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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 Segments

Segment Number	Segment Name
1002	Lake Houston
1003	East Fork San Jacinto
1004	West Fork San Jacinto
1004D	Crystal Creek
1004E	Stewarts Creek
1008	Spring Creek
1008B	Upper Panther Branch
1008H	Willow Creek
1009	Cypress Creek
1009C	Faulkey Gully
1009D	Spring Gully
1009E	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
1008, 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
	16631	BEAR BRANCH AT RESEARCH FOREST	Mar-99	Jul-05	18	202
	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
	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
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 FORE	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 1004E; Willow Creek, Segment 1008H; and Spring Gully, Segment 1009D. 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 1008H) 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.

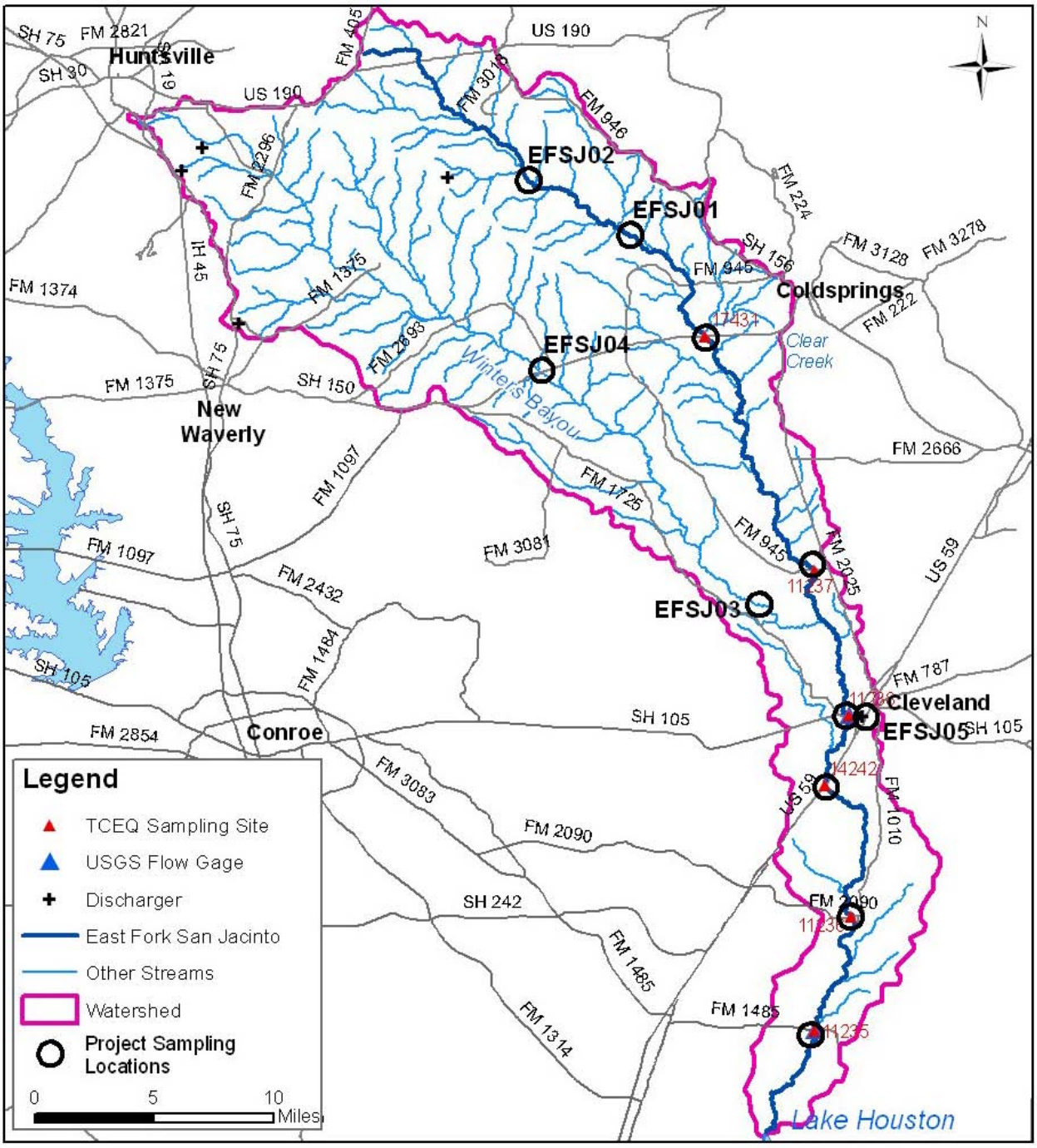

Figure 2-1: Sampling Stations for East Fork San Jacinto River, Segment 1003

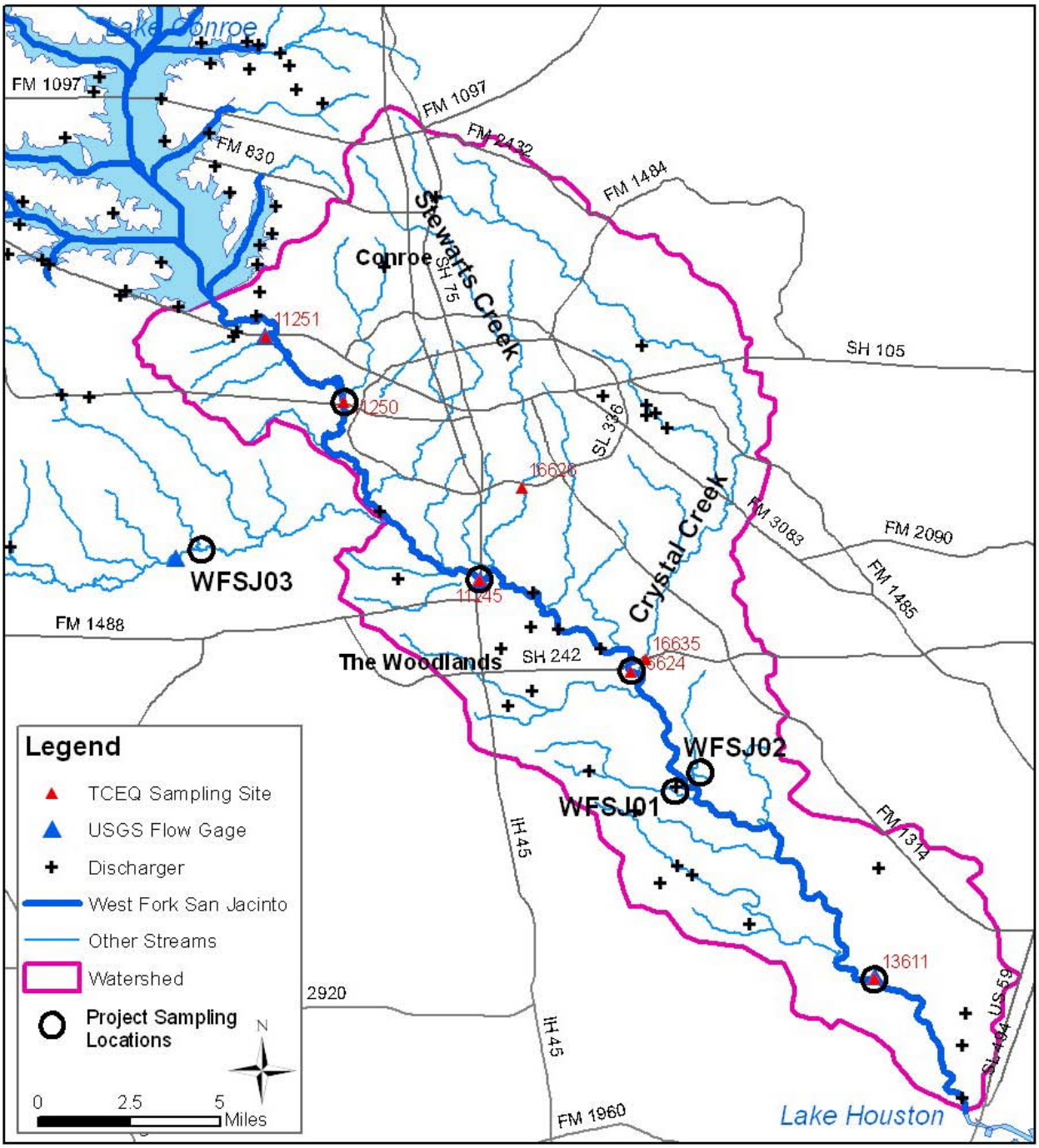

Figure 2-2: Sampling Stations for West Fork San Jacinto River, Segment 1004

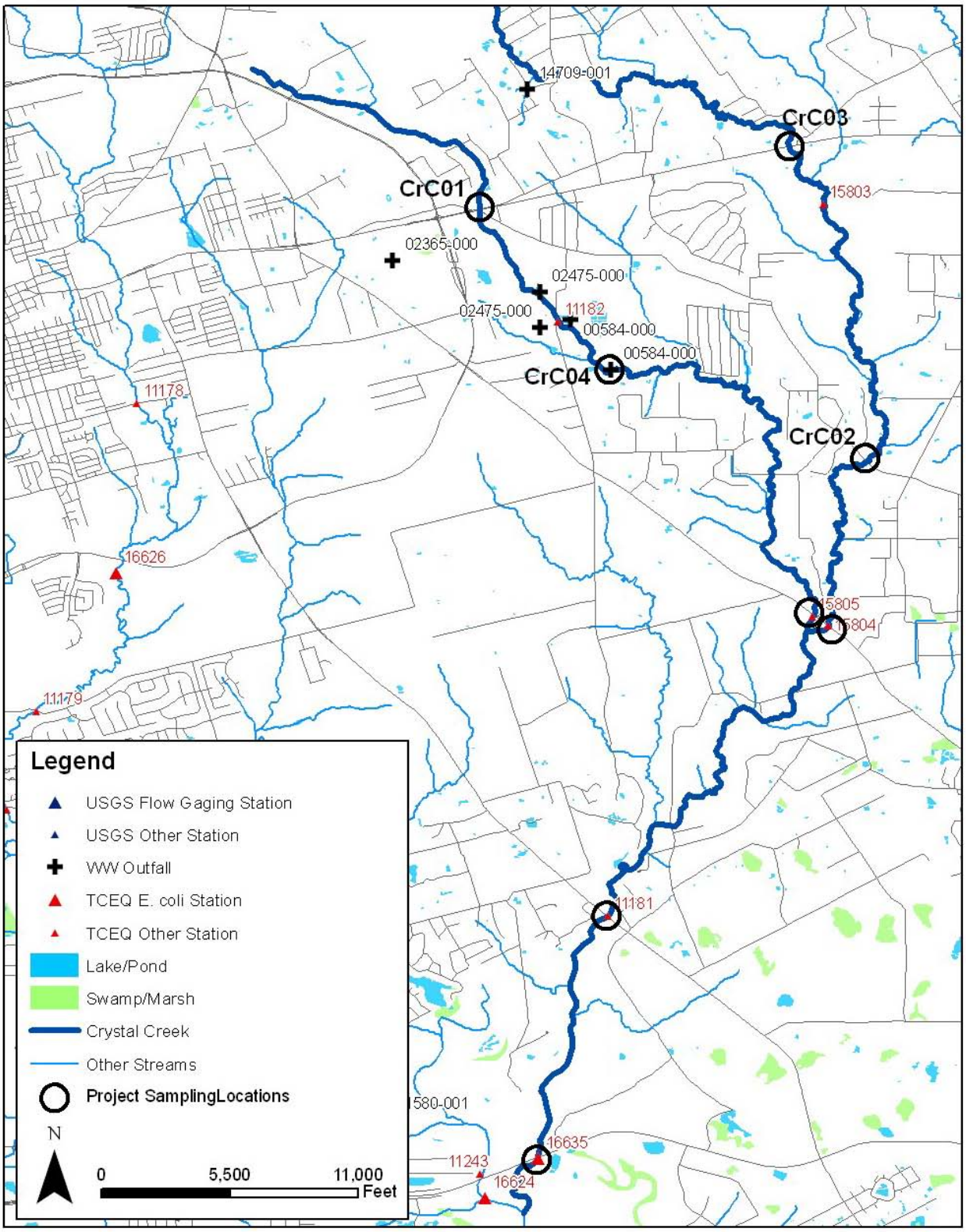

Figure 2-3: Sampling Stations for Crystal Creek, Segment 1004D

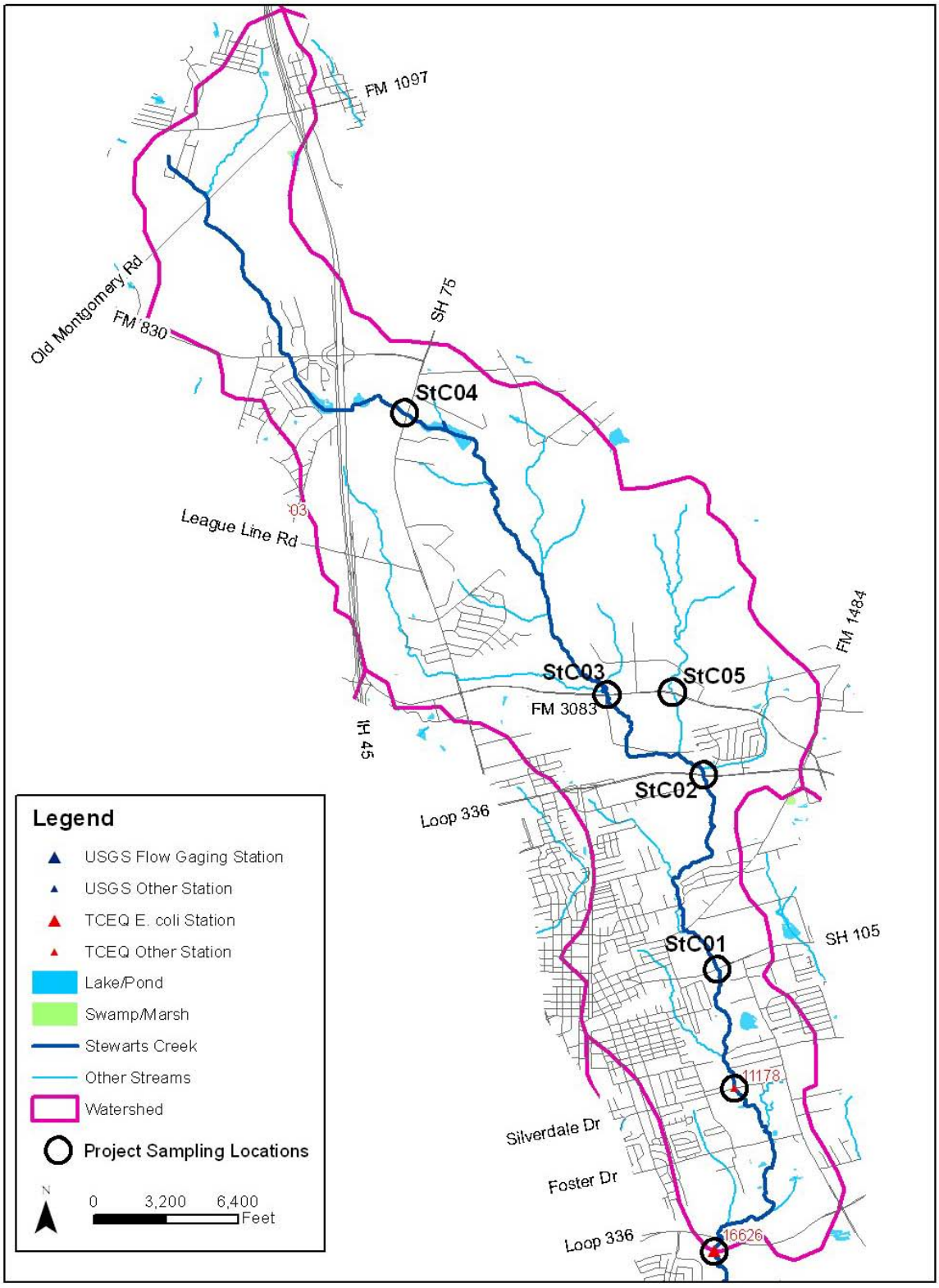

Figure 2-4: Sampling Stations for Stewarts Creek, Segment 1004E

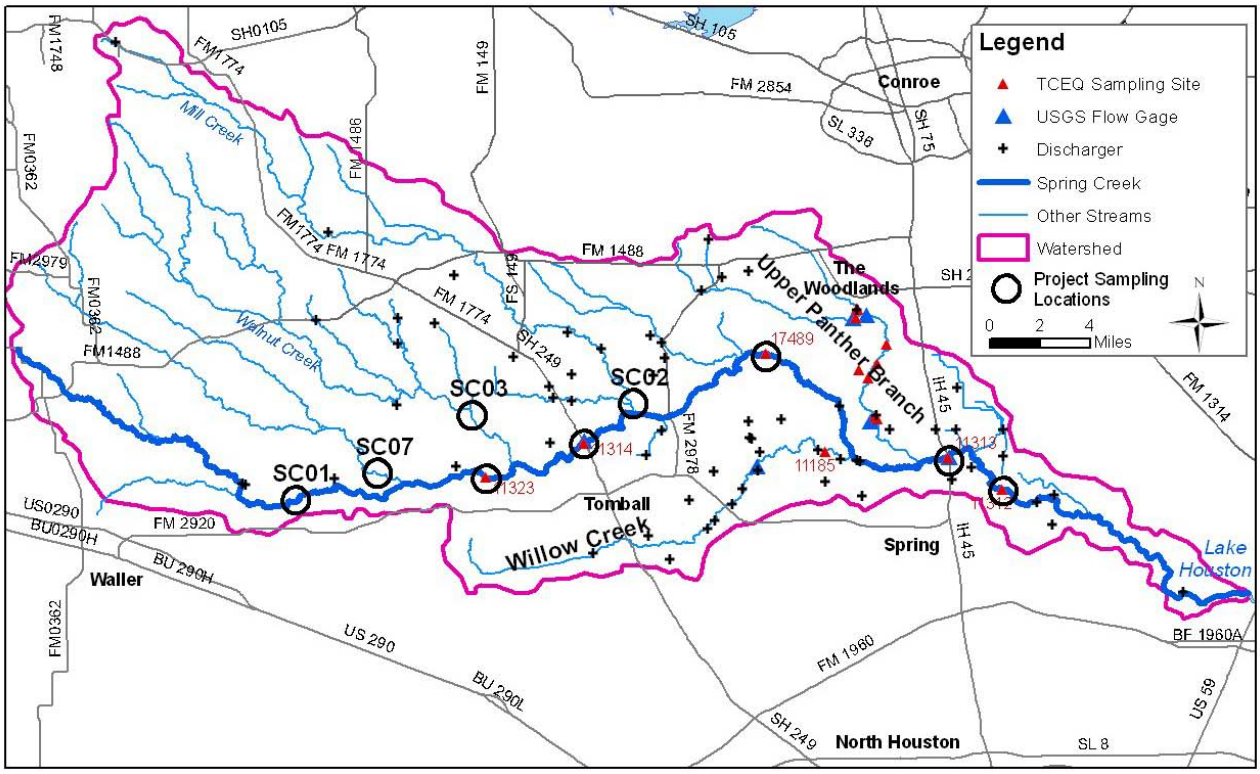

Figure 2-5: Sampling Stations for Spring Creek, Segment 1008

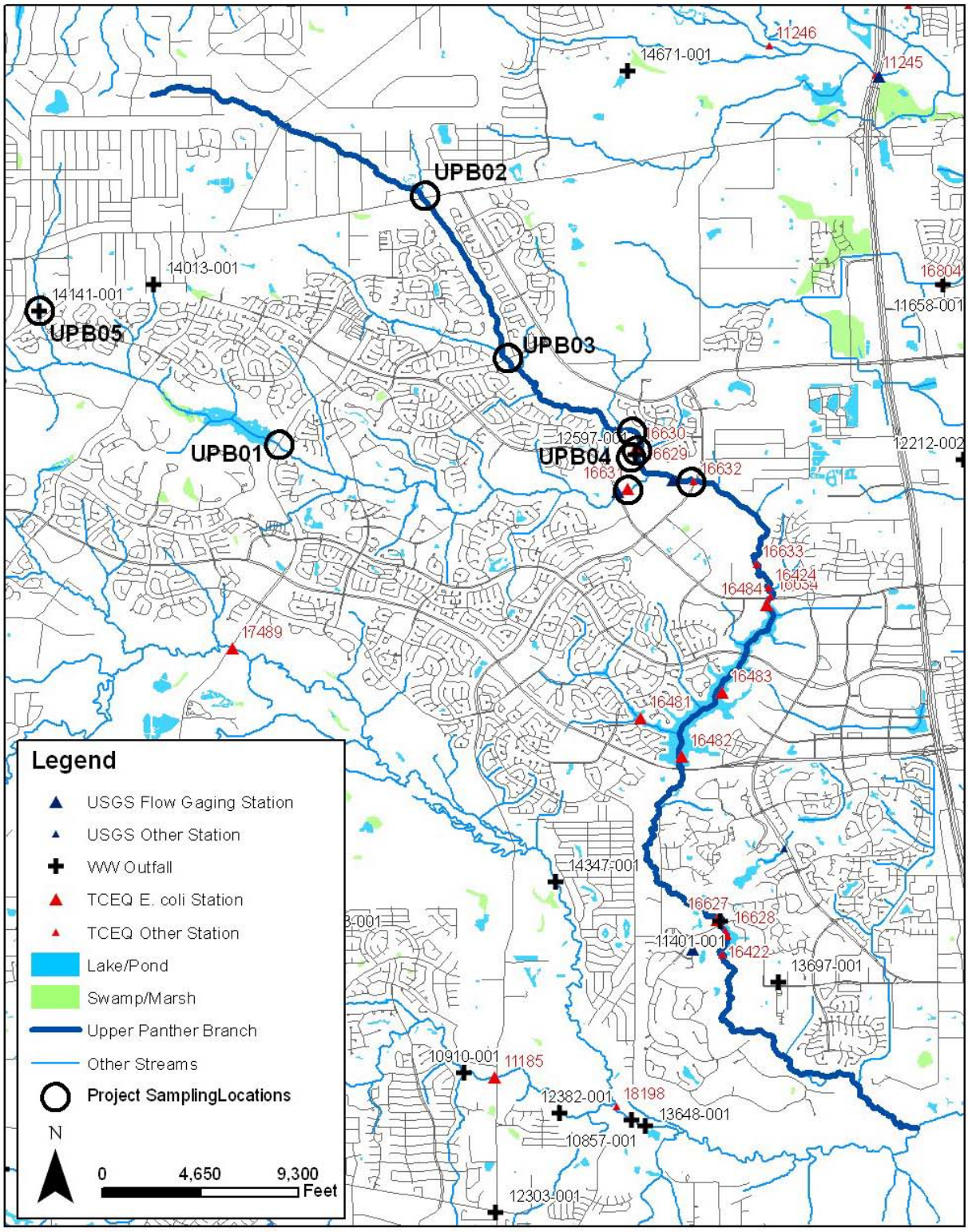

Figure 2-6: Sampling Stations for Upper Panther Branch , Segment 1008B

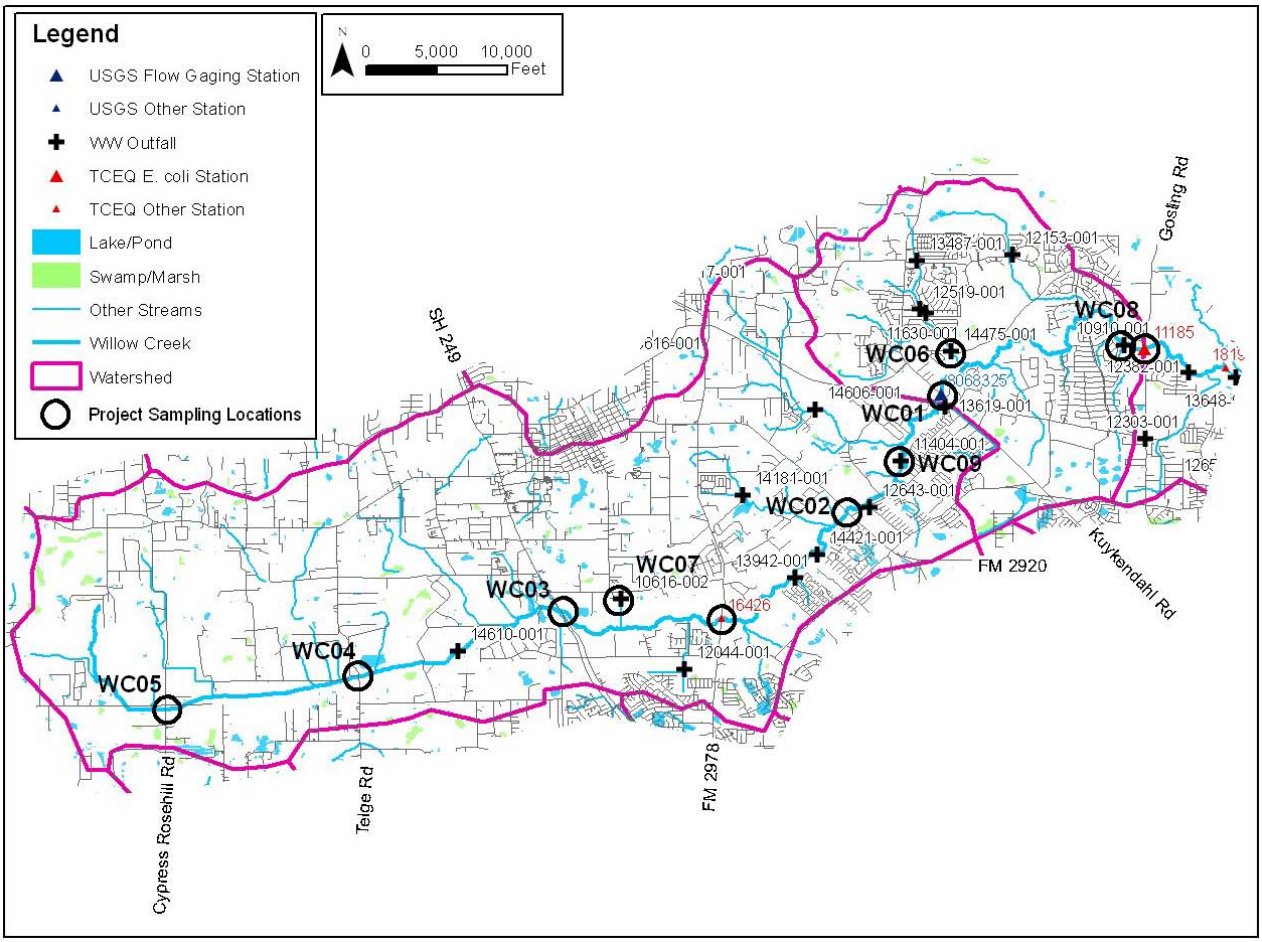

Figure 2-7: Sampling Stations for Willow Creek, Segment 1008H

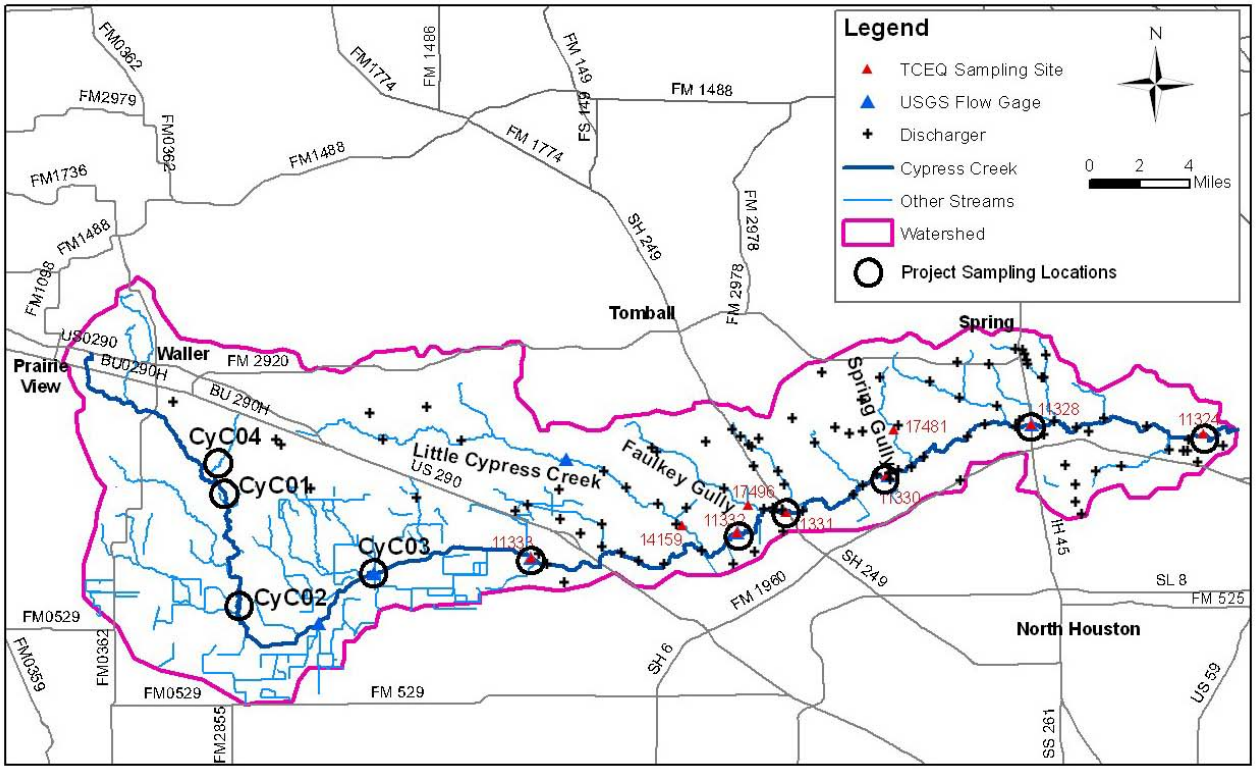

Figure 2-8: Sampling Stations for Cypress Creek, Segment 1009

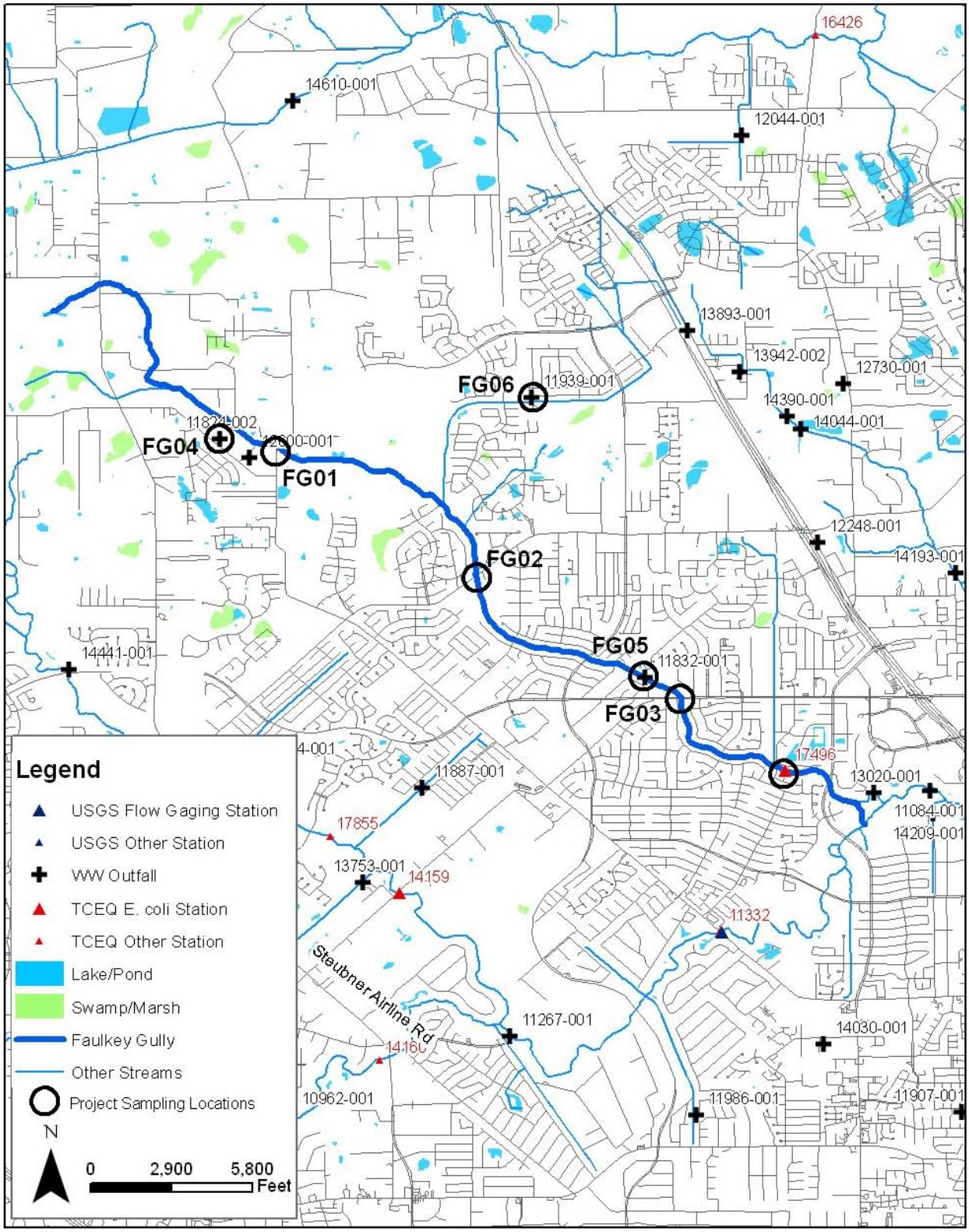

Figure 2-9: Sampling Stations for Faulkey Gully, 1009C

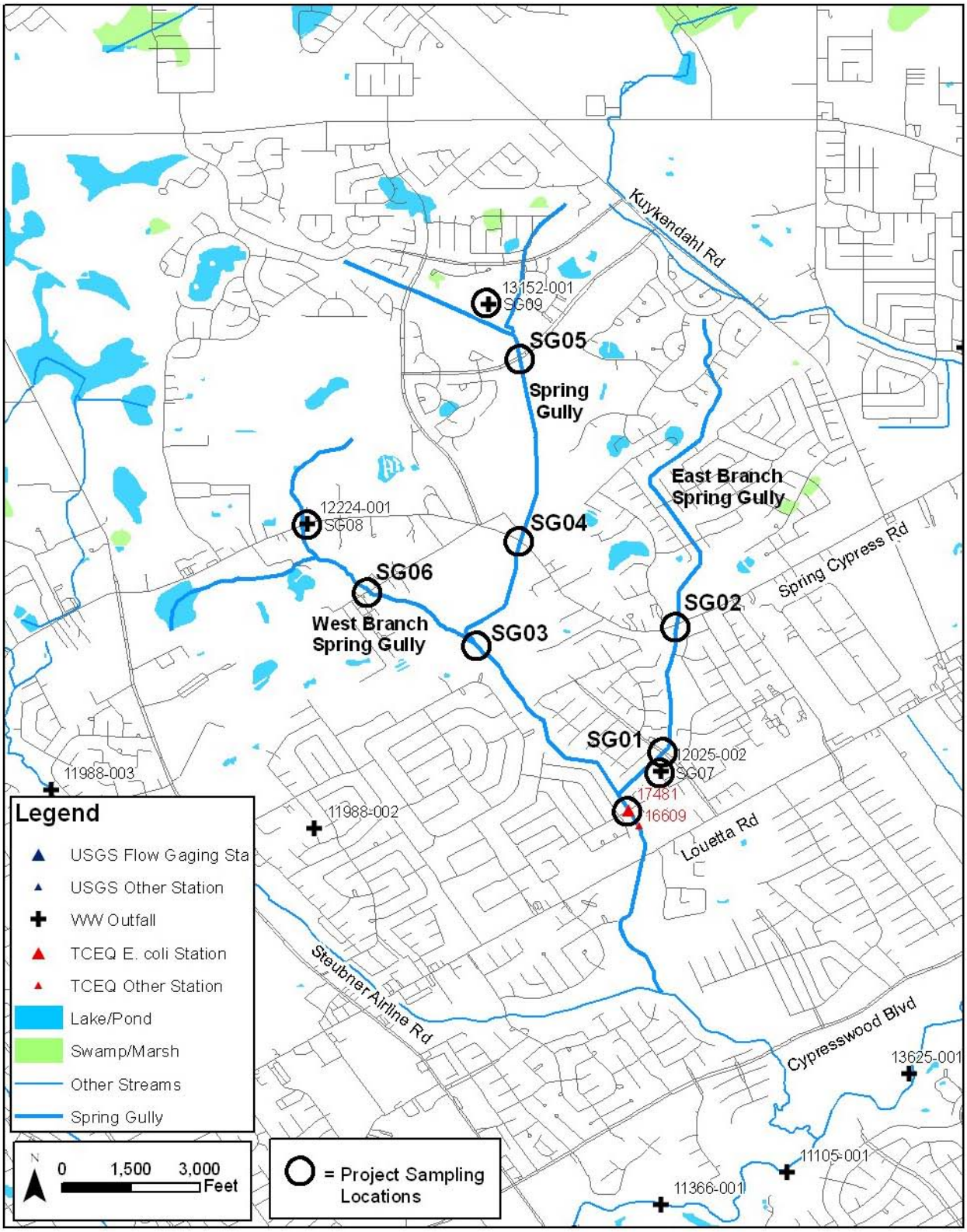

Figure 2-10: Sampling Stations for Spring Gully, 1009D

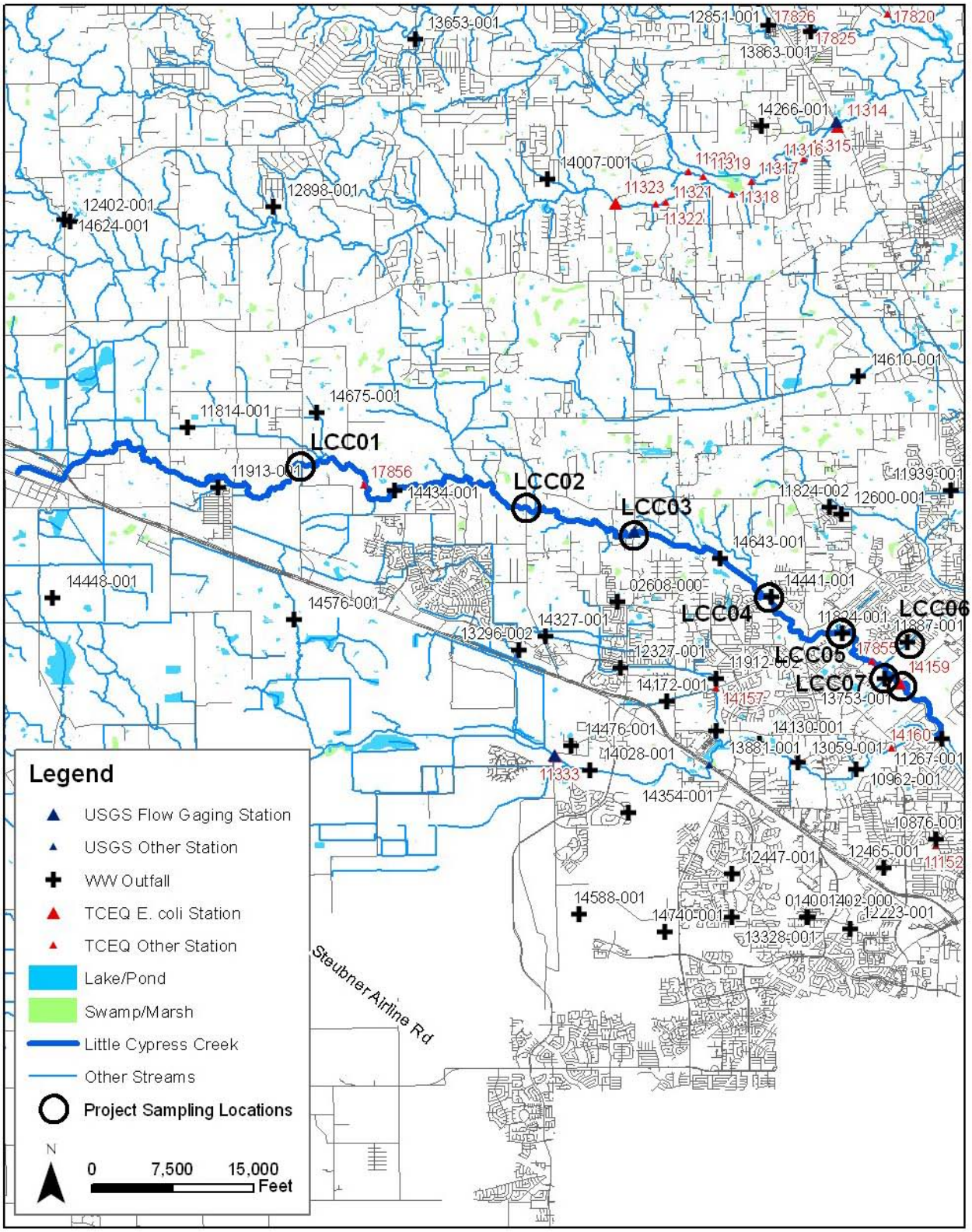

Figure 2-11: Sampling Stations for Little Cypress Creek, 1009E

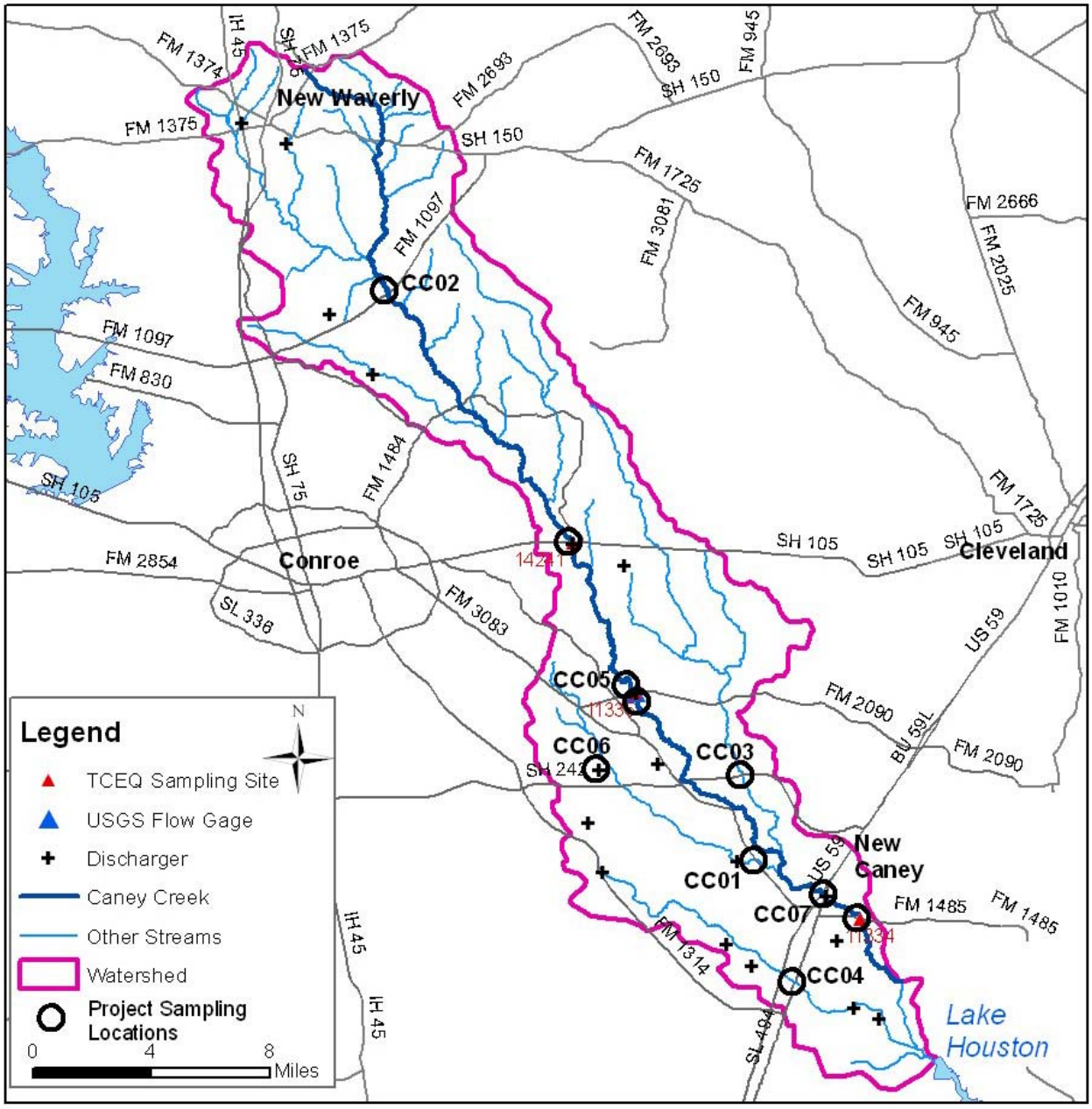

Figure 2-12: Sampling Stations for Caney Creek, 1010

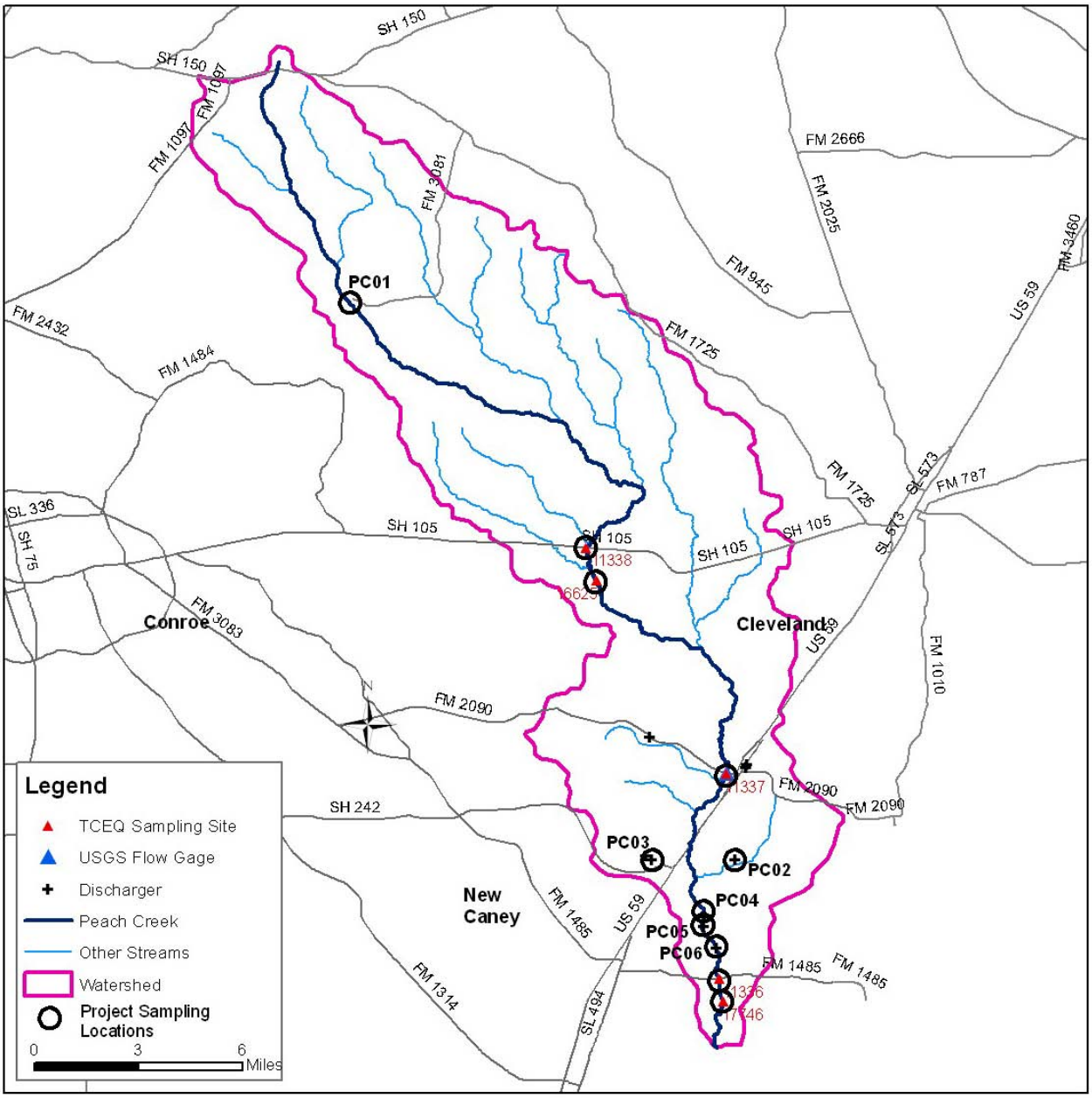

Figure 2-13: Sampling Stations for Peach Creek, 1011

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 1004E), Willow Creek (Segment 1008H), and Spring Gully (Segment 1009D), will be scheduled for Spatially-Intensive Source Sampling. One of the impaired segments, Willow Creek (Segment 1008H) 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 1004E, representing an urbanized area without permitted wastewater treatment facility discharges; Willow Creek Segment 1008H, representing both a relatively rural area with septic systems and an urbanized area with numerous permitted wastewater treatment facilities; and Spring Gully Segment 1009D, 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 1008H, 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.

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]	Prog 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/NW	BF				2	2	2
12	11236	East Fork San Jacinto River @ FM 2090	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	14242	East Fork San Jacinto River @ US 59	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	11238	East Fork San Jacinto River @ Cleveland	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	EFSJ05	Cleveland WWTP Outfall 10766-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	EFSJ03	Winters Bayou @ Shell Oil Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	EFSJ04	Winters Bayou @ SH 150	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
10	11237	East Fork San Jacinto River @ FM 945	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
10	17431	East Fork San Jacinto River @ SH 150	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	EFSJ01	East Fork San Jacinto River @ Hines Lake Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	EFSJ02	East Fork San Jacinto River @ Jenkins Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2

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

[2]JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3]BF is the Program 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]	Prog 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/NW	BF				2	2	2
12	WFSJ01	White Oak Creek @ Sleepy Hollow	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	13611	West Fork San Jacinto River SW of Porter Heights	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	16624	West Fork San Jacinto River @ SH 242	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	11245	West Fork San Jacinto River @ IH 45	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WFSJ03	Lake Creek @ Honea Egypt Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	11250	West Fork San Jacinto River @ FM 2854	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2

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

[2]JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3]BF is the Program 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 1004D

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Prog 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/NW	BF				2	2	2
12	11181	Crystal Creek @ FM 1314	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	15804	East Fork Crystal Creek @ FM 3083	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	CrC02	East Fork Crystal Creek @ FM 1484	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	CrC03	East Fork Crystal Creek @ SH 105	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	15805	West Fork Crystal Creek @ FM 3083	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	CrC04	Huntsman Corporation WWTP 00584-000	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	CrC01	West Fork Crystal Creek @ SH 105	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2

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

[2]JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3]BF is the Program 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 1004E

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Prog 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/NW	BF				2	2	2
12	16626	Stewarts Creek @ SH Loop 336	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	StC01	Stewarts Creek @ SH 105	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	StC02	Stewarts Creek @ North SH Loop 336	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	StC05	Little Caney Branch @ Fm 3083	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	StC03	Stewarts Creek @ FM 3083	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	StC04	Stewarts Creek @SH 75	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2

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

[2] JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3] BF is the Program 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]	Prog 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/NW	BF				2	2	2
12	11313	Spring Creek @ IH 45	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	17489	Spring Creek @ Kuykendahl Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	SC02	Mill Creek @Neidgt Lake Outfall	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	11314	Spring Creek at SH 249	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	SC03	Walnut Creek @ Cypress Rosehill	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	SC07	Brushy Creek at Glenmont Estates	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	11323	Spring Creek @ Decker Prairie Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	SC01	Spring Creek @ Murrell Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2

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

[2] JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3] BF is the Program 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]	Prog 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/NW	BF				2	2	2
12	UPB04	Woodlands Plant 2 WWTP Outfall 12597-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	16631	Bear Branch @Research Forest Dr	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	UPB01	Bear Branch @ Kuykendahl Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	UPB05	Old Egypt Buisness Center WWTP Outfall 1414-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	16630	Upper Panther Branch downstream of outfall	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	16629	Upper Panther Branch upstream of outfall	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	UPB03	Upper Panther Branch @ Green Bridge Drive	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	UPB02	Upper Panther Branch @ FM 1488	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2

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

[2] JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3] BF is the Program 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 1008H

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Prog 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/NW	BF				2	2	2
12	WC08	Northhampton WWTP Outfall 10910-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC06	Unnamed Trib of Willow Creek @ W Rayford Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC01	Willow Creek @ Kuykendahl Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC09	Dowdell WWTP Outfall 11404-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC02	Willow Creek @ Fm 2920	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	16426	Willow Creek @ Huffsmith Kohrville Rd (FM 2978)	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC07	Tomball WWTP Outfall 10616-002	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC03	Willow Creek @ SH 249	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC04	Willow Creek @ Telge Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC05	Willow Creek @ Cypress Rosehill Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2

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

[2] JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3] BF is the Program 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]	Prog 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/NW	BF				2	2	2
12	WC08	Northhampton WWTP Outfall 10910-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC06	Unnamed Trib of Willow Creek @ W Rayford Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC01	Willow Creek @ Kuykendahl Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC09	Dowdell WWTP Outfall 11404-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC02	Willow Creek @ Fm 2920	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	16426	Willow Creek @ Huffsmith Kohrville Rd (FM 2978)	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC07	Tomball WWTP Outfall 10616-002	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC03	Willow Creek @ SH 249	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC04	Willow Creek @ Telge Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	WC05	Willow Creek @ Cypress Rosehill Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2

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

[2] JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3] BF is the Program Code for sampling that cannot be precisely scheduled in advance because they target a certain flow condition that must be

[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 1009C

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Prog 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/NW	BF				2	2	2
12	FG03	Faulkey Gully @ Louetta RD	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	FG05	FG MUD WWTP Outfall 11832-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	FG02	Faulkey Gully @ Spring Cypress Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	FG06	NWHC MUD #15 WWTP Outfall 11939-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	FG01	Faulkey Gully @ Shaw Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	FG04	NWHC MUD #5 WWTP Outfall 11824-002	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2

[1] WWTP outfalls will be sampled at discharge point to stream channel if accessible
[2]JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)
[3]BF is the Program 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 1009D

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Prog 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/NW	BF				2	2	2
12	SG01	East Branch Spring Gully @ TC Jester Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	SG07	Bilma WWTP Outfall 12025-002	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	SG02	East Branch Spring Gully @ Spring Cypress Rd	Oct 07	Aug 08	JM	JM/NW	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/NW	BF				2	2	2
12	SG06	West Branch Spring Gully @ Klein Cemetery Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	SG08	KISD WWTP Outfall 1224-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	SG04	Spring Gully @ Spring Cypress Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	SG05	Spring Gully @ Pine Lakes Blvd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	SG09	NWHC MUD #32 WWTP Outfall 13152-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2

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

[2]JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3]BF is the Program 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 1009E

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Prog 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/NW	BF				2	2	2
12	LCC07	HC MUD #360 WWTP Outfall 13753-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	LCC06	Grand Rd PUD WWTP Outfall 11887-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	LCC05	NWHC MUD #5 WWTP Outfall 11824-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	LCC04	Little Cypress Creek @ Spring Cypress Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	LCC03	Little Cypress Creek @ Rosehill Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	LCC02	Little Cypress Creek @ Mueschke Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	LCC01	Little Cypress Creek @ Bauer Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2

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

[2] JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3] BF is the Program 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]	Prog 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/NW	BF				2	2	2
12	11334	Caney Creek @ FM 1485	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	CC07	Whitestone Caney Creek WWTP Outfall 14559-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	CC01	Dry Creek @ 1485	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	CC06	Lone Star Ranch WWTP Outfall 14029-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	CC03	Spring Branch @ SH 242	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	CC05	Conroe ISD WWTP Outfall 13690-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	11335	Caney Creek @ FM 2090	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	14241	Caney Creek @ SH 105	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	CC02	Caney Creek @ FM 1097	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2

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

[2] JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3] BF is the Program 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]	Prog 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/NW	BF				2	2	2
12	11336	Peach Creek @ FM 1485	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	PC06	Whitestone Peach Creek WWTP Outfall 14560-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	PC05	Roman Forest WWTF Outfall 13638-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	PC04	Woodbranch Village WWTP Outfall 1193-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	PC03	Mare Branch WWTP Outfall 14311-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	PC02	MC MUD #16 WWTP Outfall 11386-001	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	11337	Peach Creek @ FM 2090	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	16625	Peach Creek @ Faulkner Rd	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	11338	Peach Creek @ Old Highway 105 (SH 105)	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2
12	PC01	Peach Creek @ intersection of Peach Creek Dr and Summit Dr	Oct 07	Aug 08	JM	JM/NW	BF				2	2	2

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

[2]JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3]BF is the Program 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	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Prog Code[3]	Conv	Amb Tox Wat	Amb Tox Sed	Bacteria[4]	Inst Flow[5]	Field[6]
12	NA	SH 150 to FM 945, reach length 18,500 ft	Oct 07	Aug 08	JM	JM/NW	BF				1	1	1
12	NA	FM 945 to Winfrey Rd, reach length 28,000 ft	Oct 07	Aug 08	JM	JM/NW	BF				1	1	1
12	NA	Winfrey Rd to Jenkins Rd, reach length 35,000 ft	Oct 08	Aug 09	JM	JM/NW	BF				1	1	1
12	NA	Jenkins Rd to Headwaters, reach length 64,000 ft	Oct 09	Aug 10	JM	JM/NW	BF				1	1	1

[1]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

[2]JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3]BF is the Program 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 3-15: 2007-2008 Spatially-Intensive Source Sampling Schedule for Stewarts Creek, Segment 1004E

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

[1]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

[2]JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3]BF is the Program 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 3-16: 2007-2008 Spatially-Intensive Source Sampling Schedule for Willow Creek, Segment 1008H

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

[1]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

[2]JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3]BF is the Program 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 3-17: 2007-2008 Spatially-Intensive Source Sampling Schedule for Spring Gully, Segment 1009D

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

[1]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

[2]JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3]BF is the Program 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 3-18: 2007-2008 Wet Weather Point Source Sampling for Willow Creek, Segment 1008H

							Monitoring Frequency (2007-2008)						
Region	Station ID	Station Description[1]	Start Date	End Date	Data Submittal[2]	Data Collection[2]	Prog 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/NW	BF				1	1	1
12	WC09	Dowdell WWTP Outfall 11404-001	Oct 07	Aug 08	JM	JM/NW	BF				1	1	1
12	WC07	Tomball WWTP Outfall 10616-002	Oct 07	Aug 08	JM	JM/NW	BF				1	1	1

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

[2]JM is source code for James Miertschin and Associates (JMA) and NW is the source code for North Water District Laboratory (NWDL)

[3]BF is the Program 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	Matrix	Container	Preservation	Sample Volume	Holding Time
E. Coli	EPA 1603; SM 9222-D+9222-G; SM9213D; SM 9223B	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	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	water	N/A	N/A	N/A	N/A
Conductivity (probe)	EPA 120.1, TCEQ SOP	water	N/A	N/A	N/A	N/A
Flow	TCEQ SOP	water	N/A	N/A	N/A	N/A
Residual Chlorine	SM 400-Cl G and TCEQ SOP v1	water	N/A	N/A	N/A	N/A

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*.

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.

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.*

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