide an advanced degree of specificity regarding the identification of sources of bacterial indicators. MST results are expected to provide a substantial

benefit to identification of potential sources, in that emphasis could be placed upon the specific sources identified.

Application of some newer non-library MST technology and approaches is recommended for the proposed study. Methods based upon two tests specific to human bacteria sources should be considered. One test is based on detection of *Enterococcus faecium*, which is a strain of *Enterococcus* genus specific to humans. These *Enterococcus* bacteria are able to survive for extended periods of time outside of the host. The other test is based on detection of strains of *Bacteroidetes* that are specific to humans. These *Bacteroidetes* are strict anaerobes that are indicative of recent fecal contamination because they cannot proliferate in soil or sediments. Both of these tests are analyzed using qPCR DNA technology. These tests are useful to identify or confirm that bacteria are attributable to human sources. This may be a key piece of information for this study area, with its proliferation of municipal wastewater treatment plants.

The present scope for MST includes collection of one water sample at a monitoring station on Spring Gully in conjunction with the spatially intensive study. A sample from a wastewater treatment plant in the same watershed will also be tested. This effort will then focus upon a relatively small targeted watershed. If the resultant data proves useful, the sampling could be expanded to additional sites.

3.3 MONITORING LOCATIONS AND FREQUENCY

Monitoring schedules for synoptic sampling of each segment are tables 3-1 to 3-13. Monitoring schedules for the Spatially-Intensive Source Studies are provided in Table 3-14 to 3-17 for the East Fork San Jacinto, Stewarts Creek, Willow Creek, and Spring Gully, respectively. A monitoring schedule for Wet Weather Point Source Sampling of Willow Creek is provided in Table 3-18.

Station IDs that begin with EFSJ, WFSJ, CrC, StC, SC, UPB, WC, CyC, FG, SG, LCC, CC, and PC do not coincide with TCEQ station IDs. Samples from these stations will not be submitted for inclusion in SWQMIS.

Table 3-1: 2007-2008 Monitoring Schedule for East Fork San Jacinto, Segment 1003

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Monit. Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	11235	East Fork San Jacinto River @ FM 1485	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11236	East Fork San Jacinto River @ FM 2090	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	14242	East Fork San Jacinto River @ US 59	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11238	East Fork San Jacinto River @ Cleveland	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	EFSJ05	Cleveland WWTP Outfall 10766-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	EFSJ03	Winters Bayou @ Shell Oil Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	EFSJ04	Winters Bayou @ SH 150	Oct 07	Aug 08	JM	JM	BF				2	2	2
10	11237	East Fork San Jacinto River @ FM 945	Oct 07	Aug 08	JM	JM	BF				2	2	2
10	17431	East Fork San Jacinto River @ SH 150	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	EFSJ01	East Fork San Jacinto River @ Hines Lake Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	EFSJ02	East Fork San Jacinto River @ Jenkins Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible

[2]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.

[3]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.

[4]Number of events to collect E.coli samples

[5]Number of events to measure stream flow or determine stream flow from USGS gauging station records; event to consist of single determination of stream flow

[6]Field Parameters will consist of temperature and conductivity

Table 3-2: 2007-2008 Monitoring Schedule for West Fork San Jacinto, Segment 1004

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Monit. Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	WFSJ02	Woodson's Gully @ Riley Fuzzel	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	WFSJ01	White Oak Creek @ Sleepy Hollow	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	13611	West Fork San Jacinto River SW of Porter Heights	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	16624	West Fork San Jacinto River @ SH 242	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11245	West Fork San Jacinto River @ IH 45	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	WFSJ03	Lake Creek @ Honea Egypt Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11250	West Fork San Jacinto River @ FM 2854	Oct 07	Aug 08	JM	JM	BF				2	2	2

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible

[2] JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.

[3] BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.

[4] Number of events to collect E.coli samples

[5] Number of events to measure stream flow or determine stream flow from USGS gauging station records; event to consist of single determination of stream flow

[6] Field Parameters will consist of temperature and conductivity

Table 3-3: 2007-2008 Monitoring Schedule for Crystal Creek, Segment 1004

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Monit. Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	16635	Crystal Creek @ SH 242	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11181	Crystal Creek @ FM 1314	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	15804	East Fork Crystal Creek @ FM 3083	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	CrC02	East Fork Crystal Creek @ FM 1484	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	CrC03	East Fork Crystal Creek @ SH 105	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	15805	West Fork Crystal Creek @ FM 3083	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	CrC04	Huntsman Corporation WWTP 00584-000	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	CrC01	West Fork Crystal Creek @ SH 105	Oct 07	Aug 08	JM	JM	BF				2	2	2

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible
[2]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.
[3]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.
[4]Number of events to collect E.coli samples
[5]Number of events to measure stream flow or determine stream flow from USGS gauging station records; event to consist of single determination of stream flow
[6]Field Parameters will consist of temperature and conductivity

Table 3-4: 2007-2008 Monitoring Schedule for Stewarts Creek, Segment 1004

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Monit. Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	11178	Stewarts Creek @ Sliverdale Dr	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	16626	Stewarts Creek @ SH Loop 336	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	StC01	Stewarts Creek @ SH 105	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	StC02	Stewarts Creek @ North SH Loop 336	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	StC05	Little Caney Branch @ Fm 3083	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	StC03	Stewarts Creek @ FM 3083	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	StC04	Stewarts Creek @SH 75	Oct 07	Aug 08	JM	JM	BF				2	2	2

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible
[2]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.
[3]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.
[4]Number of events to collect E.coli samples
[5]Number of events to measure stream flow or determine stream flow from USGS gauging station records; event to consist of single determination of stream flow
[6]Field Parameters will consist of temperature and conductivity

Table 3-5: 2007-2008 Monitoring Schedule for Spring Creek, Segment 1008

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Monit. Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	11312	Spring Creek @ Riley Fuzzel Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11313	Spring Creek @ IH 45	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	17489	Spring Creek @ Kuykendahl Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	SC02	Mill Creek @Neidgt Lake Outfall	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11314	Spring Creek at SH 249	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	SC03	Walnut Creek @ Cypress Rosehill	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	SC07	Brushy Creek at Glenmont Estates	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11323	Spring Creek @ Decker Prairie Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	SC01	Spring Creek @ Murrell Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible

[2]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.

[3]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.

[4]Number of events to collect E.coli samples

[5]Number of events to measure stream flow or determine stream flow from USGS gauging station records; event to consist of single determination of stream flow

[6]Field Parameters will consist of temperature and conductivity

Table 3-6: 2007-2008 Monitoring Schedule for Upper Panther Branch, Segment 1008B

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Monit. Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	16632	Upper Panther Branch at Gosling Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	UPB04	Woodlands Plant 2 WWTP Outfall 12597-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	16631	Bear Branch @Research Forest Dr	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	UPB01	Bear Branch @ Kuykendahl Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	UPB05	Old Egypt Buisness Center WWTP Outfall 1414-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	16630	Upper Panther Branch downstream of outfall	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	16629	Upper Panther Branch upstream of outfall	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	UPB03	Upper Panther Branch @ Green Bridge Drive	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	UPB02	Upper Panther Branch @ FM 1488	Oct 07	Aug 08	JM	JM	BF				2	2	2

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible
[2]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.
[3]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.
[4]Number of events to collect E.coli samples
[5]Number of events to measure stream flow or determine stream flow from USGS gauging station records; event to consist of single determination of stream flow
[6]Field Parameters will consist of temperature and conductivity

Table 3-7: 2007-2008 Monitoring Schedule for Willow Creek, Segment 1008

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Monit. Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	11185	Willow Creek @ Gosling Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	WC08	Northhampton WWTP Outfall 10910-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	WC06	Unnamed Trib of Willow Creek @ W Rayford Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	WC01	Willow Creek @ Kuykendahl Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	WC09	Dowdell WWTP Outfall 11404-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	WC02	Willow Creek @ Fm 2920	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	16426	Willow Creek @ Huffsmith Kohrville Rd (FM 2978)	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	WC07	Tomball WWTP Outfall 10616-002	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	WC03	Willow Creek @ SH 249	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	WC04	Willow Creek @ Telge Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	WC05	Willow Creek @ Cypress Rosehill Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible

[2] JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.

[3] BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.

[4] Number of events to collect E.coli samples

[5] Number of events to measure stream flow or determine stream flow from USGS gauging station records; event to consist of single determination of stream flow

[6] Field Parameters will consist of temperature and conductivity

Table 3-8: 2007-2008 Monitoring Schedule for Cypress Creek, Segment 1009

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Monit. Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	11324	Cypress Creek @ Cypresswood Dr	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11328	Cypress Creek @ IH 45	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11330	Cypress Creek @ Steubner-Airline Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11331	Cypress Creek @ SH 249	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11332	Cypress Creek @ Grant Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11333	Cypress Creek @ House Hahl Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	CyC03	Cypress Creek @ Katy Hoddey Cuttoff	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	CyC02	Cypress Creek @ Hebert Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	CyC04	Mound Creek @ Mathis Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	CyC01	Cypress Creek @ Mathis Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible
[2]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.
[3]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.
[4]Number of events to collect E.coli samples
[5]Number of events to measure stream flow or determine stream flow from USGS gauging station records; event to consist of single
[6]Field Parameters will consist of temperature and conductivity

Table 3-9: 2007-2008 Monitoring Schedule for Faulkey Gully, Segment 1009

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Monit. Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	17496	Faulkey Gully @ Cypress Creek Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	FG03	Faulkey Gully @ Louetta RD	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	FG05	FG MUD WWTP Outfall 11832-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	FG02	Faulkey Gully @ Spring Cypress Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	FG06	NWHC MUD #15 WWTP Outfall 11939-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	FG01	Faulkey Gully @ Shaw Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	FG04	NWHC MUD #5 WWTP Outfall 11824-002	Oct 07	Aug 08	JM	JM	BF				2	2	2

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible
[2]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.
[3]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.
[4]Number of events to collect E.coli samples
[5]Number of events to measure stream flow or determine stream flow from USGS gauging station records; event to consist of single determination of stream flow
[6]Field Parameters will consist of temperature and conductivity

Table 3-10: 2007-2008 Monitoring Schedule for Spring Gully, Segment 1009

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Monit. Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	17481	Spring Gully @ Spring Creek Oaks Dr	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	SG01	East Branch Spring Gully @ TC Jester Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	SG07	Bilma WWTP Outfall 12025-002	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	SG02	East Branch Spring Gully @ Spring Cypress Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	SG03	Spring Gully, 0.4 mi SW of Spring Cypress Rd., 0.4 mi SE of Klein Cemetery Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	SG06	West Branch Spring Gully @ Klein Cemetery Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	SG08	KISD WWTP Outfall 1224-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	SG04	Spring Gully @ Spring Cypress Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	SG05	Spring Gully @ Pine Lakes Blvd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	SG09	NWHC MUD #32 WWTP Outfall 13152-001	Oct 07	Aug 08	JM	JM	BF				2	2	2

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible
[2]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.
[3]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.
[4]Number of events to collect E.coli samples
[5]Number of events to measure stream flow or determine stream flow from USGS gauging station records; event to consist of single
[6]Field Parameters will consist of temperature and conductivity

Table 3-11: 2007-2008 Monitoring Schedule for Little Cypress Creek, Segment 1009

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Monit. Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	14159	Little Cypress Creek @ Kluge Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	LCC07	HC MUD #360 WWTP Outfall 13753-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	LCC06	Grand Rd PUD WWTP Outfall 11887-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	LCC05	NWHC MUD #5 WWTP Outfall 11824-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	LCC04	Little Cypress Creek @ Spring Cypress Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	LCC03	Little Cypress Creek @ Rosehill Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	LCC02	Little Cypress Creek @ Mueschke Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	LCC01	Little Cypress Creek @ Bauer Rd	Oct 07	Aug 08	JM	JM	BF				2	2	2

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible

[2]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.

[3]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.

[4]Number of events to collect E.coli samples

[5]Number of events to measure stream flow or determine stream flow from USGS gauging station records; event to consist of single determination of stream flow

[6]Field Parameters will consist of temperature and conductivity

Table 3-12: 2007-2008 Monitoring Schedule for Caney Creek, Segment 1010

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Monit. Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	CC04	White Oak Creek @ SH 494	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11334	Caney Creek @ FM 1485	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	CC07	Whitestone Caney Creek WWTP Outfall 14559-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	CC01	Dry Creek @ 1485	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	CC06	Lone Star Ranch WWTP Outfall 14029-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	CC03	Spring Branch @ SH 242	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	CC05	Conroe ISD WWTP Outfall 13690-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11335	Caney Creek @ FM 2090	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	14241	Caney Creek @ SH 105	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	CC02	Caney Creek @ FM 1097	Oct 07	Aug 08	JM	JM	BF				2	2	2

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible
[2]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.
[3]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.
[4]Number of events to collect E.coli samples
[5]Number of events to measure stream flow or determine stream flow from USGS gauging station records; event to consist of single determination of stream flow
[6]Field Parameters will consist of temperature and conductivity

Table 3-13: 2007-2008 Monitoring Schedule for Peach Creek, Segment 1011

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Monit. Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	17746	Peach Creek @ Lake Houston Park	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11336	Peach Creek @ FM 1485	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	PC06	Whitestone Peach Creek WWTP Outfall 14560-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	PC05	Roman Forest WWTF Outfall 13638-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	PC04	Woodbranch Village WWTP Outfall 1193-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	PC03	Mare Branch WWTP Outfall 14311-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	PC02	MC MUD #16 WWTP Outfall 11386-001	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11337	Peach Creek @ FM 2090	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	16625	Peach Creek @ Old Hwy 105 (Faulkner Rd)	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	11338	Peach Creek @ SH 105	Oct 07	Aug 08	JM	JM	BF				2	2	2
12	PC01	Peach Creek @ intersection of Peach Creek Dr and Summit Dr	Oct 07	Aug 08	JM	JM	BF				2	2	2

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible

[2] JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.

[3] BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.

[4] Number of events to collect E.coli samples

[5] Number of events to measure stream flow or determine stream flow from USGS gauging station records; event to consist of single determination of stream flow

[6] Field Parameters will consist of temperature and conductivity

Table 3-14: 2007-2008 Spatially-Intensive Source Sampling Schedule for East Fork San Jacinto River, Segment 1003

							Monitoring Frequency (2007-2008)							
Region	Station ID[1]	Station Description[2]	Start Date	End Date	Data Submittal[3]	Data Collection[3]	Monit. Code[4]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[5]	Sediment[5,6]	Inst Flow[7]	Field[8]
12	NA	SH 150 to FM 945, reach length 18,500 ft	Oct 07	Aug 08	JM	JM	BF				1	5	1	1
12	NA	FM 945 to Winfrey Rd, reach length 28,000 ft	Oct 07	Aug 08	JM	JM	BF				1	0	1	1
12	NA	Winfrey Rd to Jenkins Rd, reach length 35,000 ft	Oct 08	Aug 09	JM	JM	BF				1	0	1	1
12	NA	Jenkins Rd to Headwaters, reach length 64,000 ft	Oct 09	Aug 10	JM	JM	BF				1	0	1	1

[1]Data collected with stations labeled as "NA" will not be stored in SWQMIS
[2]Samples to be collected at approximately 1,000 ft intervals, drainage pipes and culverts, WWTP outfalls, etc; exact locations to be determined in the field; WWTP outfalls will be sampled at discharge point to stream channel if accessible
[3]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.
[4]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.
[5]Number of events to collect E.coli samples
[6]Samples to be collected at a location to be determined in the field; select area with exposed soil
[7]Number of events to measure stream flow or determine stream flow from USGS gauging station records event to consist of single determination of stream
[8]Field Parameters will consist of temperature and conductivity

Table 3-15: 2007-2008 Spatially-Intensive Source Sampling Schedule for Stewarts Creek, Segment 1004

							Monitoring Frequency (2007-2008)							
Region	Station ID[1]	Station Description[2]	Start Date	End Date	Data Submittal[3]	Data Collection[3]	Monit. Code[4]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[5]	Sediment[5,6]	Inst Flow[7]	Field[8]
12	NA	Loop 336 South to SH 105, reach length 16,500 ft	Oct 07	Aug 08	JM	JM	BF				1	5	1	1
12	NA	SH 105 to Loop 336 North, reach length 10,600	Oct 07	Aug 08	JM	JM	BF				1	0	1	1
12	NA	Loop 336 North to SH 75, reach length 23,900	Oct 08	Aug 09	JM	JM	BF				1	0	1	1
12	NA	SH 75 to Headwaters, reach length 19,600	Oct 09	Aug 10	JM	JM	BF				1	0	1	1

[1]Data collected with stations labeled as "NA" will not be stored in SWQMIS
[2]Samples to be collected at approximately 1,000 ft intervals, drainage pipes and culverts, WWTP outfalls, etc; exact locations to be determined in the field; WWTP outfalls will be sampled at discharge point to stream channel if accessible
[3]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.
[4]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be
[5]Number of events to collect E.coli samples
[6]Samples to be collected at a location to be determined in the field; select area with exposed soil
[7]Number of events to measure stream flow or determine stream flow from USGS gauging station records event to consist of single determination of stream
[8]Field Parameters will consist of temperature and conductivity

Table 3-16: 2007-2008 Spatially-Intensive Source Sampling Schedule for Willow Creek, Segment 1008

							Monitoring Frequency (2007-2008)							
Region	Station ID[1]	Station Description[2]	Start Date	End Date	Data Submittal[3]	Data Collection[3]	Monit. Code[4]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[5]	Sediment[5,6]	Inst Flow[7]	Field[8]
12	NA	Gosling Rd to Kuykendahl Rd, reach length 22,500 ft	Oct 07	Aug 08	JM	JM	BF				1	5	1	1
12	NA	Kuykendahl Rd to FM 2920, reach length 12,300 ft	Oct 07	Aug 08	JM	JM	BF				1	0	1	1
12	NA	FM 2920 to FM 2978, reach length 14,200 ft	Oct 08	Aug 09	JM	JM	BF				1	0	1	1
12	NA	FM 2978 to SH 249, reach length 11,900 ft	Oct 09	Aug 10	JM	JM	BF				1	0	1	1
12	NA	SH 249 to Telge Rd, reach length 14,300 ft	Oct 10	Aug 11	JM	JM	BF				1	0	1	1
12	NA	Telge Rd to Cypress Rosehill Rd, reach length 12,300 ft	Oct 11	Aug 12	JM	JM	BF				1	0	1	1
12	NA	Cypress Rosehill Rd to Headwaters, reach length 11,000 ft	Oct 12	Aug 13	JM	JM	BF				1	0	1	1

[1]Data collected with stations labeled as "NA" will not be stored in SWQMIS
[2]Samples to be collected at approximately 1,000 ft intervals, drainage pipes and culverts, WWTP outfalls, etc; exact locations to be determined in the field;
[3]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.
[4]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be
[5]Number of events to collect E.coli samples
[6]Samples to be collected at a location to be determined in the field; select area with exposed soil
[7]Number of events to measure stream flow or determine stream flow from USGS gauging station records event to consist of single determination of stream
[8]Field Parameters will consist of temperature and conductivity

Table 3-17: 2007-2008 Spatially-Intensive Source Sampling Schedule for Spring Gully, Segment 1009

							Monitoring Frequency (2007-2008)							
Region	Station ID[1]	Station Description[2]	Start Date	End Date	Data Submittal[3]	Data Collection[3]	Monit. Code[4]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[5]	Sediment[5,6]	Inst Flow[7]	Field[8]
12	NA	Main Stem (upstream from Louetta Rd), reach length 16,500 ft	Oct 07	Aug 08	JM	JM	BF				1	5	1	1
12	NA	East Branch Spring Gully, reach length 11,600 ft	Oct 07	Aug 08	JM	JM	BF				1	0	1	1
12	NA	West Branch Spring Gully, reach length 7,000 ft	Oct 07	Aug 08	JM	JM	BF				1	0	1	1

[1]Data collected with stations labeled as "NA" will not be stored in SWQMIS
[2]Samples to be collected at approximately 1,000 ft intervals, drainage pipes and culverts, WWTP outfalls, etc; exact locations to be determined in the field; WWTP outfalls will be sampled at discharge point to stream channel if accessible
[3]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.
[4]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.
[5]Number of events to collect E.coli samples
[6]Samples to be collected at a location to be determined in the field; select area with exposed soil
[7]Number of events to measure stream flow or determine stream flow from USGS gauging station records event to consist of single determination of stream flow
[8]Field Parameters will consist of temperature and conductivity

Table 3-18: 2007-2008 Wet Weather Point Source Sampling for Willow Creek, Segment 1008

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Monit. Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	WC08	Northhampton WWTP Outfall 10910-001	Oct 07	Aug 08	JM	JM	BF				1	1	1
12	WC09	Dowdell WWTP Outfall 11404-001	Oct 07	Aug 08	JM	JM	BF				1	1	1
12	WC07	Tomball WWTP Outfall 10616-002	Oct 07	Aug 08	JM	JM	BF				1	1	1

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible
[2]JM is the Submitting Entity Code and Collecting Entity Code for James Miertschin and Associates.
[3]BF is the Monitoring Type Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be present in order for the sample to be taken.
[4]Number of events to collect E.coli samples
[5]Number of events to measure stream flow or determine stream flow from USGS gauging station records event to consist of single determination of stream flow
[6]Field Parameters will consist of temperature and conductivity

4.0 MONITORING PROCEDURES

4.1 TYPE OF SAMPLES

The proposed monitoring plan emphasizes collection of samples for *E. coli* bacteria analysis. As a companion activity, field measurements will be routinely collected for temperature and conductivity. These field measurements will be collected if practicable, and if time allows, by the field crews, since the primary effort will be devoted to the collection of *E. coli* samples and maintenance of their relatively short holding and transport time requirements.

4.2 METHODS OF COLLECTION

4.2.1 FIELD MEASUREMENTS

All field measurement equipment will be calibrated according to manufacturer's recommendations. Field Measurements will be collected using the standard methods found in TCEQ *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (December 2003). Field instrumentation will be used to measure temperature and conductivity. Selected samples, namely those collected from point sources or immediately downstream, may be tested in the field for residual chlorine. Treatment plant flow meters will be relied upon for plant flows at the time of sampling. Water flow velocity will be measured at selected sampling stations, when practical, in accordance with the SWQM Manual.

4.2.2 SAMPLE COLLECTION AND HANDLING

All water samples will be collected from roughly 0.5 foot below the water surface directly into the sample container, or with decontaminated buckets or dippers and transferred into the sample container. Decontamination of all sampling equipment will be performed by washing and scrubbing, followed by rinsing with a bleach solution, then rinsing with distilled water prior to use at each station. The sampling bucket or dipper will also be rinsed thoroughly with ambient water at each sampling location immediately prior to use in order to remove any disinfectant residue.

Sterile sampling containers will be used for all bacterial samples. Sterile sampling techniques will be applied, and no collection equipment will be used without sterilization.

Samples will be collected using standard methods found in TCEQ *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (December 2003). The following table identifies the parameters, containers, and preservatives to be utilized.

Table 4-1: Sampling Parameters, Containers and Preservation

Parameter	Method	Parameter Codes	Matrix	Container	Preservation	Sample Volume	Holding Time
E. Coli	EPA 1603; SM 9222-D+9222-G; SM9213D; SM 9223B	31648*, 31648*, 31700, 31699, 31702	water, sewage	polyurethane or glass bottle, or Whirlpak bag	4° C, dark	100-250 ml	6+2 hrs (6 field hours and 2 lab hours)
E. Coli	EPA 1603; SM 9222-D+9222-G; SM9213D; SM 9223B	31648*, 31648*, 31700, 31699, 31702	sediment	polyurethane or glass bottle, or Whirlpak bag	4° C, dark	100-250 ml	6+2 hrs (6 field hours and 2 lab hours)
Temperature (probe)	EPA 170.1, TCEQ SOP	00010	water	N/A	N/A	N/A	N/A
Conductivity (probe)	EPA 120.1, TCEQ SOP	00094	water	N/A	N/A	N/A	N/A
Flow	TCEQ SOP	00061	water	N/A	N/A	N/A	N/A
Residual Chlorine	SM 4500-Cl G and TCEQ SOP v1	50060	water	N/A	N/A	N/A	N/A

*Note: New parameter codes will be requested prior to data submittal

Quality Assurance/Quality Control to TCEQ standards will be performed for this entire sampling program.

4.3 PARAMETERS

Water samples will be collected for laboratory analysis of *E. coli*. Sediment samples will be collected as a component of special sediment sampling surveys and tested for *E. Coli*. Sediment data will not be stored in SWQMIS.

4.4 MICROBIAL SOURCE TRACKING

Microbial Source Tracking

Microbial source tracking will be conducted on Spring Gully in order to define the presence of absence of bacteria from human sources.

Ambient Water Sampling, Culturing, and Isolation

Field collection of water samples from the subject water course will be analyzed to segregate and quantify sources of *E. coli* bacteria. For the FY 2008 activities, one water sample for MST analysis will be collected from Spring Gully and one sample will be collected from a wastewater treatment facility in the same watershed.

Following sample collection, the samples will be shipped overnight to the qPCR laboratory, where the E. coli genetic markers will be isolated and identified using quantitative polymerase chain reaction.

The QAPP of the present JMA project will include procedures for collection, handling, and shipping of samples to the qPCR lab for subsequent analysis. For the present study, Source Molecular, Inc. (SMI) will provide the qPCR testing. The qPCR procedures employed by the laboratory, Source Molecular, Inc. (SMI) will be contained in Attachment 1 of this monitoring plan. SMI is a subcontractor to the JMA project team.

5.0 REFERENCES

JMA. 2007. *Preliminary Data Review: Northwest Houston Bacteria Impairments* (July 2007).

JMA and PES. 2002. *Historical Water Quality Data Assessment, Project Area 2 - Basins Groups D & E Bacteria Impairments. Report to TNRCC TMDL, Strategic Assessment Division.*

TCEQ. 2003 (RG-415). *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (December 2003).

TCEQ 2006. *Draft 2006 303(d) list.*

TCEQ. 2003. *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data, 2004.*

TCEQ. 2002. *Draft 305(b) Assessment.*

Attachment 1
Microbiology Guide Document
and Quality Control Procedures

Version: 2
Revision: 2
Date accepted: 07/11/07 by Dr. T.M. Scott

Microbiology Guide Document and Quality Control Procedures

(MGD-1)

Source Molecular Corporation

4842 SW 74th Court
Miami, FL 33155

Policy Statement

The management and personnel of Source Molecular Corporation are committed to good professional practice and to provide analytical services in compliance with stringent standards of quality. All analyses performed by said Laboratory shall be in accordance with established assurance practices and specific, written testing procedures. All employees shall be familiar with their responsibilities under the program and implement the

policies and procedures in their work. The quality manual shall be readily available to all employees and maintained up-to-date along with quality documentation.

Objectives

1. Test results shall be of known quality
2. The precision and accuracy of all test data shall be determined
3. Data acquisition, transfer and report preparation steps shall be documented
4. All reports shall be reviewed for completeness and conformance to the quality system program by the appropriate department head, the lab director or the lab manager.
5. Raw data, quality control data and reports shall be stored and retrievable
6. Sample receiving shall ensure that the Laboratory sample acceptance policy is met.
7. Samples shall be retrievable until disposal is called for
8. All operations shall be performed in accordance with and in conformance to detailed, documented standard operating procedures.

Methods and Procedures

1.0 Reference Cultures. All reference cultures of Microorganisms for positive and negative controls and routine laboratory analyses are purchased from the American Type Culture Collection (ATCC). ATCC information is logged into the reference culture notebook and cultures are stored according to supplier's specifications.

2.0 Revival of Reference Cultures. Reference cultures are stored according to supplier's specifications. Frozen cultures are revived and subcultured only once to provide reference stocks. Reference stocks are only revived once to maintain working stocks. Reference cultures are only replaced directly from supplier (e.g. ATCC).

3.0 Working Cultures. Working stocks are preserved by a method deemed appropriate that maintains desired characteristics of the reference organism. Working stocks are not thawed and reused. Working Cultures do not replace reference cultures.

3.1 Bacterial cultures. Maintained on solid media plates (non-selective). Prior to analyses, cultures are streaked onto selective and differential medium to assess desired characteristics. Bacterial cultures are only subcultured 5 times before obtaining another Reference Culture.

3.2 Mammalian Tissue Culture. Stocks are maintained in culture flasks and passed no more than 300 times. After 300 passages, stocks are destroyed and reordered from ATCC.

3.3 Viral Cultures. Viral cultures are kept frozen at –20 oC in minimal essential medium (MEM) supplemented with 10% fetal bovine serum (FBS).

4.0 Cleaning and disinfection of work areas. All floors and work surfaces are cleaned and disinfected weekly with a commercially available cleaning/disinfection agent. Routine surface area disinfection is accomplished by spraying work areas with an aqueous solution containing 70% ethanol and wiping with paper towels. Flooring in the laboratory is tile and all work surfaces are sealed formica. Dusting is performed weekly.

5.0 Food and Drink in the Laboratory. All food and drink is prohibited in the laboratory. Food and drink is only allowed in offices and reception areas.

6.0 Temperature monitoring and recording. All incubators, refrigerators, freezers, and water baths are monitored by NIST traceable thermometers. Temperature logs are kept at the equipment and when log is full it is filed in equipment notebook under the appropriate item. Data on traceability of thermometers is available in the equipment notebook. Temperatures are read and recorded to most precise scale measured by the thermometer.

7.0 Equipment calibration and performance.

7.1 Thermometers. All thermometers are replaced annually by NIST-traceable products.

7.2 Autoclave. Autoclaves are monitored for maximum temperature on each run and all data is recorded on autoclave log sheet with each run. Temperature measurements are made from different quadrants in succession and the thermometer location is reference on the log sheet. All items to be autoclaved are appropriately labeled and marked with temperature tape. Spore tests are performed at least monthly and results are logged on autoclave performance sheet. Autoclave thermometers are replaced annually. Autoclave timing device is checked quarterly by comparing to atomic clock at www.nist.gov. All completed log sheets and performance sheets are filed in the equipment notebook.

7.3 Pipets. All pipets and volumetric equipment is calibrated every six months by an outside vendor. Results from calibrations are recorded in the equipment notebook. Each lot number of disposable pipets and pipet tips is checked for accuracy by weighing amount of discharged purified water on an analytical balance (eg. 10 ml = 10 g). All pipets are calibrated monthly in-

house by this method and results are recorded on pipet calibration log sheets. Completed log sheets are filed in the equipment notebook.

7.4 UV disinfection instruments. UV bulbs are not used for routine surface disinfection. UV bulb in the Biosafety cabinet is checked quarterly for biocidal activity by Plate Count Agar spread plates.

7.5 pH Meters. All pH meters are calibrated using two separate lots of NIST traceable buffers (pH 4.0, 7.0, 10.0) and results are recorded on pH meter calibration log sheet. Completed sheets are filed in the equipment notebook.

7.6 Incubators and water baths. All incubators and water bath temperatures are monitored twice daily. Water bath temperatures are recorded from four quadrants with an infrared laser thermometer and the average temperature is recorded on the log sheet. Incubator temperature is recorded from a fixed thermometer location for daily measurements. Uniformity of temperature is measured using an infrared laser thermometer aimed at all four corners of the incubator. Average temp. is only recorded if it deviates from the temperature displayed by the fixed thermometer.

8.0 Dishwashing. SOPs for washing of labware are available for reference at the dishwashing station. Only detergents designed for laboratory use are used for washing labware. All laboratory glassware is made of borosilicate glass and has readable measurement marks if applicable.

9.0 Glassware. All glassware is tested annually (or with a new lot number of detergent) for inhibitory residue by performing an inhibitory residue test in conjunction with the media performance tests required by a specific method. Inhibitory residue test results are recorded in the media performance log sheet. Completed media performance log sheets are filed in the media log notebook. All glassware are tested daily for acid or alkaline residues with a pH indicator and results are recorded on glassware log sheet. Completed glassware log sheets are filed in the media log notebook.

10.0 Sterility checks. All lot numbers of sterile materials that are purchased are subjected to a sterility test.

10.1 Sample Containers. A sample container is filled with sterile dilution water and the solution is filtered through a filter membrane (of a lot number previously tested for sterility). The filter membrane is placed on a sterile petri plate (of a lot number previously tested for sterility) containing plate count agar and incubated for 48 hours at 35 ^{o}C. Results are recorded on a media QC bench sheet. Completed bench sheets are filed in the media log notebook.

10.2 Dilution water. Sterile dilution water is purchased from an outside vendor and checked for sterility according to procedure outlined in section 10.1.

10.3 Membrane filters. One filter from each new lot is tested for sterility according to method outlined in section 10.1.

11.0 Analyst Demonstration of Capability. Each laboratory analyst shall have the required level of education and experience outlined by NELAC or individual method requirements, whichever is greater. Each new analyst must demonstrate an initial and at least annual ongoing demonstrations of capability. In addition, a new demonstration of capability must be performed each time there is a change in equipment, personnel, or test method. All associated supporting data (i.e. bench sheets) are retained in the PT notebook under the specified analytical method. Source Molecular Corporation does not use specialized work cells

11.1 Bacteria by membrane filtration. All bacteriological analysts are required to perform an initial proficiency (PT) sample prior to commencing laboratory analyses. PT samples are obtained from reputable NELAP-accredited vendor. PT samples are logged and processed according to all standard methods employed by the laboratory. Results**.** are logged in the PT notebook.

11.1.1 Total coliforms and *E coli* - Total coliforms and *E. coli* are analyzed by EPA Method 1604. The published method is available for reference in the laboratory.

11.1.2 Enterococci - Enterococci are analyzed by EPA Method 1600. The published method is available for reference in the laboratory.

11.1.3 Method Blanks and Sterility Blanks- A Method Blank is performed with each new media lot prepared for use. Sterility Blanks are performed each time the method is performed both prior to and after analysis and at least once every 10 samples analyzed. Filter funnels are rinsed three times with sterile rinse water between filtration series. Method Blank and Sterility Blank results and supporting documentation for bacterial analyses are filed in the Bacteriology PT notebook.

11.1.4 Analysis time. Membrane filtration is considered ended when more than 30 minutes has elapsed between successive filtrations.

11.1.5 Result Interpretation. At least once per month, the analysis in the 1 person laboratory must do repetitive counting on the same plate with no more than 5% difference between the counts. Results are recorded on laboratory bench sheet and filed in the bacteriology PT notebook.

11.2 *Cryptosporidium* and *Giardia* by EPA Method 1623. All parasitology analysts are required to perform an initial proficiency (PT) sample prior to commencing laboratory analyses. PT samples

are obtained quarterly from the United States Environmental Protection Agency as part of the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESTWR) Laboratory Accreditation Program. PT samples are logged and processed according to all standard methods employed by the laboratory. Results are logged in the PT notebook.

11.2.1 Matrix Spikes – Matrix spikes are required each time a new matrix is analyzed under EPA Method 1623. Matrix spike results and supporting documents are recorded in the OPR and Matrix Spike notebook

11.2.2 Ongoing Proficiency Testing - Ongoing Proficiency Testing is a method 1623 requirement and must be performed at least every week testing is being performed, or every 20 samples processed, whichever is greater. OPR results and supporting documentation are filed in the OPR and Matrix Spike notebook.

11.2.3 Method Blanks – Processing of a method blank is a method 1623 requirement and must be performed at least every week testing is being performed, or every 20 samples processed, whichever is greater. Method blank results and supporting documentation are filed in the OPR and Matrix Spike notebook.

11.3 Enteric Viruses by EPA, SM 9510, and ASTM D4994-89. All virology analysts are required to perform an initial proficiency (PT) sample prior to commencing laboratory analyses. PT samples generated in-house and are verified by the QC manager.

11.3.1 Matrix Spikes – Matrix spikes are performed each time a new matrix is analyzed. Matrix spike results and supporting documents are recorded in the OPR and Matrix Spike notebook

11.3.2 Ongoing Proficiency Testing - Ongoing Proficiency Testing is performed with each new lot of Beef Extract used in the method. OPR results and supporting documentation are filed in the OPR and Matrix Spike notebook.

11.3.3 Method Blanks – Processing of a method blank is performed with each new lot of Beef Extract used in the method. Method Blank results and supporting documentation are filed in the OPR and Matrix Spike notebook.

12.0 Quality Control. Positive and negative controls are run with each analysis to verify that filtration equipment and filters, sample containers, media, and reagents have not been contaminated by improper handling or preparation, inadequate sterilization, or environmental exposure. Each new batch of media prepared by the laboratory is tested for use with at least one pure culture of a positive control organism and at least one pure culture of a negative control organism. See Corporate Quality Control Manual for specific measures and procedures.

12.1 EPA Method 1603. Positive control – *E. coli*, Negative control – *Ent. faecium*

12.2 EPA Method 1600. Positive control – Ent. faecium, Negative control – E. coli

12.3 EPA Method 1623. Positive control - BTF Bio Easy Seed flow sorted *Cryptosporidium* and *Giardia* for matrix spikes and OPRs. Positive Staining control organisms are included with each staining kit.

12.4 Enteric Viruses by EPA ICR, ASTM D4994-89, SM9510. Positive Control – Poliovirus Lsc1, Negative Control – Sterile PBS. 40 Liters spiked water processed through entire method from filtration to cell culture.

13.0 Method evaluation and document control . The laboratory records and retains all microbiological validation data for as long as the pertinent test method is in force and for at least five years past the date of its last use.

14.0 Statistical calculations. Calculations, data reduction, and statistical interpretations are performed according to method requirements. See SOP Q-5.

15.0 Sampling

15.1 The laboratory has procedures for sampling on file in the SOP Notebook. Sampling plans are constructed on a per-project basis and are filed in the client file.

15.2 The sampling plan and procedures for sampling are taken to the locations where sampling is undertaken

15.3 Whenever reasonable, sampling plans are based on statistical methods

15.4 The sampling procedures address factors to be controlled to ensure validity of the environmental test results

15.5 The laboratory uses procedures dictated by individual analysis methods (when available) to obtain representative samples

15.6 All deviations, additions, or exclusions required by the client are recorded in detail with all appropriate sampling data, communicated to the client and appropriate personnel, and are included on final reports

15.7 Sampling procedures include steps to be taken to ensure adequate recording of pertinent data and operations relevant to sampling.

15.8 These records include sampling procedure used, identification of the sampler, environmental conditions, diagrams, sampling location, and statistical methods (if applicable) used.

15.8.1 See Field Data Sheet (FDS-1) located in sampling notebook

16.0 EPA Method 1623 Equipment and Quality Control

All equipment and associated supplies for performance of EPA Method 1623 are available for use in the laboratory. All Quality Control checks and Equipment Maintenance records are on file in the appropriate notebooks.

16.1 Jouan 4 22 centrifuge (serial #49710072)

16.2 Immunomagnetic separation kits (Dynal), magnetic particle concentrators, and rotator

16.3 Primary staining antibodies (BTF – Easy Stain)

16.4 Olympus BX-51 TRF epifluorescence microscope with Differential Interference Contrast and excitation/band pass filters for FITC and DAPI (Serial # 2D10657)

16.5 Microscope adjustments (Hg bulb adjustments/replacement, transmitted bulb replacement, adjustment of oculars, calibration of ocular micrometer, establishing Kohler illumination) are performed according to manufacturer's instruction or EPA Method 1623. Checklist for microscope adjustments are on slide data sheets and are filed with supporting documentation. Bulb replacements are documented in Equipment Maintenance Notebook.

16.6 Acceptance Criteria. Acceptance criteria for Initial Demonstration of Capability (IDC), Ongoing proficiency (OPR), and Matrix Spikes (MS) are outlined in EPA Method 1623 and SOP Q-7

16.7 Analyst proficiency. See Quality Control section EPA Method 1623

16.8 Holding times. Dictated by Method and outlined in SOP P-1

17.0 Enteric Viruses by EPA ICR, ASTM D4994-89, SM9510 Equipment and Quality Control

17.1 Filters. 1-MDS filters are used for EPA ICR, 1-MDS or Filterite Filters are used for SM9510

17.2 Cell lines. Buffalo Green Monkey cell lines are used for all analyses. Only passage 117-250 are used for virus analysis. Other cell lines are also routinely used and specified in reports and data collection/analysis.

17.3 Cell culture positive control. Poliovirus –1 (attenuated) inoculated onto monolayer. Look for development of CPE within 48 hours (SOP V-3)

17.4 Cell culture negative control. Sterile PBS inoculated onto cell culture monolayer. No CPE observed (SOP V-3)

17.5 Cell culture maintenance. Each lot of calf serum and cell culture media is tested for sterility and performance and recorded in the media log notebook.

17.6 Methods manuals and SOPs for all test methods are available in laboratory SOP notebook and at work stations.

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Date accepted: 07/11/07 by Dr. T.M. Scott

Host Associated Molecular Markers (PCR and Quantitative PCR based assays)

Filtration of samples - A specified volume of water from each sample (*Enterococcus* or *Bacteroidetes)* is filtered through a 0.45 micron filter to collect bacterial cells for molecular analysis. In case of a clogged filter, an additional filter is utilized until an appropriate volume of water is filtered. Each filter is then processed according to methodology outlined below.

Preparation of *Enterococcus* template DNA for PCR and qPCR reactions - PCR and qPCR reactions are performed on composite DNA samples extracted from membrane filters. Filters containing enterococci colonies are lifted, suspended in Azide dextrose broth (Difco), vortexed vigorously, and incubated for 3 hours at 41 ^{o}C to wash bacteria from the filters and partially enrich the culture. DNA extraction is performed on the resulting culture of bacteria using a Qiagen Stool DNA extraction kit according to manufacturer's instructions (Qiagen, Inc.).

Preparation of *Bacteroidetes* template DNA for PCR and qPCR reactions - PCR and qPCR reactions are performed on composite DNA samples extracted from membrane filters. Water samples are filtered and filters are lifted, suspended in Qiagen Stool Lysis Buffer and vortexed vigorously. The resulting lysate is processed for DNA extraction according to manufacturer's instructions (Qiagen stool DNA extraction kit).

PCR primers and reaction conditions for Human *Enterococcus* marker - Primers specific for the *esp* gene in *E. faecium* were developed by Scott et al. (2005). The forward primer, which is specific for the *E. faecium esp* gene is: (5'-TAT GAA AGC AAC AGC ACA AGT T-3'). A conserved reverse primer (5'-ACG TCG AAA GTT CGA TTT CC-3'), developed previously by Hammerum and Jensen, was used for all reactions. PCR reactions were performed in a 50 uL reaction mixture containing 1X PCR buffer, 1.5 mM $MgCl_2$, 200 uM of each of the four deoxyribonucleotides, 0.3 uM of each primer, 2.5 U of HotStarTaq DNA polymerase (Qiagen), and 5 ul of template DNA. Amplification was performed with an initial step at 95 ^{o}C for 15 minutes (to activate Taq polymerase), followed by 35 cycles of 94°C for 1 min, 58°C for 1 min, and 72°C for 1 min. PCR products were separated on a 1.5% agarose gel stained with GelStar nucleic acid stain (BioWhittaker) and viewed under UV light. The PCR product is 680 base pairs in length.

qPCR primers and probes and reaction conditions for Total *Enterococcus* marker and Human *Enterococcus* marker – qPCR primers specific for the esp gene in *E. faecium* were developed based on

Scott et al. (2005). The forward primer, which is specific for the *E. faecium* gene is: 5'-TATGAAAGCAACAGCACAAGTT-3' and is identical to the forward primer for conventional PCR. The reverse primer is: 5'- TATGAAAGCAACAGCACAAGTT-3' and the sequence for the "Taqman" probe is 5'- CCATTTGGTGAAGATTTCATCTTTGATTC-3'. The probe is labeled with FAM at the 5' end and TAMRA at the 3' end.

A qPCR assay for the total *Enterococcus* marker was designed based on the target sequence described by Cheng et al. (Journal of Clinical Chemistry, 35, 1248-1250, 1997). The marker sequence was lodged with GenBank under accession number L78127. The forward primer is: 5'-GTTGGTGCAGCTGTGCCA-3'; the reverse primer is: 5'-CGAACGCGACCGTCATG-3'; the sequence for the "Taqman" probe is 5'-CCAAATCGATCCGCATCCATGATCA-3'. The probe is labeled with FAM at the 5' end and TAMRA at the 3' end.

qPCR reactions for both the human *Enterococcus* marker and total *Enterococcus* marker were performed in 25ul reaction mixtures containing 1X Taqman Universal Master Mix (Applied Biosystems) with 900nM of both forward and reverse primers and 250nM probe and 2ul of template DNA. Amplification and analysis was undertaken in an Applied Biosystems 7700 with the following amplification conditions: 50°C for 10 minutes and 95°C for 15 seconds followed by 40 cycles of 95°C for 15 seconds and 57°C for 1 minute. Gene marker copy numbers were calculated by reference to standard curves generated using synthetic target amplicons.

9.7.1 Quality Control

All molecular biology is performed in an isolation room separated from live bacterial, viral, and tissue cell cultures.

Experiments are performed using separate pipettors with aerosol resistant tips, latex gloves are used at all times, and equipment and bench space is routinely wiped down with DNAse and RNAse inhibitors.

Negative and positive controls are used in all PCR reactions. All DNA extractions are performed using kits that remove PCR inhibitors. When applicable, negative samples are spiked with positive control DNA to assess the presence of PCR inhibitors.

Version: 2
Revision: 2
Date accepted: 07/11/07 by Dr. T.M. Scott

APPENDIX B.
SAMPLING PROCESS DESIGN AND MONITORING SCHEDULE

(The Sampling process design and monitoring schedule are integrated into the Work Plan in Appendix A.)

APPENDIX C. FIELD DATA REPORTING FORM

Field Data Sheet
James Miertschin and Associates, Inc.

Project Name/Location

Job Number

Sampler(s) Names (printed) and Signature(s)

Date	Time	Station ID/Sample ID	DO (mg/L)	pH	Temp. (˚C)	Flow (fps)	Flow Severity (1)	Residual Chlorine	Cond.	Observations (2)
		Calibration: Equip.:		DO:		1st pH:		2nd pH:		Cond.:
		Post Calibration:	DO:		1st pH:		2nd pH:		Cond:	

1 1-no flow, 2-low, 3-normal, 4-flood, 5-high, 6-dry

2 Observation: (use the entire next row of this table if necessary, complete for each location) Water appearance, weather, biological activity, stream uses, unusual odors, specific sample information, missing parameters, and if pertinent: recent rainfall (day and amount) or days since last significant rainfall.

APPENDIX D. CHAIN-OF-CUSTODY FORM

North Water District Laboratory Services
8725 Fawn Trail, The Woodlands, Texas 77385

CHAIN OF CUSTODY RECORD

Project Name:					# of containers	Analyses Required											
Station ID	Date	Time (24hr)	Matrix	Description													Sample ID

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:	Laboratory remarks:
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:	Lab log #
Relinquished by: (Signature)	**Date:**	**Time:**	**Received for lab by: (Signature)**	**Date:**	**Time:**	**Laboratory Name:**

APPENDIX E. DATA MANAGEMENT PLAN

APPENDIX E. DATA MANAGEMENT PLAN

Data Management Process

Implementation of the data management plan is displayed graphically on Figure E.1. Field data will be recorded on field data reporting forms, and then entered into a database file. Field data forms will be maintained for five years. The results of EC tests will be maintained in an electronic database file.

If any calculations are made, at least 10% will be checked by hand for accuracy. JMA will archive copies of each file to CD-ROM format. The data file, along with a database review checklist, will then be transferred to the TCEQ Project Manager by e-mail. After approving the database review checklist, the TCEQ Project Manager will convey the file to the TCEQ TMDL Data Manager.

Personnel

Casey Johnson is responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. He provides the primary point of contact between the JMA Project Team and the TCEQ. Casey tracks and reviews deliverables to ensure that tasks in the work plan are completed as specified in the contract. He reviews and approves QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TCEQ participants. He is responsible for verifying that the QAPP is followed by the JMA Project Team. Casey notifies the TCEQ QAS and TMDL Program Manager of significant project nonconformance and corrective actions taken as documented in quarterly progress reports from JMA Project Team Project Manager.

Kerry Niemann, the TMDL Data Manager, tracks and validates data generated by TMDL projects and associates all applicable incoming data with a Project and QAPP in SWQMIS. Responsibilities include receiving data (Event/Results Files) and review checklists from TMDL Project Managers, and loading data sets into SWQMIS. The SWQMIS data loader identifies invalid stations, invalid parameter codes, outliers, and orphans. Deficiencies are provided to Project Managers via a SWQMIS Data Loading Validator Report. The TMDL Data Manager ensures data deficiencies are corrected before data sets are accepted by SWQMIS and loaded.

Dr. James Miertchin is responsible for managing this TMDL project. He is responsible for ensuring that data is managed by the subcontractors according to this data management plan and QAPP. Dr. Miertschin is responsible for ensuring that tasks and other requirements in the contract are executed on time and with the quality assurance / quality control requirements in the system as defined by the contract and in the project QAPP; assessing the quality of subcontractor/participant work; submitting accurate and timely deliverables to the TCEQ project Manager; and coordinating attendance at conference calls, training, meetings, and related project activities with the TCEQ. Responsible for verifying that the QAPP is distributed and followed by the JMA Project Team (including all subcontractors) and that the project is producing data of

known and acceptable quality. James is responsible for ensuring adequate training and supervision of all activities involved in generating analytical and field data, including the facilitation of audits and in the implementation, documentation, verification and reporting of corrective actions.

Dan Obenour is responsible for the acquisition, verification, and transfer of data to the TCEQ. Dan oversees data management for the study. Performs data quality assurances prior to transfer of data to TCEQ. Responsible for transferring data to TCEQ in the acceptable format. Ensures that the data review checklist is completed and data submitted with appropriate codes and data. Provides the point of contact for the TCEQ Project Manager to resolve issues related to the data and assumes responsibility for the correction of any data errors.

Al Capps is the quality assurance officer for the JMA Project Team. Responsible for coordinating development and implementation of JMA's QA program. Responsible for writing and maintaining the QAPP and monitoring its implementation. Responsible for maintaining records of QAPP distribution, including appendices and amendments. Ensures the data collected for the project is of known and acceptable quality and adheres to the specifications of the QAPP. Responsible for maintaining written records of sub-tier commitment to requirements specified in this QAPP. Responsible for identifying, receiving, and maintaining project quality assurance records. Responsible for compiling and submitting the QA report. Responsible for coordinating with the TCEQ QAS to resolve QA-related issues. Notifies the JMA Project Manager and TCEQ Project Manager of particular circumstances which may adversely affect the quality of data. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques.

Steve Grychka is responsible for the NWDLS personnel involved in generating analytical data for this project. He is responsible for insuring NWDLS personnel involved in generating analytical data have adequate training and a thorough knowledge of the QAPP and the SOPs specific to the analysis or task performed and or supervised. Responsible for oversight of all NWDLS operations ensuring that all QA/QC requirements are met and documentation related to the analysis is complete and accurately reported. Enforces corrective actions as required.

Systems Design

Data will be entered into, stored in, and transmitted between personal computers operating on Microsoft Windows 95/98/NT, and using common commercially-available software. Microsoft Excel or Microsoft Access XP will be used as databases, and data files created by these software programs will be transmitted between computers via e-mail. The TCEQ database hardware and software are described elsewhere and available from the TCEQ IR Program.

Data Dictionary - Terminology and field descriptions are included in the *SWQM Data Management Reference Guide, 2007* or most recent version. For the purposes of verifying which codes are included in this QAPP, a table outlining the codes that will be used when submitting data under this QAPP is included below:

Name of Monitoring Entity	Tag Prefix	Submitting Entity	Collecting Entities
JMA Project Team	JM	JM	JM

Quality Assurance/Control - See Section D of this QAPP.

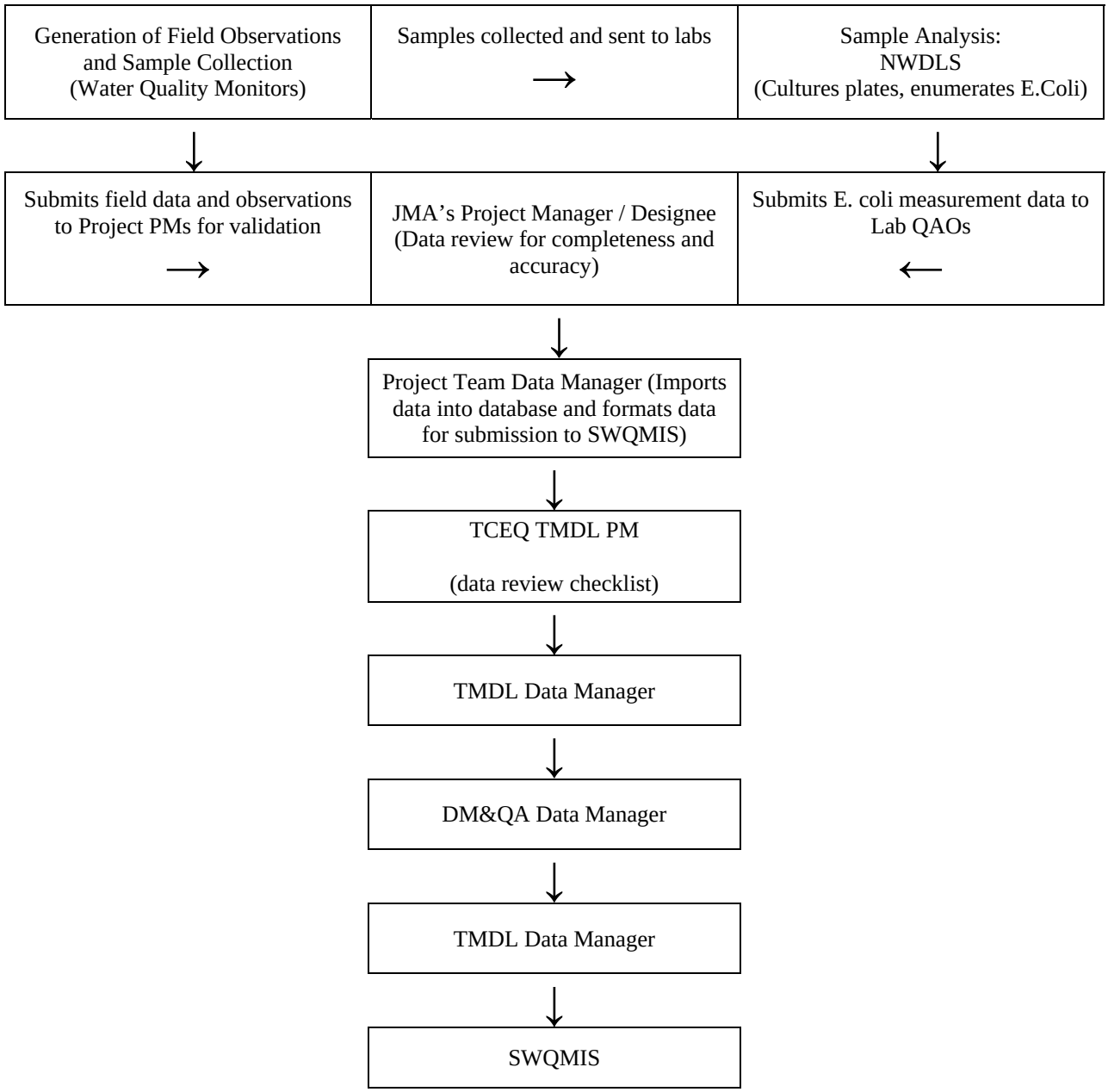
Migration/Transfer/Conversion - The JMA Project Team's data manager is Dan Obenour. He is responsible for the acquisition, verification, and transfer of data to the TCEQ TMDL Project Manager. Mr. Obenour oversees data management for the project by performing data quality assurances prior to transfer of data to TCEQ in the format specified in the SWQM Data Management Reference Guide (2007) or most recent version. Mr. Obenour transfers the laboratory results into a Microsoft Access database. After ensuring the data is free of transcription errors, he converts the data base into an ASCII pipe delimited format. He ensures that the data review checklist is completed and data is submitted with appropriate codes. All migration, transfer, and conversion of data, as well as data history will accompany his final submission.

Backup/Disaster Recovery – Data files stored on the network servers at JMA, and TCEQ computer systems are routinely backed up. After a summary report is produced at JMA, it will then be saved to a CD-ROM for distribution and archive. Copies of the field data reporting forms and laboratory paper records will be maintained at JMA for a period of five years as additional insurance against data loss.

Archives/Data Retention - Complete original data sets are archived on permanent media (CD-ROM*)* and retained on-site by the JMA for a retention period specified in Table A9.1 Project Documents and Records.

Information Dissemination - Project updates will be provided to the TMDL Project Manager in progress reports and the information will be made available at stakeholder meetings. Environmental data collected as part of the project described in this QAPP will be accessible to the general public from the TCEQ SWQMIS database once the data has undergone the QA/QC protocol described herein.

Figure E.1: Data Flow Chart



APPENDIX F. DATA REVIEW CHECKLIST

TCEQ TMDL Program Data Review Checklist

QAPP Title:

_____

Effective Date of QAPP:_____

Y, N, or N/A

Data Format and Structure

A. Are there any duplicate *Tag ID* numbers? _____
B. Are the *Tag prefixes* correct? _____
C. Are all *Tag ID* numbers 7 characters? _____
D. Are TCEQ station location (SLOC) numbers assigned? _____
E. Are sampling *Dates* in the correct format, MM/DD/YYYY? _____
F. Is the sampling *Time* based on the 24-hour clock (e.g. 13:04)? _____
G. Is the *Comment* field filled in where appropriate (e.g. unusual occurrence, sampling problems, unrepresentative of ambient water quality)? _____
H. *Submitting Entity Code, Collecting Entity Code, and Monitoring Type Code* used correctly? _____
I. Is the sampling date in the *Results* file the same as the one in the *Events* file? _____
J. Values represented by a valid parameter code with the correct units? _____
K. Are there any duplicate parameter codes for the same *Tag Id*? _____
L. Are there any invalid symbols in the Greater Than/Less Than (*GT/LT*) field? _____
M. Are there any tag numbers in the *Results* file that are not in the *Events* file? _____
N. Have confirmed outliers been identified? (with a "1" in the Verify_flg field) _____
O. Have grab data (bacteria, for example) taken during 24-hr events been reported separately as RT samples? _____

Data Quality Review

A. Are all the values reported at or below the AWRL? If no, explain on next page. _____
B. Have the outliers been verified? _____
C. Checks on correctness of analysis or data reasonableness performed? _____
e.g.: Is ortho-phosphorus less than total phosphorus?
Are dissolved metal concentrations less than or equal to total metals?
D. Have at least 10% of the data in the data set been reviewed against the field and laboratory data sheets? _____
E. Are all parameter codes in the data set listed in the QAPP? _____
F. Are all stations in the data set listed in the QAPP? _____
G. Was all data collected in accordance with the approved QAPP? _____

Documentation Review

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

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

_____

_____

_____

_____

_____

_____

_____

_____

Date Submitted to TCEQ: _____

Tag ID Series: _____

Date Range: _____

Data Source: _____

Comments (attach README.TXT file if applicable):

_____

_____

_____

_____

Lead Organization Data Manager: _____Date: _____

Data was collected as specified in the QAPP? Yes No (based on the responses above)

Did the contractor describe any data reporting inconsistencies with the AWRL specifications? Yes No
If yes, ensure the data was not reported to the TCEQ.

Did the contractor list any failures in sampling methods, field measurements, and/or laboratory measurements? Yes No
If yes, ensure the data was not reported to the TCEQ.

TMDL Project Manager:_____Date:_____

APPENDIX G. EXAMPLE LETTER

APPENDIX G. EXAMPLE LETTER TO DOCUMENT ADHERENCE TO THE QAPP

TO: *(name)*
(organization)

FROM: *(name)*
(organization)

RE: QAPP for Northwest Houston Area Bacteria TMDL Project

Please sign and return this form by (*date*) to:

(*address)*

I acknowledge receipt of the referenced document(s). I understand the document(s) describe quality assurance, quality control, data management and other technical activities that must be implemented to ensure the results of work performed will satisfy stated performance criteria.

_____

Signature Date