Total Maximum Daily Loads for Fecal Pathogens

in the Clear Creek Watershed

Contract No. 582-6-70860
Work Orders No. 582-6-70860-03 and 582-6-70860-06

Draft Quarterly Report No. 2

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CHAPTER 1

INTRODUCTION

1.1 PROBLEM STATEMENT

The Texas Commission on Environmental Quality (TCEQ) is responsible for administering provisions of the constitution and laws of the State of Texas to promote judicious use of and the protection of the quality of waters in the State. A major aspect of this responsibility is the continuous monitoring and assessment of water quality to evaluate compliance with state water quality standards that are established within Texas Water Code, §26.023 and Title 30 Texas Administrative Code, §§307.1-307.10. Texas Surface Water Quality Standards 30 TAC 307.4(d) specify that surface waters will not be toxic to aquatic life. Pursuant to the federal Clean Water Act §303(d), states must establish Total Maximum Daily Loads (TMDLs) for pollutants contributing to violations of water quality standards. The target water bodies for this project, segments 1101 (Clear Creek Tidal), 1101B (Chigger Creek), 1102 (Clear Creek Above Tidal) 1102A (Cowarts Creek), 1102B (Mary's Creek/North Fork Mary's Creek), and 2425C Robinson Bayou are located within the Clear Creek Watershed and these segments are on Texas' Clean Water Act §303(d) List because their waters do not meet the fecal coliform and *E. coli*-based water quality criteria for contact recreation.

The main objective of this TMDL is to develop the TMDL allocation equation for bacteria for the segments listed above. Two work orders have been issued for this project under Contract 582-6-70860. There are three main tasks to be completed for WO# 582-6-70860-03:

1. Administer project,
2. Participate in stakeholder process, and
3. Data analysis for determining and supporting TMDL equation.

Additionally, there are four main tasks to be completed for WO# 582-6-70860-06:

1. Administer project,
2. Participate in stakeholder process,
3. QAPP/Sampling Plan/Data Management, and
4. Data Collection.

1.2 DESCRIPTION OF THE REPORT

This document constitutes the second quarterly report for Work Orders No. 582-6-70860-03/06 (Contract No. 582-6-70860) of the Clear Creek Bacteria TMDL Project and summarizes the activities undertaken by the University of Houston during the period December 1, 2005 to February 28, 2006.

This report reflects the progress made towards the following subtasks delineated in the Project Work Plans:

Subtask 3.1/WO3 - Utilize all available information and the selected analysis method to determine the TMDL allocation equation.

Subtask 3.2/WO3 - Determine what additional data are needed and if environmental samples need to be collected.

Subtask 3.1/WO6 – Submit a detailed Sampling Plan.

Subtask 3.2/WO6 – Prepare and submit for approval a draft and final QAPP prior to the first scheduled monitoring event.

Statistical analyses to determine spatial/temporal trends and differences in datasets collected under different flow conditions are presented in Chapter 2. Chapter 3 presents a detailed sampling plan for the activities to be conducted in 2006. A description of the activities completed towards the development of a Quality Assurance Project Plan (QAPP) for this study is included in Chapter 4. Finally, a summary of activities as well as a list of activities to be conducted in the next quarter of the project is presented in Chapter 5.

CHAPTER 2

ADDITIONAL DATA ANALYSES

Additional analyses to those presented in Work Order 9 (Contract No. 582-0-80121) were performed using the Clear Creek Watershed data to determine temporal/spatial trends and to analyze bacteria levels under different flow conditions. The following sections present a description of the analyses completed during the reporting period.

2.1 SPATIAL ANALYSIS OF HISTORICAL DATA

Indicator bacteria concentration profiles along Clear Creek and its major tributaries covered under this TMDL study were prepared. These data provide an indication of spatial patterns. Enterococci and *E.coli* have been considered for spatial analysis at the main stem. Specific indicators have been selected for the major tributaries. Data are compared to the respective Texas water quality standards. It is noted that Enterococci and *E.coli* have different limits and may not indicate equivalent levels of fecal contamination.

2.1.1 Main Stem

As shown in Figure 2.1, the Enterococci geomean concentration decreased from upstream to downstream. Station 15458 is the only station where the Enterococci geomean value is below the recreation contact limit of 35MPN/dL. This trend is significant at the confidence level of 95% or more.

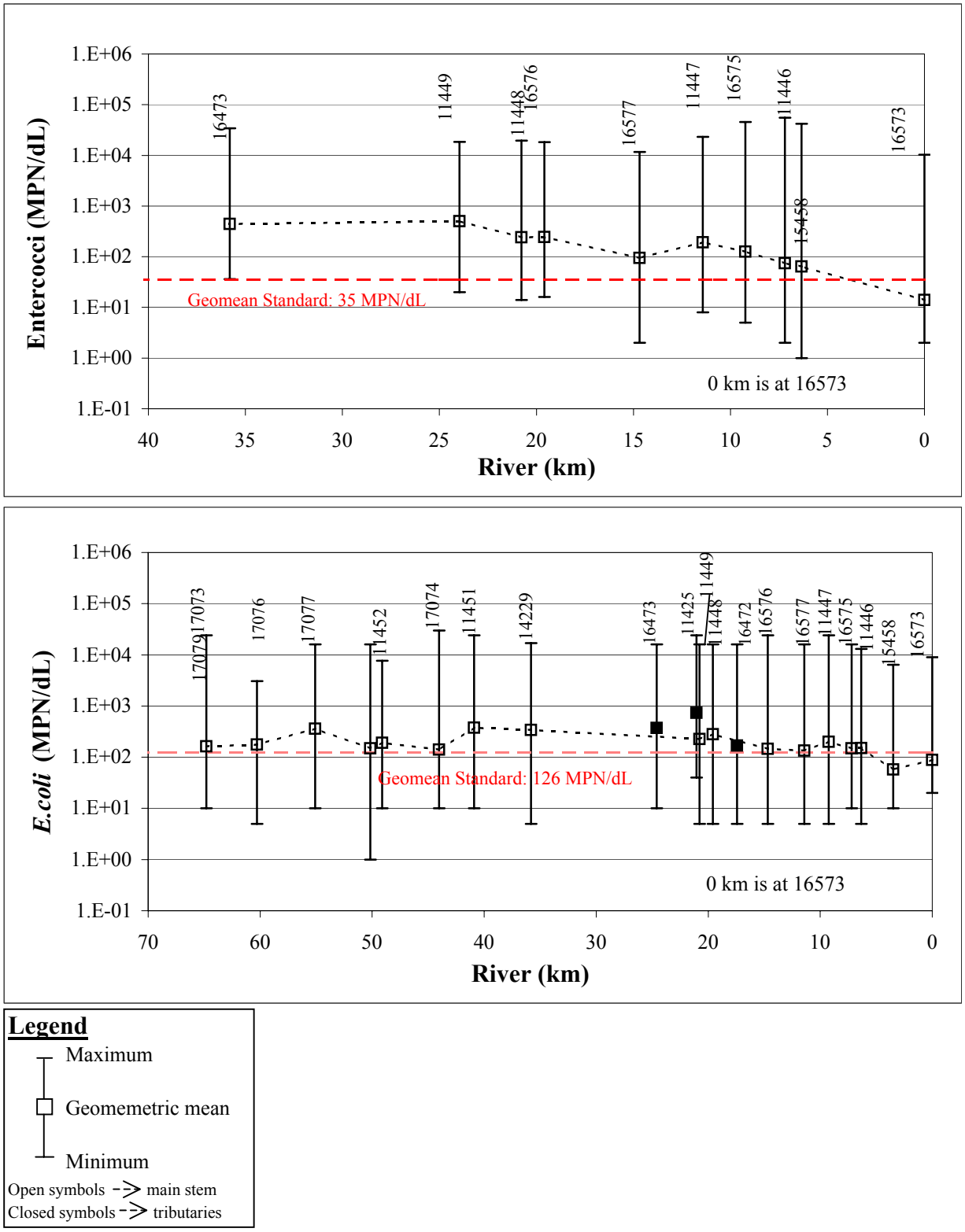


Figure 2.1 Enterococci and *E.coli* Profiles for Main Stem in the Clear Creek TMDL Study

E.coli geomean values also exhibited a slight decreasing trend from upstream to downstream. One station (15458) had geomean data below the standard of 126 MPN/dL. However, the decreasing trend for *E. coli* is not statistically significant at a 95% confidence level.

2.1.2 Tributaries

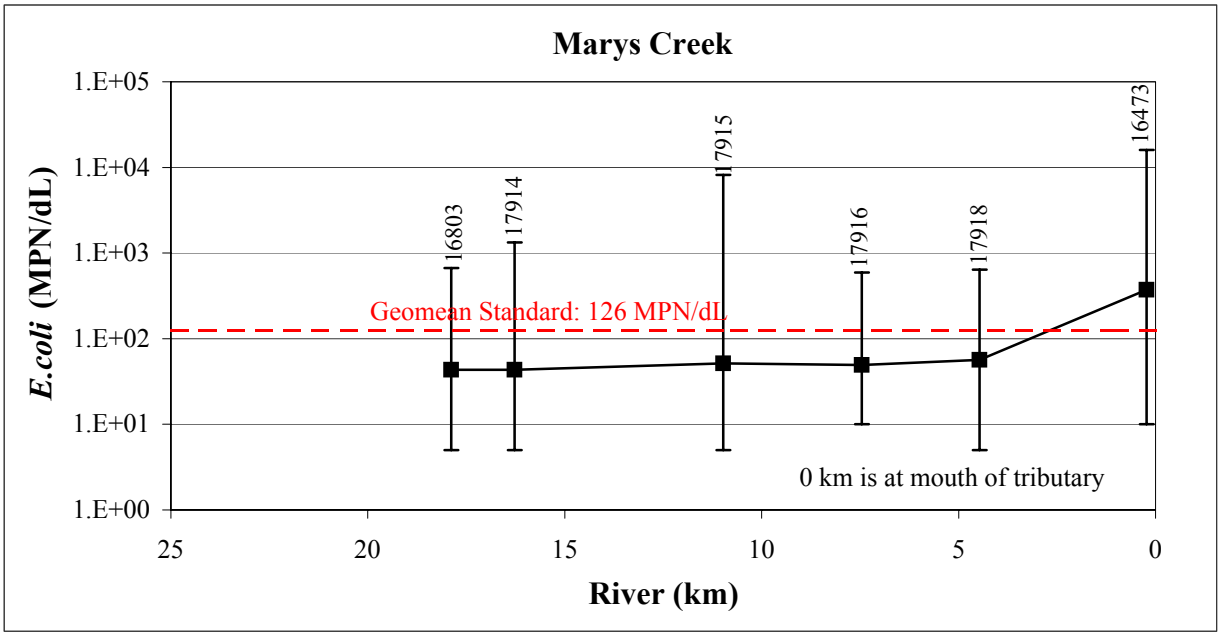
For Marys Creek, Cowart Creek and Chigger Creek, *E.coli* was selected as the indicator bacteria. As shown in Figure 2.2, increasing trends from upstream to downstream were found for Marys Creek and Cowart Creek. The geomean data at almost all stations in Marys Creek were below the water quality standard, but Station 16473 near the mouth exceeded the geomean standard of 126MPN/dL. In contrast, all three stations in Cowart Creek were above the standard. The first three stations along Chigger Creek exhibited increases while the geomean at the furthest downstream station 16472 decreased from the upstream geomean concentrations. In summary, *E.coli* concentrations basically increased from upstream to downstream for the three tributaries.

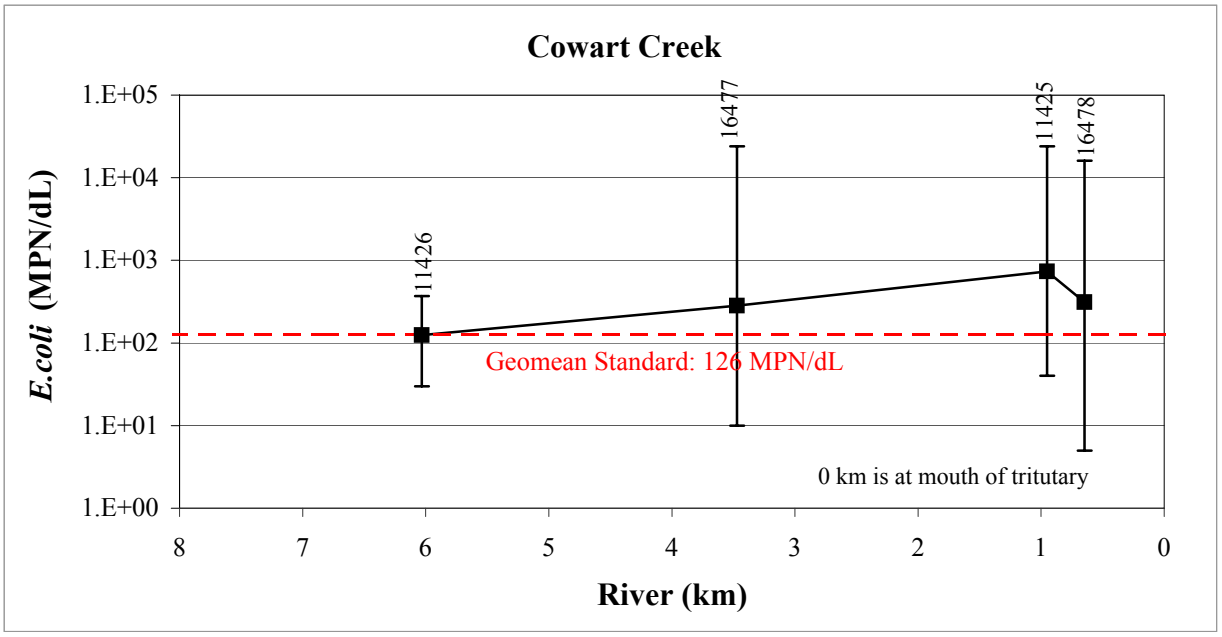
2.2 TEMPORAL ANALYSIS OF HISTORICAL DATA

The temporal trends for *E.coli*, Enterococci and fecal coliform are shown in Tables 2.1, 2.2, and 2.3, respectively. The trend was considered significant when the P-value was less than 0.05.

2.2.1 Segment 1101

Of the 11 stations with available Enterococci data, eight stations exhibited decreasing trends while the other three showed increasing trends. However, it should be noted that only one station (11448) was found to have a decreasing trend with 95% or





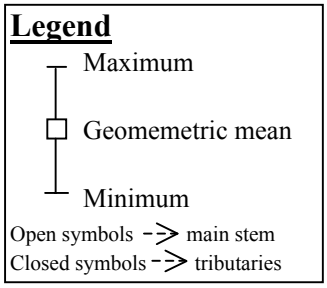
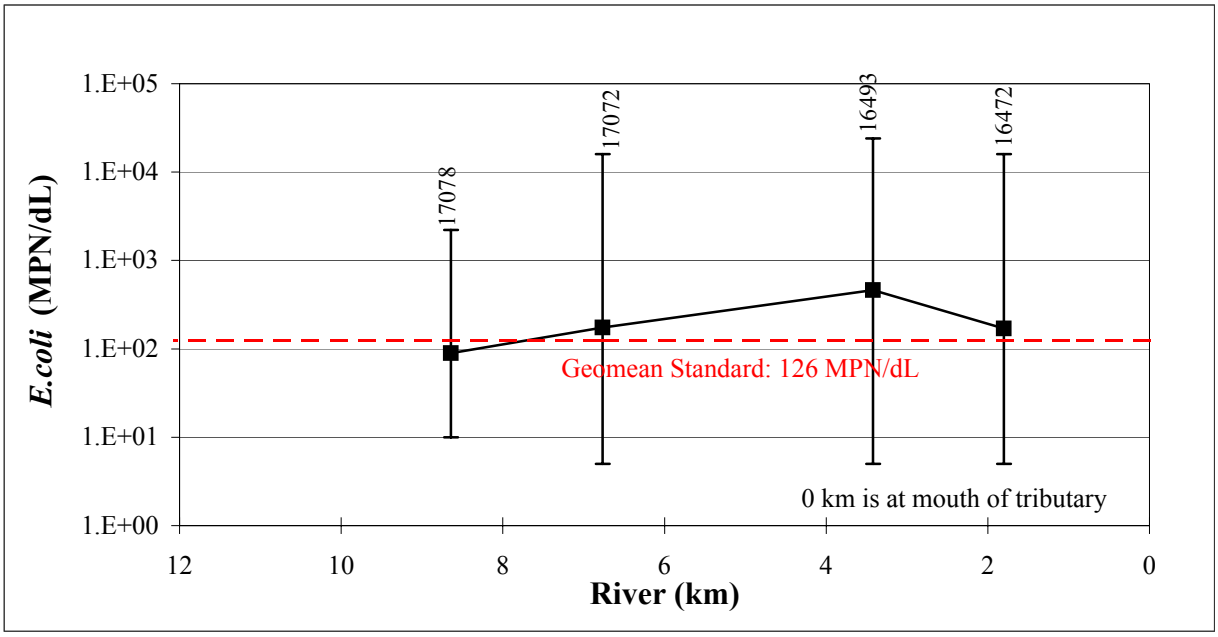


Figure 2.2a *E.coli* Profiles for Tributaries in the Clear Creek TMDL Study



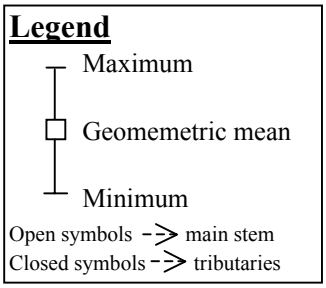


Figure 2.2b *E.coli* Profile for Chigger Creek

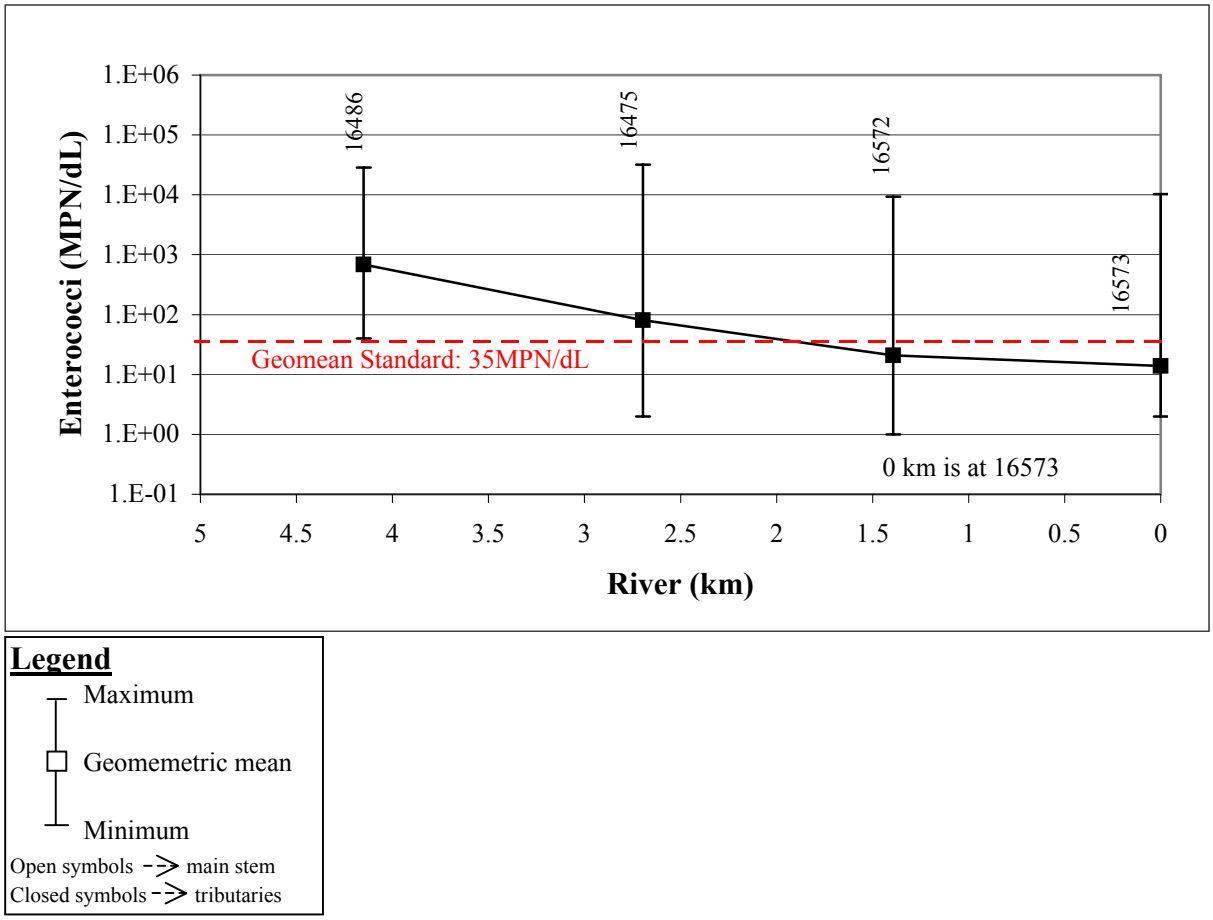


Figure 2.2c Enterococci Profile for Robinson's Bayou

Table 2.1 Summary of EC Temporal Trends in Clear Creek

Segment ID	Station ID	Slope	Trend	P-value	Indicator	No.Obs
1101	11446	-0.0005	Decreasing	0.7114	E.coli	32
	11447	-0.0117	Decreasing	0.3173	E.coli	43
	11448	-0.0062	Decreasing	0.4776	E.coli	48
	15458	0.3244	Increasing	0.0031	E.coli	10
	16472	-0.0068	Decreasing	0.5087	E.coli	49
	16493	-0.0371	Decreasing	0.1292	E.coli	51
	16572	0.0091	Increasing	0.8667	E.coli	29
	16573	0.0075	Increasing	0.6569	E.coli	28
	16575	-0.0180	Decreasing	0.7849	E.coli	43
	16576	-0.0013	Decreasing	0.1692	E.coli	49
	16577	-0.0002	Decreasing	0.3714	E.coli	50
	16611	-0.0075	Decreasing	0.7406	E.coli	4
	17072	0.0010	Increasing	0.7166	E.coli	27
	17078	0.0002	Increasing	0.7458	E.coli	17
1102	11425	0.0002	Increasing	0.4571	E.coli	19
	11426	-0.0028	Decreasing	0.2064	E.coli	5
	11449	-0.0009	Decreasing	0.0005	E.coli	48
	11450	-0.0002	Decreasing	0.1966	E.coli	63
	11451	-0.0006	Decreasing	0.0845	E.coli	31
	11452	-0.0001	Decreasing	0.8624	E.coli	26
	14229	-0.0003	Decreasing	0.0802	E.coli	53
	16473	-0.0003	Decreasing	0.0718	E.coli	53
	16477	-0.0007	Decreasing	0.0121	E.coli	49
	16478	-0.0016	Decreasing	0.0000	E.coli	34
	16803	0.0006	Increasing	0.2411	E.coli	14
	17068	-0.0004	Decreasing	0.2883	E.coli	28
	17069	-0.0025	Decreasing	0.0001	E.coli	23
	17070	-0.0020	Decreasing	0.0000	E.coli	31
	17071	-0.0020	Decreasing	0.0000	E.coli	23
	17073	-0.0006	Decreasing	0.0549	E.coli	31
	17074	-0.0007	Decreasing	0.0675	E.coli	29
	17076	-0.0002	Decreasing	0.3801	E.coli	29
	17077	-0.0003	Decreasing	0.3586	E.coli	30
	17079	0.0002	Increasing	0.6283	E.coli	21
	17914	-0.0021	Decreasing	0.1625	E.coli	9
	17915	-0.0004	Decreasing	0.6230	E.coli	15
	17916	-0.0001	Decreasing	0.8331	E.coli	14
	17917	-0.0005	Decreasing	0.2953	E.coli	15
	17918	-0.0005	Decreasing	0.3378	E.coli	16
2425	16475	-0.0007	Decreasing	0.0164	E.coli	43
	16476	-0.0002	Decreasing	0.6808	E.coli	39
	16485	-0.0007	Decreasing	0.0585	E.coli	30
	16486	-0.0013	Decreasing	0.0000	E.coli	39
	16571	0.0001	Increasing	0.8790	E.coli	28
	16671	0.0003	Increasing	0.3558	E.coli	30

Green shading indicates statistically significant trend

Table 2.2 Summary of Entercocci Temporal Trends in Clear Creek

Segment ID	Station ID	Slope	Trend	P-value	Indicator	No.Obs
1101	11446	-0.0010	Decreasing	0.6668	Entercocci	44
	11447	-0.0088	Decreasing	0.6923	Entercocci	27
	11448	-0.0457	Decreasing	0.0096	Entercocci	26
	15458	0.2457	Increasing	0.6667	Entercocci	3
	16472	0.0123	Increasing	0.7236	Entercocci	26
	16493	-0.1830	Decreasing	0.2350	Entercocci	24
	16572	-0.0110	Decreasing	0.8845	Entercocci	24
	16573	0.0763	Increasing	0.6896	Entercocci	23
	16575	-0.0206	Decreasing	0.3554	Entercocci	30
	16576	-0.0002	Decreasing	0.3097	Entercocci	30
	16577	-0.0012	Decreasing	0.1876	Entercocci	26
1102	11425	-0.0026	Decreasing	0.6160	Entercocci	15
	11449	0.0012	Increasing	0.2291	Entercocci	26
	11450	-0.0005	Decreasing	0.0235	Entercocci	38
	11451	0.0336	Increasing	0.1927	Entercocci	3
	14229	0.0017	Increasing	0.1043	Entercocci	23
	16473	0.0018	Increasing	0.0243	Entercocci	26
	16477	0.0014	Increasing	0.1667	Entercocci	26
	16478	0.0023	Increasing	0.2696	Entercocci	11
	17068	0.0305	Increasing	0.1685	Entercocci	3
	17069	0.0487	Increasing	0.2671	Entercocci	3
	17070	0.0033	Increasing	0.5958	Entercocci	6
	17073	0.0319	Increasing	0.4440	Entercocci	3
	17074	0.0393	Increasing	0.2513	Entercocci	3
	17076	0.0445	Increasing	0.2332	Entercocci	3
	17077	0.0481	Increasing	0.1363	Entercocci	3
2425	13335	-0.0006	Decreasing	0.0310	Entercocci	18
	16475	0.0001	Increasing	0.6698	Entercocci	33
	16476	0.0000	Decreasing	0.8733	Entercocci	39
	16485	-0.0001	Decreasing	0.7153	Entercocci	25
	16486	0.0002	Increasing	0.6905	Entercocci	19
	16571	0.0004	Increasing	0.1562	Entercocci	25
	16671	0.0004	Increasing	0.0805	Entercocci	26

Green shading indicates staitistically significant trend

Table 2.3 Summary of Fecal Coliform Temporal Trends in Clear Creek

Segment ID	Station ID	Slope	Trend	P-value	Indicator	No.Obs
1101	11446	0.0001	Increasing	0.6624	Fecal Coliform	190
	11447	0.0001	Increasing	0.9602	Fecal Coliform	104
	11448	0.0016	Increasing	0.1088	Fecal Coliform	180
	15458	-0.0048	Decreasing	0.5977	Fecal Coliform	47
	16472	0.0085	Increasing	0.4685	Fecal Coliform	41
	16493	0.0628	Increasing	0.2620	Fecal Coliform	38
	16572	0.0061	Increasing	0.6813	Fecal Coliform	29
	16573	0.0056	Increasing	0.8499	Fecal Coliform	29
	16575	0.0017	Increasing	0.8658	Fecal Coliform	40
	16576	0.0002	Increasing	0.4692	Fecal Coliform	40
	16577	0.0009	Increasing	0.4233	Fecal Coliform	40
	17072	0.0047	Increasing	0.1282	Fecal Coliform	14
	17078	0.0005	Increasing	0.5349	Fecal Coliform	8
1102	11425	-0.0035	Decreasing	0.2450	Fecal Coliform	17
	11426	-0.0002	Decreasing	0.9405	Fecal Coliform	5
	11449	0.0000	Decreasing	0.5046	Fecal Coliform	83
	11450	0.0000	Decreasing	0.7171	Fecal Coliform	193
	11451	0.0000	Decreasing	0.5598	Fecal Coliform	45
	11452	0.0000	Decreasing	0.0021	Fecal Coliform	203
	11453	0.0002	Increasing	0.2138	Fecal Coliform	42
	14229	-0.0003	Decreasing	0.0947	Fecal Coliform	46
	16473	-0.0002	Decreasing	0.5573	Fecal Coliform	40
	16477	-0.0006	Decreasing	0.1142	Fecal Coliform	40
	16478	0.0001	Increasing	0.0000	Fecal Coliform	23
	16803	0.0000	Decreasing	0.9939	Fecal Coliform	6
	17068	-0.0004	Decreasing	0.2453	Fecal Coliform	21
	17069	-0.0008	Decreasing	0.6691	Fecal Coliform	15
	17070	-0.0013	Decreasing	0.1027	Fecal Coliform	20
	17071	-0.0015	Decreasing	0.3830	Fecal Coliform	12
	17073	-0.0005	Decreasing	0.1525	Fecal Coliform	22
	17074	-0.0004	Decreasing	0.1809	Fecal Coliform	19
	17076	-0.0004	Decreasing	0.1631	Fecal Coliform	21
	17077	-0.0005	Decreasing	0.1262	Fecal Coliform	21
	17079	0.0000	Decreasing	0.9470	Fecal Coliform	13
	17915	0.0031	Increasing	0.4131	Fecal Coliform	6
	17916	-0.0008	Decreasing	0.6024	Fecal Coliform	6
	17917	-0.0014	Decreasing	0.5228	Fecal Coliform	6
	17918	0.0025	Increasing	0.1568	Fecal Coliform	6
2425	11401	-0.0001	Decreasing	0.1089	Fecal Coliform	65
	13332	-0.0001	Decreasing	0.0003	Fecal Coliform	119
	13333	0.0000	Decreasing	0.7546	Fecal Coliform	67
	13334	0.0000	Increasing	0.9347	Fecal Coliform	97
	13335	0.0000	Decreasing	0.0999	Fecal Coliform	135
	14239	-0.0013	Decreasing	0.4686	Fecal Coliform	8
	16475	0.0003	Increasing	0.5218	Fecal Coliform	40
	16476	-0.0003	Decreasing	0.5127	Fecal Coliform	40
	16485	-0.0010	Decreasing	0.0148	Fecal Coliform	31
	16486	-0.0004	Decreasing	0.3252	Fecal Coliform	32
	16571	-0.0003	Decreasing	0.3312	Fecal Coliform	29
	16671	0.0001	Increasing	0.8350	Fecal Coliform	30

Green shading indicates staitistically significant trend

higher confidence. Nine of fourteen stations showed a decreasing trend, while the remaining stations exhibited increasing trends for *E.coli*, but only one station (15458) was determined to have an increasing trend at the 95% or higher confidence. Only one of thirteen stations showed a decreasing trend while the remaining showed increasing trends for fecal coliform data, however, these trends were not statistically significant.

2.2.2 Segment 1102

Three of twenty-five stations exhibited increasing trends for *E.coli*, but the remaining stations showed decreasing trends. It is noted that only six of the stations had significant trends (decreaing), at the 95% confidence level. Only two of fifteen stations with available Enterococci data showed decreasing trends, while others displayed an increasing trend. At the considered confidence level mentioned above, one station with a decreasing trend and the other with an increasing trend had significant trends. For fecal coliform data, only four of twenty-five stations exhibited increasing trends, while the others showed decreasing trends. The trend at station 11452 (decreasing) and that at station 16478 (increasing) were significant at the 95% or higher confidence level. Other data collected showed a large amount of variability, as a result, no significant trends were determined. Overall, most of the stations exhibited a decreasing trend.

2.2.3 Segment 2425

Three of seven stations had increasing trends for Enterococci, while the remaining stations had decreasing trends, with only the trend at station 13335 being significant at the 95% confidence level. Nine stations had decreasing trends, while the other three had increasing trends for fecal coliform (the decreasing trends at 13332 and 16485 were

statistically significant). A total of six stations had available *E.coli* data, two of which had increasing trends, while the remaining four had decreasing trends (again, only the decreasing trends at 16475 and 16486 were significant).

2.3 FLOW INFLUENCE OF HISTORICAL DATA

There is only one active flow gage in the Clear Creek watershed, therefore flow data were not available for further analysis. Thus, rainfall data gathered for the study area were used instead. For a given station, if the amount of rain for the date of sample collection was less than 0.4 inches, the sample was classified as a low flow sample, otherwise the sample was considered as collected under high flow. Low flow and high flow data for the various stations are included in Table 2.4. Student *t*-tests were undertaken for all stations with available low and high flow data (observation points > =5), but there was no significant difference found between low and high low data. This may suggest either that flow does not impact bacteria concentrations in the study area or that rainfall is not a good measure of the flow conditions. The *t*-test results are shown in Table 2.5.

Table 2.4 Low and High Flow Analysis

Analysis for Enteroccoci in Segment 1101

Rainfall Gage	Station ID	Low Flow Data			High Flow Data		
		Obs Nos	Geomean	Std Dev	Obs Nos	Geomean	Std Dev
110	11446	31	61	7721.7	13	71	1739.8
	11447	92	317	11629.3	12	158	2235.3
	16575	30	75	10060.2	High Flow not reported		
120	11448	163	560	17160.2	17	298	4472.0
	16493	33	901	6161.9	5	457	7022.8
130	16472	26	171	4667.3	High Flow not reported		
170	15458	3	15	12.1	High Flow not reported		
	16572	21	150	2156.3	8	89	3154.2
	16573	23	14	2139.1	High Flow not reported		

Analysis for *E.coli* in Segment 1102

Rainfall Gage	Station ID	Low Flow Data			High Flow Data		
		Obs Nos	Geomean	Std Dev	Obs Nos	Geomean	Std Dev
105	14229	47	350	4140.2	5	227	887.1
	16473	46	437	3374.7	6	120	409.2
	16477	43	279	5903.5	5	383	1171.3
120	11425	17	791	6739.5	2	378	685.9
	11449	41	227	3934.3	6	176	1170.6
	16478	29	318	4591.8	4	394	2391.3
125	11426	5	124	133.5	High Flow not reported		
135	11450	19	196	4139.1	2	27	45.3
140	17069	Low Flow not reported			High Flow not reported		
	17070	Low Flow not reported			High Flow not reported		
	17071	Low Flow not reported			High Flow not reported		
150	11451	27	253	759.9	3	18315	4618.8
	17074	25	87	649.5	3	9345	14150.3
	17915	15	51	2518.5	High Flow not reported		
	17916	14	49	150.8	High Flow not reported		
	17917	15	75	475.6	High Flow not reported		
	17918	16	57	172.9	High Flow not reported		
180	11452	54	340	4051.7	3	3590	15961.0
	17068	10	211	1525.1	2	12000	4949.7
	17076	10	556	3962.8	2	3600	10741.0
	17077	10	188	2464.7	2	8944	7778.2
190	17073	Low Flow not reported			High Flow not reported		
	17079	Low Flow not reported			High Flow not reported		
4220	11453	Low Flow not reported			High Flow not reported		
	16803	10	30	82.2	3	110	334.5
	17914	6	81	528.9	2	5	0

Analysis for Enteroccoci in Segment 2425

Rainfall Gage	Station ID	Low Flow Data			High Flow Data		
		Obs Nos	Geomean	Std Dev	Obs Nos	Geomean	Std Dev
170	16475	30	54	508.1	3	4318	16532.1
	16486	16	473	2497.6	3	4854	14501.7

Green Shading indicates that FC was used

Table 2.5 *t* -test for Low and High Flow Data

Station ID	t Stat	t Critical two-tail
11446	0.6187857	2.100923666
11447	0.7811824	2.178812792
16575	No data available for analysis	
11448	0.9833122	2.109818524
16493	0.4211265	3.182449291
16472	No data available for analysis	
15458	No data available for analysis	
16572	0.6179034	2.262158887
16573	No data available for analysis	

Station ID	t Stat	t Critical two-tail
14229	0.2308554	3.182449291
16473	1.6863814	2.570577635
16477	-0.193654	3.182449291
11425	No data available for analysis	
11449	0.4223807	2.570577635
16478	No data available for analysis	
11426	No data available for analysis	
11450	No data available for analysis	
17069	No data available for analysis	
17070	No data available for analysis	
17071	No data available for analysis	
11451	No data available for analysis	
17074	No data available for analysis	
17915	No data available for analysis	
17916	No data available for analysis	
17917	No data available for analysis	
17918	No data available for analysis	
11452	No data available for analysis	
17068	No data available for analysis	
17076	No data available for analysis	
17077	No data available for analysis	
17073	No data available for analysis	
17079	No data available for analysis	
11453	No data available for analysis	
16803	No data available for analysis	
17914	No data available for analysis	

Station ID	t Stat	t Critical two-tail
16475	No data available for analysis	
16486	No data available for analysis	

No dataset are significantly different.

CHAPTER 3

DETAILED SAMPLING PLAN FOR ACTIVITIES TO BE CONDUCTED IN FY 2006

The goal of this sampling effort is to provide sufficient data for the development of Load Duration Curves (LDC) and Mass Balances (MB) to support development of total maximum daily loads (TMDLs) for Indicator Bacteria in Clear Creek and its tributaries (Mary's Creek, Cowart Creek, Chigger Creek, and Robinson Bayou). Sampling is also aimed at quantifying major contributors of indicator bacteria to the study segments to aid in load allocations. There are five main sampling components to be completed under this sampling plan: intensive survey, stormwater sampling, WWTP sampling, in-stream sampling, and stormwater outfall survey

3.1 INTENSIVE SURVEY

Sampling will be conducted to obtain flow/EC data to build the LDCs for the non-tidal segments and to obtain data for the MB for the tidal segments (flow, EN, salinity). Twenty tentative locations have been identified including end of all study segments, mouths of major tributaries, and locations with historically high EC/EN concentrations. For the intensive survey, samples will be collected during three different events to cover different flow conditions. During a given event, 5-6 water samples will be collected from each station for a total of 15-18 data points. The fresh water segments, 1101B (Chigger Creek), 1102 (Clear Creek Above Tidal), 1102A (Cowarts Creek), and 1102B (Mary's

Creek/North Fork Mary's Creek), will be sampled for *E. coli*, flow and TSS, while the marine segments, 1101 (Clear Creek Tidal) and 2425C (Robinson Bayou), will be sampled for Enterococci, flow, TSS, and salinity. In the tidal segments, flow will be measured at a lower frequency (but not less than 2 times per week) and rating curves will be developed using tide data from deployed YSI sondes.

Preliminary locations for sampling are included in Figure 3.1. However, it is noted that the monitoring and data collection program is dynamic and may change as data are collected and analyzed. If the monitoring and data collection program is to change, TCEQ project management will be notified, and if necessary, the QAPP will be updated accordingly. Sampling locations and frequencies are listed in Table 3.1.

3.2 STORMWATER SAMPLING

Sampling will be conducted to quantify runoff loads from the major tributaries. Runoff event monitoring will include sampling of a network of spatially distributed stations. These surveys will be mounted in response to significant rainfall in the project area, sufficient to produce runoff in the study segments. Generally, it is anticipated that rainfall on the order of 1.0-inch or greater will be necessary to produce the required runoff condition. Field crews will keep track of local weather forecasts during preparation for sampling. If possible, preference will be given to events where sampling can be initiated during daylight hours. After rainfall has commenced, sampling will be initiated as soon as possible on the rising limb of the hydrograph, and include a total of 3-5 samples per station over a maximum three-day period along the runoff hydrograph. In order to meet the holding time for EC, runners will collect the samples from the sampling teams at a pre-determined location to take samples back to the laboratory for immediate

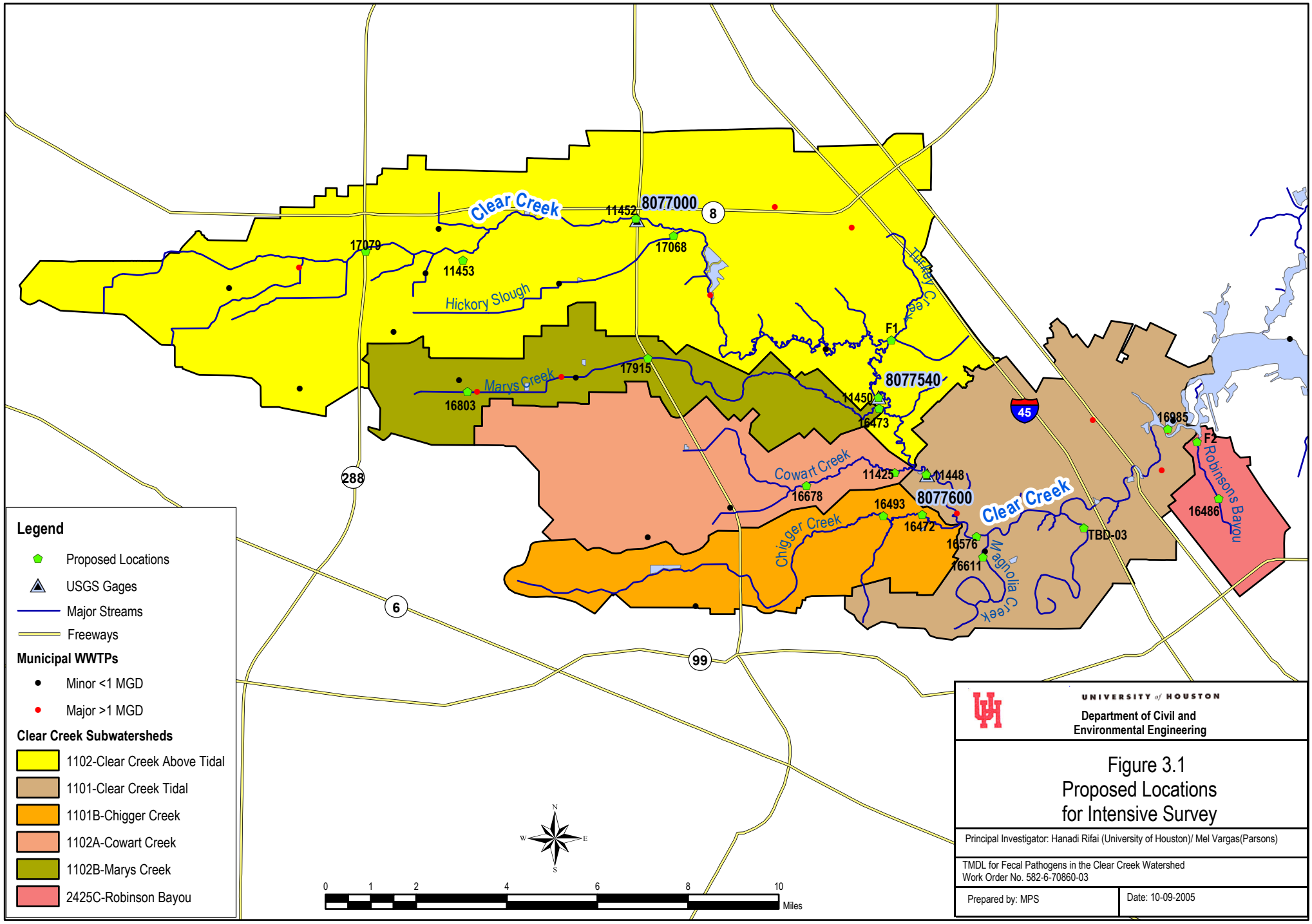

Clear Creek
8077000
11452
17079
11453
17068
Hickory Slough
Turkey Creek
F1
8077540
17915
Marys Creek
16803
11450
16473
45
16985
F2
Robinsons Bayou
Cowart Creek
11425
11448
16678
8077600
16493
16472
Clear Creek
16486
Chigger Creek
16576
16611
TBD-03
Magnolia Creek
288
6
99
8
Legend
Proposed Locations
USGS Gages
Major Streams
Freeways
Municipal WWTPs
Minor <1 MGD
Major >1 MGD
Clear Creek Subwatersheds
1102-Clear Creek Above Tidal
1101-Clear Creek Tidal
1101B-Chigger Creek
1102A-Cowart Creek
1102B-Marys Creek
2425C-Robinson Bayou
N
W
E
S
0
1
2
4
6
8
10
Miles
UNIVERSITY of HOUSTON
Department of Civil and Environmental Engineering
Figure 3.1
Proposed Locations
for Intensive Survey
Principal Investigator: Hanadi Rifai (University of Houston)/ Mel Vargas(Parsons)
TMDL for Fecal Pathogens in the Clear Creek Watershed
Work Order No. 582-6-70860-03
Prepared by: MPS
Date: 10-09-2005

Table 3.1 Monitoring Sites and Frequencies - Sampling for FY2006

Sampling Component	Location ID/ Permit ID	TCEQ Short Description/Tributary-Ditch Name/Facility Name	Segment	Monitoring frequencies						
				Field parameters[a]	Flow	*E. Coli* in water	*Enterococci* in water	Turbidity	TSS	HACH Parameters[b]
1	16803	NORTH FORK MARY'S CREEK AT BRAZORIA CR89	1102B	15-18	15-18	15-18		15-18	15-18	
	17915	MARY'S CREEK AT MAIN STREET/SH35	1102B	15-18	15-18	15-18		15-18	15-18	
	16473	MARYS CREEK AT MARYS CROSSING	1102B	15-18	15-18	15-18		15-18	15-18	
	16678	COWART CREEK AT BAKER ROAD BRIDGE	1102A	15-18	15-18	15-18		15-18	15-18	
	11425	COWART CREEK AT FM 518 IN FRIENDSWOOD	1102A	15-18	15-18	15-18		15-18	15-18	
	17068	HICKORY SLOUGH AT ROBINSON DR		15-18	15-18	15-18		15-18	15-18	
	17079	CLEAR CREEK AT SH28 BRIDGE	1102	15-18	15-18	15-18		15-18	15-18	
	11452	CLEAR CREEK AT TELEPHONE RD	1102	15-18	15-18	15-18		15-18	15-18	
	11450	CLEAR CREEK AT CLEAR LAKE CITY BLVD	1102	15-18	15-18	15-18		15-18	15-18	
	11453	CLEAR CREEK AT CULLEN BLVD.	1102	15-18	15-18	15-18		15-18	15-18	
	F1[c]	TURKEY CREEK AT MOUTH		15-18	15-18	15-18		15-18	15-18	
	16472	CHIGGER CREEK AT OAK DRIVE IN POLLY RANCH SUBDIVISION IN EAST FRIENDSWOOD	1101B	15-18	15-18	15-18		15-18	15-18	
	16493	CHIGGER CREEK AT FM528 BRIDGE IN FRIENDSWOOD	1101B	15-18	15-18	15-18		15-18	15-18	
	16611	MAGNOLIA CREEK APPROX 600M UPSTREAM OF FM518, LEAGUE CITY		15-18	6-10		15-18	15-18	15-18	
	TBD-03[d]	UNNAMED TRIB <E OF MAGNOLIA CR>		15-18	6-10		15-18	15-18	15-18	
	F2[c]	ROBINSON BAYOU AT MOUTH	2425C	15-18	6-10		15-18	15-18	15-18	
	16486	ROBINSONS BAYOU AT WEBSTER STREET BRIDGE OFF FM270 IN LEAGUE CITY	2425C	15-18	6-10		15-18	15-18	15-18	
	11448	CLEAR CREEK TIDAL AT FM 528	1101	15-18	6-10		15-18	15-18	15-18	
	16576	CLEAR CREEK TIDAL AT BROOKDALE DR APPROX 0.1MI DOWNSTREAM OF GRISSOM RD	1101	15-18	6-10		15-18	15-18	15-18	
	16985	CLEAR CREEK TIDAL AT NASAU BAY WWTP	1101	15-18	6-10		15-18	15-18	15-18	
2	R1[c]	DITCH # 11 DD2	1102	2(5)[e]	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	
	17068	HICKORY SLOUGH AT ROBINSON DR	1102	2(5)[e]	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	
	F1[c]	TURKEY CREEK	1102	2(5)[e]	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	
	16473	MARYS CREEK AT MARYS CROSSING	1102B	2(5)[e]	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	
	11425	COWART CREEK AT FM518 IN FRIENDSWOOD	1102A	2(5)[e]	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	
	16493	CHIGGER CREEK AT FM528 BRIDGE IN FRIENDSWOOD	1101B	2(5)[e]	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	
	16611	MAGNOLIA CREEK APPROX 600M UPSTREAM OF FM518, LEAGUE CITY	1101	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	2(5)[e]	
	TBD-03[d]	UNNAMED TRIB <E OF MAGNOLIA CR>	1101	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	2(5)[e]	
	16486	ROBINSONS BAYOU AT WEBSTER STREET BRIDGE OFF FM270 IN LEAGUE CITY	2425C	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	2(5)[e]	
3	10520-001[f]	WEBSTER	1101	2(5)[e]	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	2(5)[e]
	10134-008[f]	PEARLAND	1102	2(5)[e]	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	2(5)[e]
	10134-002[f]	PEARLAND (STP #2)	1102	2(5)[e]	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	2(5)[e]
	10134-007[f]	PEARLAND	1102	2(5)[e]	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	2(5)[e]
	10568-005[f]	LEAGUE CITY	1101	2(5)[e]	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	2(5)[e]
	11571-001[f]	GULF COAST WASTE DISPOSAL AUTH	1101	2(5)[e]	2(5)[e]	2(5)[e]		2(5)[e]	2(5)[e]	2(5)[e]
4	17068	HICKORY SLOUGH AT ROBINSON DR	1102	2-9	2-9	2-9		2-9	2-9	
	17074	CLEAR CREEK 200FT UPSTREAM OF BARRYROSE WWTP	1102	2-9	2-9	2-9		2-9	2-9	
	TBD-06[d]	UNNAMED TRIB <TURKEY CR>		2-9	2-9	2-9		2-9	2-9	
	11449	CLEAR CREEK AT FRIENDSWOOD LINK ROAD	1102	2-9	2-9	2-9		2-9	2-9	
	16611	MAGNOLIA CREEK APPROX 600M UPSTREAM OF FM518	1101	2-9	2-9		2-9	2-9	2-9	
	16475	ROBINSONS BAYOU AT FM270	2425C	2-9	2-9		2-9	2-9	2-9	

Notes:
TBD- to be defined following submittal of Station Location request form (SLOC)
[a] Field parameters include temperature, DO, pH, conductivity, and flow severity
[b] HACH parameters include orthophosphate, Ammonia-N, and chlorine residual
[c] A SLOC request will be submitted once GPS readings are completed during reconnaissance activities
[d] Station sampled in 2005, SLOC request in process
[e] Number in parentheses indicate the maximum number of samples to be collected per sampling event
[f] ID numbers correspond to TCEQ permit numbers

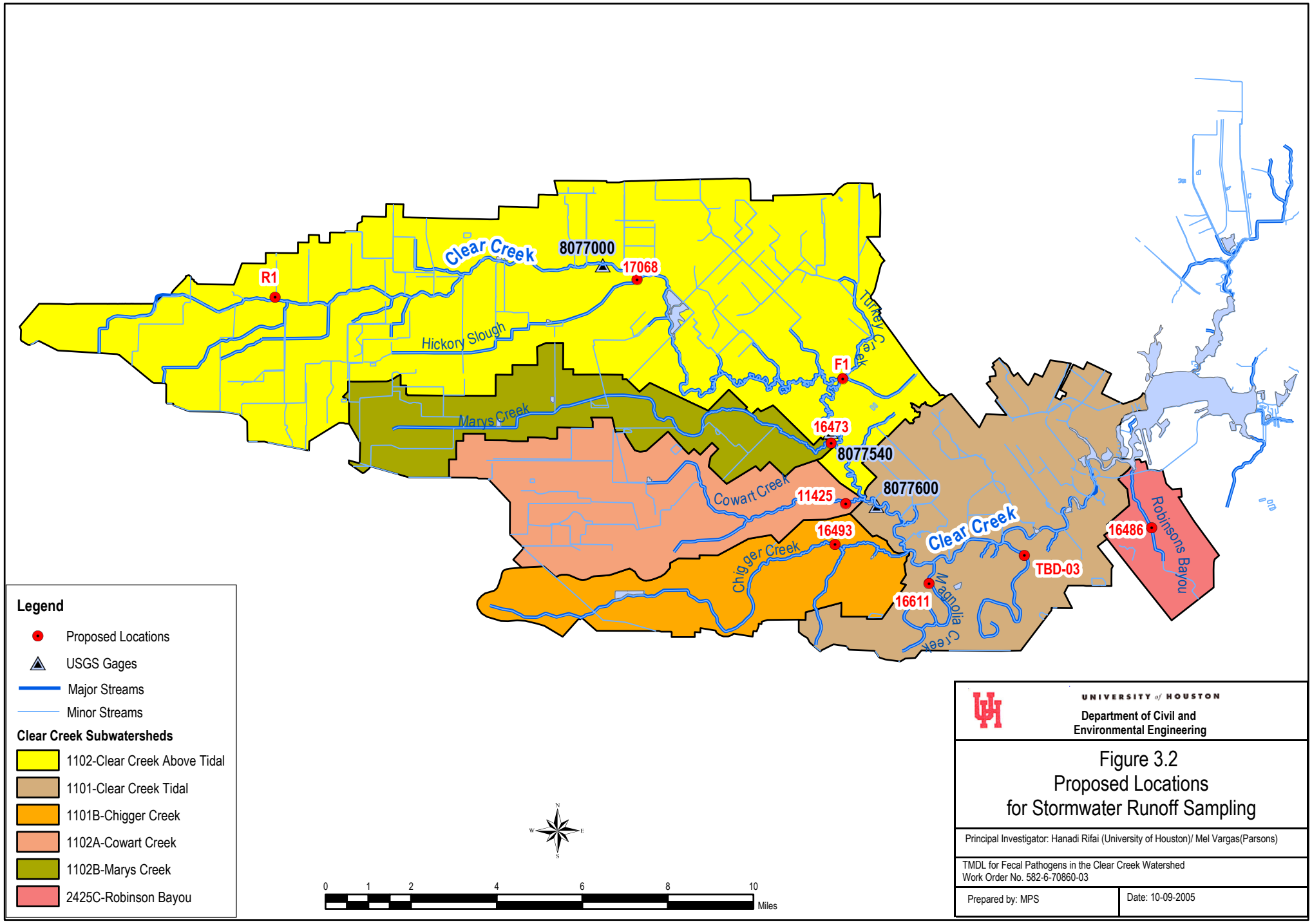
analysis. Velocity measurements will be made once during each sampling event at selected stations where time and conditions permit. Velocity will be measured either using a Marsh McBirney meter or, when safety is a concern, using a float and stopwatch to measure time of travel over a specified distance. The velocity data combined with hand measured cross-sectional depth data will be used to calculate flows.

Nine locations have been identified for sampling during two storm events (Figure 3.2). However, it is noted that the monitoring and data collection program is dynamic and may change as data are collected and analyzed. If the monitoring and data collection program is to change, TCEQ project management will be notified, and if necessary, the QAPP will be updated accordingly. In addition to EC/EN and flow, field parameters and TSS will be measured. Sampling sites and schedules are presented in Table 3.1.

3.3 WWTP SAMPLING

This sampling will be conducted to quantify loads from overflows (if any) from major plants after significant rain events. Samples will be collected at the WWTP outfall where the effluent enters the bayou. An initial round of samples will be collected directly from the identified outfalls during dry weather to obtain a baseline. When rainfall is forecast to occur, the sampling team will mobilize to collect no more than 5 samples per day over the course of two rainfall events. Samples will be collected prior, during, and after the rain event. Larger rainfalls will be targeted, as they would be more likely to cause infiltration into the WWTP collection systems and thus overload the plant.

Six plants have been identified for sampling under this task and their locations are shown in Figure 3.3. The parameters to be measured include EC, TSS, chlorine residual, orthophosphate-P, ammonia, field parameters, and flow. Flow will be measured from the


Clear Creek
8077000
17068
R1
Hickory Slough
Marys Creek
Turkey Creek
F1
16473
8077540
8077600
Cowart Creek
11425
16493
Chigger Creek
Clear Creek
16611
Magnolia Creek
TBD-03
16486
Robinsons Bayou
Legend
Proposed Locations
USGS Gages
Major Streams
Minor Streams
Clear Creek Subwatersheds
1102-Clear Creek Above Tidal
1101-Clear Creek Tidal
1101B-Chigger Creek
1102A-Cowart Creek
1102B-Marys Creek
2425C-Robinson Bayou
0 1 2 4 6 8 10
Miles
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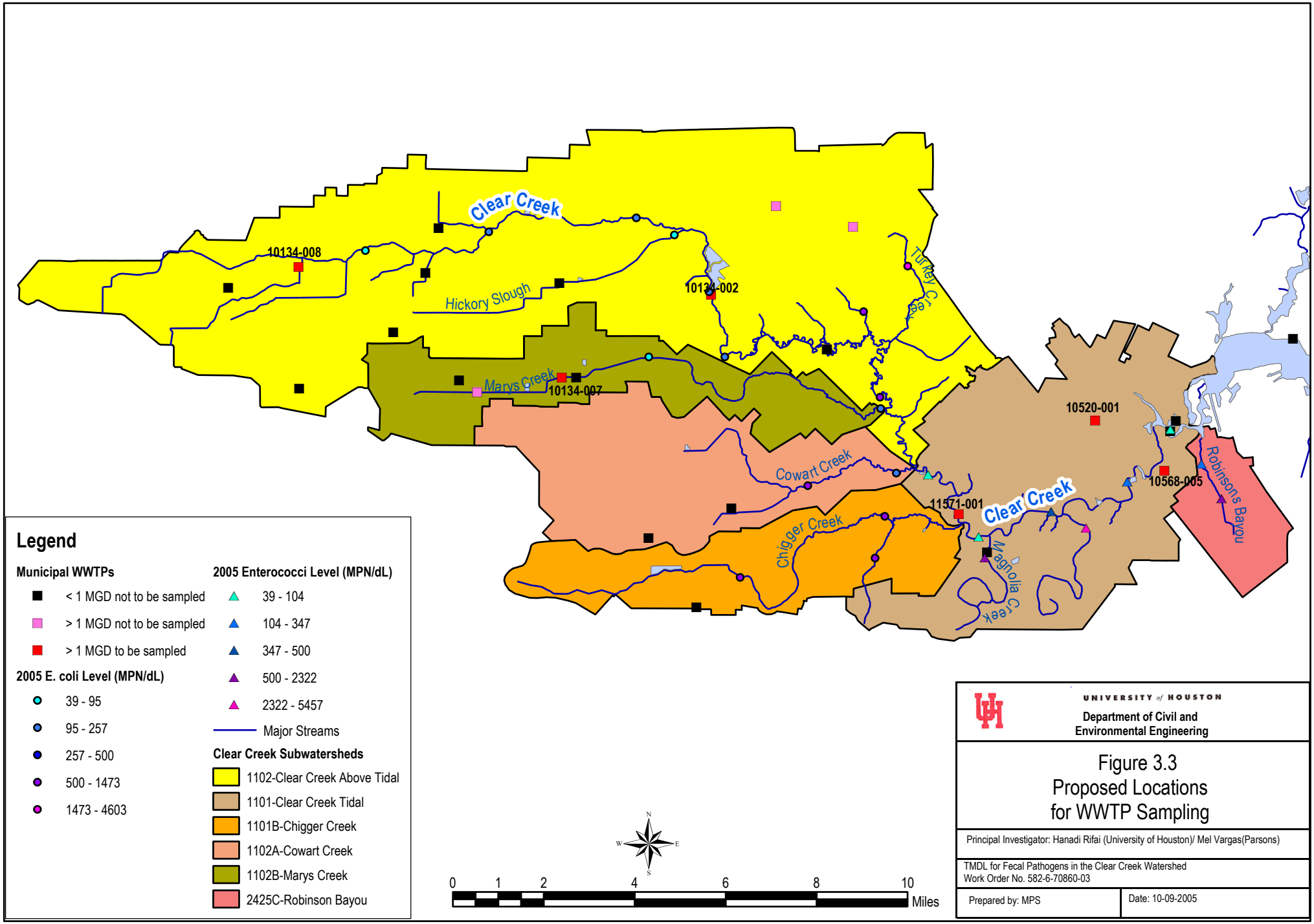
Department of Civil and Environmental Engineering
Figure 3.2
Proposed Locations
for Stormwater Runoff Sampling
Principal Investigator: Hanadi Rifai (University of Houston)/ Mel Vargas(Parsons)
TMDL for Fecal Pathogens in the Clear Creek Watershed
Work Order No. 582-6-70860-03
Prepared by: MPS
Date: 10-09-2005


Clear Creek
10134-008
Hickory Slough
10134-002
Turkey Creek
Marys Creek
10134-007
10520-001
Cowart Creek
Robinsons Bayou
10568-005
11571-001
Clear Creek
Chigger Creek
Magnolia Creek
Legend
Municipal WWTPs
< 1 MGD not to be sampled
> 1 MGD not to be sampled
> 1 MGD to be sampled
2005 E. coli Level (MPN/dL)
39 - 95
95 - 257
257 - 500
500 - 1473
1473 - 4603
2005 Enterococci Level (MPN/dL)
39 - 104
104 - 347
347 - 500
500 - 2322
2322 - 5457
Major Streams
Clear Creek Subwatersheds
1102-Clear Creek Above Tidal
1101-Clear Creek Tidal
1101B-Chigger Creek
1102A-Cowart Creek
1102B-Marys Creek
2425C-Robinson Bayou
N
W
E
S
0
1
2
4
6
8
10
Miles
UNIVERSITY of HOUSTON
Department of Civil and Environmental Engineering
Figure 3.3
Proposed Locations for WWTP Sampling
Principal Investigator: Hanadi Rifai (University of Houston)/ Mel Vargas(Parsons)
TMDL for Fecal Pathogens in the Clear Creek Watershed
Work Order No. 582-6-70860-03
Prepared by: MPS
Date: 10-09-2005

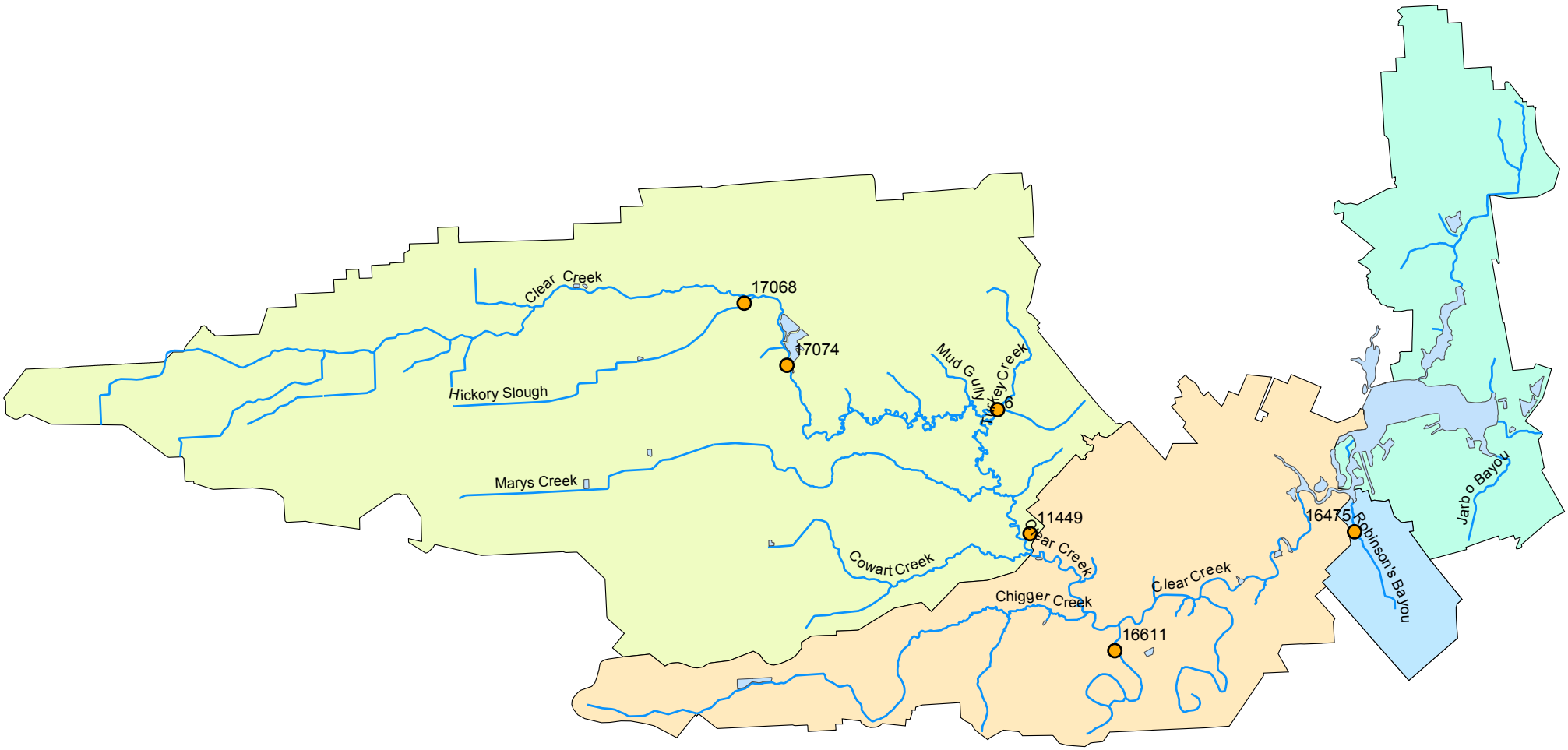
outfall pipe by documenting the length of time to fill a graduated beaker. Sampling sites and schedules are presented in Table 3.1.

3.4 IN-STREAM SAMPLING

This sampling component will aid in confirming low indicator bacteria levels and in obtaining recent data for stations that have not been sampled recently. Samples will be collected to determine concentrations of E. coli and Enterococci in Clear Creek and its tributaries during dry-weather conditions. Six locations have been tentatively selected for this component. Preliminary locations for sampling are included in Figure 3.4. However, it is noted that the monitoring and data collection program is dynamic and may change as data are collected and analyzed. In addition to EC and Enterococci, the samples will be tested for standard water quality parameters and flow measurements will be taken. Sampling sites and schedules are presented in Table 3.1.

3.5 STORMWATER OUTFALL SURVEY

This task will complete the field reconnaissance activities initiated in FY2005. Dry-weather discharges from outfalls will be noted and recorded, and the magnitude of the flow will be determined. A database with all the pipe locations, diameters, and flows (if applicable) will be compiled.



N

0 1 2 4 6 8 Miles

LEGEND

- Segment 1101
- Segment 1102
- Segment 2425C
- Segment 2425 (Outside of Project Area)
- SitesForSampleCollection

Figure 3.4
Proposed In-Stream Locations

University of Houston
Parsons Water and Infrastructure

Prepared By: GCV | Date: 10/12/2005

CHAPTER 4

QUALITY ASSURANCE PROJECT PLAN DEVELOPMENT

The goal of this task was to develop a Quality Assurance Project Plan (QAPP) for additional data collection that met the needs for the TMDL. The QAPP is a document that describes the tasks, management, structure, and policies that will be implemented in the monitoring program for this project. The QAPP will ensure that the data collected under this work order will be reliable, scientifically valid, and legally defensible.

During the reporting period, an update to the existing QAPP for the project was prepared based on the proposed sampling activities outlined in the previous chapter. Revision 0 of the Annual Report of the QAPP was submitted to the TCEQ on February 1, 2006 and comments were received on March 6, 2006. Revision 1 of the annual update (included in Appendix A) that addressed all the comments sent by the TCEQ was submittal for review on March 9, 2006. The project team is awaiting approval of the modified version of the annual update.

CHAPTER 5

SUMMARY AND FUTURE ACTIVITIES

5.1 SUMMARY

During the second quarter of this TMDL project, additional analyses of the indicator bacteria dataset compiled in WO9 were conducted. In addition, a detailed sampling plan for activities to be conducted in FY2006 was prepared and submitted to TCEQ. Finally, an annual update of the existing QAPP for the project was updated and is under review by the TCEQ.

5.2 PLANNED ACTIVITIES FOR THE THIRD QUARTER OF THE PROJECT TIME FRAME

During the period March 1 to May 31, 2006, the project team will be focusing on the following activities:

- Modify the annual update of the QAPP for the proposed sampling activities, if needed.
- Conduct sampling activities once the QAPP is approved by TCEQ.

APPENDIX A

QUALITY ASSURANCE PROJECT PLAN

(Electronic)