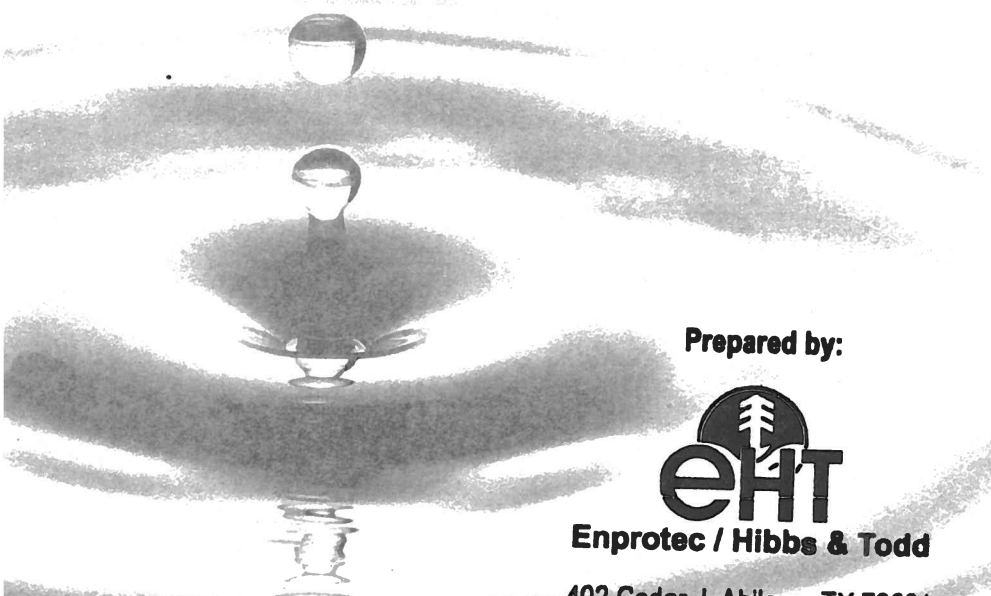
MISSOURI CITY
TEXAS
the show me city

2011 REGIONAL WATER & WASTEWATER PLANNING STUDY



Prepared by:

Enprotec / Hibbs & Todd

402 Cedar | Abilene, TX 79601
(325) 698-5560 tel | (325) 691-0058 fax
www.e-ht.com
Firm Registration No. 1151

1004831074_Final Report

January, 2012

Missouri City
TEXAS
the show me city

2011 REGIONAL WATER & WASTEWATER PLANNING STUDY

Prepared by:

Enprotec / Hibbs & Todd

402 Cedar I Abilene, TX 79601
(325) 698-5560 tel I (325) 691-0058 fax
www.e-ht.com
Firm Registration No. 1151

January, 2012

Enprotec / Hibbs & Todd

Missouri City Texas
the show me city

2011 REGIONAL WATER & WASTEWATER PLANNING STUDY

Keith P. Kindle, PE
Project Director

Jonathan Baum, PE
Project Manager

Joshua Berryhill, PE
Project Engineer

Table of Contents

Acknowledgements

The City of Missouri City Regional 2011 Water and Wastewater Planning Study (Study), covering such a large geographic area including numerous and diverse participants and interests, cannot be successfully accomplished without the assistance of a number of individuals and organizations. The Enprotec / Hibbs & Todd, Inc. (eHT) team would like to recognize those who made important contributions to our efforts over the past 15 months.

First, the eHT team would like to acknowledge the important contributions by the approximately 30 utility districts included in this Study. Your patience in answering our questions and requests for data, sometimes more than once, is gratefully acknowledged by the eHT team.

Second, we would like to acknowledge the contributions of our subconsultants: Costello, Inc.; LJA Engineering & Surveying, Inc.; and Jones & Carter, Inc. Your representation of over 70% of the utility districts in this Study allowed us to quickly coordinate and communicate with the majority of our planning participants. Most importantly, your local familiarity and detailed knowledge of the water and wastewater infrastructure in the Study area was invaluable to the development of the existing conditions and proposed consolidation projects described in this Study.

Last but certainly not least, we would like to thank the Texas Water Development Board (TWDB) Project Manager Mr. Lann Bookout, P.E. for your guidance and support and the City of Missouri City for the opportunity to perform this Study. We especially acknowledge Mr. Scott Elmer, P.E. for establishing the goals and parameters of the Study and our Project Manager Ms. Jing Chen, P.E. for ensuring timely communication and availability of resources. A special thank you goes to Greg Arnold and your colleagues in the Geographic Information System (GIS) Department of the City. Your efforts in developing the maps and exhibits were critical to the success of this Study and will be invaluable to the future planning and design of the projects identified in this Study.

Enprotec / Hibbs & Todd

Executive Summary

To: City of Missouri City and Texas Water Development Board
From: Keith P. Kindle, P.E.
Date: January 30, 2012
Subject: Final City of Missouri City Regional Water & Wastewater Plan

BACKGROUND

This Executive Summary summarizes the findings of each task and the consolidation recommendations included in the City of Missouri City Regional Water and Wastewater Planning Study (the Study). This Study is not a blueprint for the dissolution of the variety of utility districts in the area. Rather, the Study was conducted to identify regional win-win projects. The terms "Regional or Regionalization" have political connotations that infer a single, regional authority which is not the intent when the term is used in this Study. The direction and goal for this Study has been to establish the existing infrastructure and conditions of the region to identify win-win consolidation opportunities for infrastructure between the participants that benefit the area and its ratepayers in a regional manner.

The Study had several tasks to accomplish which included the following:

- Establish existing conditions for water and wastewater facilities of the 30 entities in the Study area;
- Identify specific water and wastewater consolidation projects and their associated costs and implementation schedule;
- Prepare an environmental assessment of the recommended consolidation projects;
- Analyze regional opportunities and the potential funding mechanisms; and,
- Develop a stand-alone Water Conservation and Drought Contingency Plan for the proposed Regional Water Treatment Plant (RWTP).

The development of data for the Study included direct and indirect communication with the utility districts while other key sources of data included the City's GIS department, the TCEQ Water Utilities Database, U.S. 2010 Census data, the SB 1 Region H Water Plan and the Joint Groundwater Reduction Plan (Joint GRP). It should be noted that the Joint GRP was used as the basis for establishing the existing and projected connections, population, water demand and wastewater flows. The Joint GRP plan was used because the data was specific to the Study area and the utility districts included therein; whereas the Region H and 2010 Census data included overlapping areas and utility districts outside the Study boundaries.

The Study, in geographic terms, includes the current city limits of Missouri City, as well as its ETJ. As stipulated by Chapter 42 of the Texas Local Government Code, based on city population size, Missouri City's ETJ extends 3.5 miles beyond the City limits. Exhibit 1-1 in Section 1 shows the Study area and participants. It should be noted that Fort Bend County MUD #23 and #24 are not included since they are outside of the City's ETJ. Fort Bend County WC&ID #2 is also not included due to the fact that it is in three separate jurisdictions (Missouri City, Stafford and Sugar Land). The Study participants are shown in the table below from Section 1.

Table 1-2
Regional Planning Participants

Blue Ridge West MUD	Palmer Plantation MUD #2
City of Missouri City, Texas	Quail Valley Utility District
First Colony MUD #9	Sienna Plantation Management District
Fort Bend County MUD #26	Sienna Plantation MUD #1
Fort Bend County MUD #42	Sienna Plantation MUD #2
Fort Bend County MUD #46	Sienna Plantation MUD #3
Fort Bend County MUD #47	Sienna Plantation MUD #4
Fort Bend County MUD #48	Sienna Plantation MUD #5
Fort Bend County MUD #49	Sienna Plantation MUD #6
Fort Bend County MUD #115	Sienna Plantation MUD #7
Fort Bend County MUD #129	Sienna Plantation MUD #10
Fort Bend County MUD #149	Sienna Plantation MUD #12
Harris County MUD #122	Sienna Plantation MUD #13
Harris County WC&ID – Fondren Road	Southwest Harris County MUD #1
Meadowcreek MUD	Thunderbird Utility District
Palmer Plantation MUD #1	

The following summarizes each Section of the Study as shown in the Table of Contents.

SECTION 1

Section 1 is referred to as the "Existing Conditions" section. In this section all of the existing information for the Study area such as existing water and wastewater utilities, population, water demand, treatment capacity and others factors are identified and mapped as appropriate. In addition to identifying the current conditions, factors such as population, numbers of connections, water demand, wastewater demand, and water and wastewater treatment capacity were projected to the horizon of the Study (Year 2040) and through build-out. The table below provides a summary of these findings.

Existing & Projected Conditions for Study Area								
Study Parameter	**Current (2010)**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**Build Out**
Connections	29,019	33,332	39,835	47,603	54,622	59,133	60,539	62,064
Population	89,088	102,329	122,293	146,141	167,690	181,538	185,855	190,536
Total Water Demand (MGD)	12.4	14.4	17.3	20.8	23.9	26.0	26.7	27.3
Total Wastewater Demand (MGD)	7.5	8.6	10.4	12.5	14.4	15.6	16.0	16.4

Connections

The current 2010 connections for the Study participants vary from 18 to 4,423 for a total of 29,019 connections for the Study area. Using the updated actual connection counts collected from the utility districts rather than the 2010 projected counts from the Joint GRP, but following the same expected growth patterns used in the Joint GRP, the projected connection counts were estimated in 5-year increments to the year 2040 and ultimate build-out. The 2010 total connections for the Study area are 29,019 and increase to 60,539 by 2040. Table 1-3 in Section 1 shows the current and projected connection counts for each utility district and the total for the Study area. Currently the Study area is at 47% build-out and increases to 98% build-out by 2040.

Population

Using the projected connection counts discussed above and assuming the average persons per housing unit will remain the same over time, the projected population was estimated in 5-year increments to the year 2040 and build-out. From year 2010 to 2040 the Study area is projected to increase from 89,088 to 185,855 persons – an additional 96,767 persons over the next 30 years or approximately 3,225 persons per year. Table 1-4 in Section1 shows the current and projected population for each utility district and the total for the Study area.

Water Demand

The expected water demand was obtained by multiplying the number of connections by the average usage per connection per month. The average usage per connection per month was calculated in the Joint GRP by dividing the annual pumpage by the connection count times 12 months. Those districts that are not included in the Joint GRP directly provided their average usage per connection per month.

The current water demand is 12.4 MGD for the Study area with a projected water demand in year 2040 of 26.7 MGD and a build-out demand of 27.3 MGD. Table 1-6 in Section 1 shows the current and projected water demand for each utility district and the total for the Study area.

Wastewater Demand

To determine the current and projected wastewater demands, the information on the wastewater treatment plant (WWTP) flows gathered from the utility districts was divided by the connection counts. This wastewater usage per connection was compared to the average water usage per connection. It was determined that the average wastewater usage per connection is approximately 60% of the water usage per connection. The current wastewater demand for the Study area is 7.5 MGD and more than doubles by year 2040 to 16.4 MGD. Table 1-8 in Section 1 shows the current and projected wastewater demand for each utility district and the total for the Study area.

Groundwater Wells

The majority of the water supplied to the utility districts within the Study area comes from groundwater. Currently, only a few of the northernmost utility districts are receiving surface water from the City of Houston, which include Harris County WC&ID - Fondren Road, Southwest Harris County MUD #1 and Harris County MUD #122. Almost all of the districts operate their own well, or wells, as a means to supply this groundwater. There are a total of 28 existing public wells within the planning area. Data on the wells was obtained from the Joint GRP and the utility districts and is presented in Table 1.9 of Section 1 of this Study.

Water Treatment

There are currently 24 WTPs operating within the Study area. In addition to these, the City is currently constructing a RWTP located in Sienna Plantation. This RWTP will begin operations in 2012. Exhibit 1-4 shows the location of the existing WTPs within the Study area. Total water treatment capacity currently available is 49.54 MGD. All of the WTPs use groundwater as a source. The smallest water treatment plant (WTP) is Fort Bend County MUD #149 at 0.648 MGD while the largest belongs to the Quail Valley UD with a total capacity of 8.524 MGD. Table 1-10 in Section 1 shows the existing WTPs and their associated service areas.

Water Distribution

The existing water distribution system for the Study area consists of approximately 410 miles of water transmission and distribution piping of various sizes, types and ages. Each utility district is responsible for construction and maintenance of its individual distribution system. Age, condition, type and sizing of water lines were evaluated in this Study only to the extent of determining necessary improvements when considering potential consolidation alternatives.

In addition to the normal distribution piping for each utility district water system, interconnects have been constructed between many of the existing distribution systems. These interconnects provide the capability to transfer treated water from one utility district to another. See Exhibit 1-4 for a map of the existing distribution lines and Exhibit 1-5 for the locations of existing system interconnects and major transmission lines throughout the Study area. Each interconnect on Exhibit 1-5 has been numbered and information about each interconnect can be found in Table 1-11 in Section 1of this Study.

Wastewater Treatment

There are 11 existing WWTPs within the Study area. Two of the WWTPs are owned by the City of Missouri City (Steep Bank/Flat Bank and Mustang Bayou). The remaining WWTPs are owned by utility districts. The service area for each WWTP is shown on Exhibit 1-7 of this Study.

Each WWTP was evaluated in this Study with respect to rated capacity versus average loading, treatment performance, remaining useful life of structures and equipment, treatment and potential expansion capabilities, potential for reuse and observed level of annual O&M efforts. The total wastewater treatment capacity for the Study area is 14 MGD. The largest existing WWTP is the Quail Valley UD/Thunderbird WWTP at 4.0 MGD capacity. A brief summary of information for each WWTP is shown in Tables 1-12 through 1-15 of Section 1 in this Study.

Wastewater Collection System

The existing wastewater collection system for the Study area consists of approximately 360 miles of gravity lines and 35 miles of force mains, of various sizes, types and ages. Each utility district is responsible for construction and maintenance of its collection system. Because some of the utility districts share capacity in regional WWTPs, several systems are interconnected. Some of the interconnects are direct gravity lines to a WWTP and some are force mains that transfer wastewater flows from one utility district's lift station into another utility districts collection system to ultimately travel to a regional WWTP. See Exhibit 1-6 for a map of the existing wastewater collection system lines, lift stations and existing system interconnects.

Billing Rates

An evaluation of the rate structure for each utility district was done to develop a comparison of the monthly average billing amount for water, wastewater and combined. A monthly usage of 10,000 gallons was used to compare residential rates and a monthly usage of 50,000 gallons was used to compare commercial rates. The average water billing rate for residential was $25.39 and commercial was $160.87. The average wastewater billing rate for residential was $35.81 and commercial was $152.04. The average combined billing rate for residential was $61.20 and commercial was $312.91. The residential rates were somewhat uniform across the Study participants while commercial amounts varied more widely.

GIS Mapping of Existing Facilities

A significant achievement of the Study was the development of GIS maps for the existing water and wastewater infrastructure, including transmission lines, WTPs, interconnects, water and wastewater service areas, WWTPs, lift stations and so forth. The update of the facilities mapping and review and revision of the GIS maps via comments from the various participants will provide a valuable tool for future planning. The GIS maps are referenced throughout the Study sections.

SECTIONS 2 - 4

Consolidation Project Recommendations and Costs

The Study identified various water projects for interconnects, elevated storage tanks (ESTs), SWTP expansion and water transmission lines. There are 9 interconnect projects totaling $4,795,000. There are 6 ESTs recommended at a total cost $22,302,000. The two expansions required for the RWTP total $77,880,000. Finally, there are 2 transmission line projects associated with the RWTP for a total cost of $16,540,000. The total cost for the recommended water projects is $121,517,000, as shown in Table 4-20.

Table 4-20 Summary of Cost Estimates for Water Improvements				
Project Description	**Projected Total Capital Cost for New Interconnects**	**Projected Total Capital Cost for New ESTs**	**Projected Total Capital Cost for New WTPs**	**Projected Total Capital Cost for New Transmission Lines**
Interconnect First Colony MUD #9 with Fort Bend County MUD #115	$607,000	-	-	-
Mustang Bayou WTP System and Sienna Plantation System Interconnect No. 2	$799,000	-	-	-
Mustang Bayou WTP System and Sienna Plantation System Interconnect No. 3	$683,500	-	-	-
Sienna Plantation Water System Internal Interconnect	$458,000	-	-	-
Sienna Plantation System and Palmer Plantation System Interconnect No. 1	$927,500	-	-	-
Silver Ridge Development and Sienna Plantation Water System Interconnect No. 1	$154,000	-	-	-
Fort Bend County MUD #149 and Sienna Plantation MUD #1 Water System Interconnect No. 1	$579,000	-	-	-
Mustang Bayou and Palmer Plantation Interconnect	$298,000	-	-	-
Mustang Bayou and Quail Valley Interconnect	$289,000	-	-	-
New EST at Sienna Plantation No. 1 GWTP	-	$4,602,000	-	-
New EST at Mustang Bayou WTP	-	$1,947,000	-	-
New EST at Fort Bend County MUD #149 GWTP	-	$6,372,000	-	-
New EST at Palmer Plantation MUD No. 2 GWTP	-	$3,717,000	-	-
New EST at Thunderbird Utility District System 1 GWTP No. 2	-	$3,717,000	-	-
New EST at Harris County WC&ID – Fondren Road GWTP No. 2	-	$1,947,000	-	-
RWTP Phase II	-	-	$35,400,000	$13,850,000
RWTP Phase III	-	-	$42,480,000	$2,690,000
Total Cost Per Category	**$4,795,000**	**$22,302,000**	**$77,880,000**	**$16,540,000**
Total Projected Cost	**$121,517,000**			

The Study did not identify any stand-alone wastewater collection or conveyance projects that would benefit the Study area; however, the single recommendation to consolidate the existing WWTPs into a super-regional WWTP does include costs for conveyance and pumping to re-route wastewater flows and convey re-use water. The total cost for the super-regional WWTP project is $82,689,000. A summary of the five WWTP consolidation scenarios reviewed are provided in Table 4-38.

Table 4-38
Summary of Capital and O&M Costs for WWTP Scenarios

Scenario Description	WWTPs Online in This Scenario	Projected Total Capital Cost	Projected Annual O&M Cost	Projected 30-Year Life Cycle Cost
Rehab/Expand all existing WWTPs as needed and construct new South Regional WWTP to continue use for 30 years (11 existing WWTPs plus 1 new WWTP)	SWHCMUD #1, HCMUD #122, HCMUD-Fondren Road, BRWMUD, FBCMUD #26, Palmer, QVUD, SB-FB, Vicksburg, Sienna North, Sienna South, New South Regional (Hillwood)	$113,603,000	$3,475,000	$181,722,000
Consolidate WWTPs based on MUD engineering firm recommendations (7 existing WWTPs plus 1 new WWTP)	SWHCMUD #1, HCMUD-Fondren Road, BRWMUD, QVUD, SB-FB, Vicksburg, Sienna North, New South Regional (Hillwood)	$105,191,000	$2,662,100	$157,378,000
Consolidate WWTPs to reduce total number of WWTPs using QVUD as a regional facility (4 existing WWTPs plus 1 new WWTP)	HCMUD-Fondren Road, QVUD, SB-FB, Vicksburg, New South Regional (Hillwood)	$99,036,000	$1,896,900	$136,224,000
Consolidate WWTPs to reduce total number of WWTPs using BRWMUD as a regional facility (4 existing WWTPs plus 1 new WWTP)	BRWMUD, QVUD, SB-FB, Vicksburg, New South Regional (Hillwood)	$99,874,000	$2,280,700	$144,586,000
Consolidate WWTPs to reduce total number of WWTPs using Steep Bank - Flat Bank as the only regional WWTP facility (1 existing WWTP)	**SB-FB**	**$82,689,000**	**$1,331,400**	**$108,792,000**

In addition to comparison of the life cycle costs in the table above, a full cash flow analysis was developed for the wastewater improvements (Refer to Table 4-40), to provide a basis for comparison of existing/future WWTP O&M costs, along with the impact of the potential debt service to be incurred from consolidating the various existing WWTPs. Note that a cumulative loss/gain analysis was also completed and was included in Table 4-40 which reflects a potential net gain in revenue from wastewater fees during the course of the project due to reduced WWTP O&M cost as each existing WWTP would be consolidated into the proposed super-regional WWTP.

Based on the potential revenue/cost streams evaluated, it appears that the savings in O&M by consolidating WWTPs may allow for the wastewater revenues to start paying for the O&M and debt service as early as 2021 (the first year with an annual net gain of revenue), using the implementation schedule included in this section. However, depending on actual current O&M costs attributed to each WWTP, the likely “break even” point in the proposed implementation schedule could happen earlier or later than 2021.

Table 4-40
Projected Cash Flow Analysis for Proposed Wastewater Improvements

Year	Wastewater Improvements Project	Annual Debt Service Cost for WWTP Projects [1]	Total O&M Cost for Super-regional WWTP and Transfer PS Operation [2]	Total O&M Cost for Existing WWTP Operations [2]	Total Annual Cost for Wastewater Improvements and Operations	Total Annual Revenue for Utility Districts for WWTP Operations [3]	Cumulative Net Loss/Gain During Project
2011	-	-	-	$6,261,000	$6,261,000	$6,371,000	$110,000
2012	Reroute Harris County MUD #122 WWTP to Harris County WC&ID-Fondren Rd WWTP	$4,219,000	$397,000	$5,662,000	$10,278,000	$6,575,000	($3,593,000)
2013	Construct new transfer PS at Palmer Plantation WWTP and transfer all plant flow to SB-FB WWTP	$4,219,000	$508,000	$5,207,000	$9,934,000	$6,786,000	($6,741,000)
2014	Construct new transfer PS at Sienna North WWTP and transfer all plant flow to SB-FB WWTP	$4,219,000	$630,000	$4,802,000	$9,651,000	$7,004,000	($9,388,000)
2015	-	$4,219,000	$653,000	$4,971,000	$9,843,000	$7,229,000	($12,002,000)
2016	Construct 4.0 MGD expansion at SB-FB WWTP	$4,219,000	$488,000	$5,145,000	$9,852,000	$7,461,000	($14,393,000)
2017	Construct new transfer PS at Fort Bend County MUD #26 WWTP and transfer all plant flow to Palmer WWTP PS	$4,219,000	$621,000	$4,551,000	$9,391,000	$7,700,000	($16,084,000)
2018	Construct new transfer PS at Sienna South WWTP and transfer all plant flow to Sienna North WWTP PS	$4,219,000	$872,000	$3,282,000	$8,373,000	$7,947,000	($16,510,000)
2019	-	$4,219,000	$903,000	$3,397,000	$8,519,000	$8,202,000	($16,827,000)
2020	-	$4,219,000	$935,000	$3,516,000	$8,670,000	$8,465,000	($17,032,000)
2021	Construct new transfer PS at Quail Valley UD WWTP and transfer all plant flow to SB-FB WWTP	$4,219,000	$1,294,000	$2,472,000	$7,985,000	$8,736,000	($16,281,000)
2022	Construct 4.0 MGD expansion at SB-FB WWTP	$4,219,000	$1,187,000	$2,559,000	$7,965,000	$9,016,000	($15,230,000)
2023	Construct new transfer PS at Blue Ridge West WWTP and transfer all plant flow to Fort Bend County MUD #26 WWTP PS	$4,219,000	$1,523,000	$1,718,000	$7,460,000	$9,305,000	($13,385,000)
2024	Construct new transfer PS in Hillwood development and transfer all plant flow to Sienna South WWTP PS	$4,219,000	$1,742,000	$1,779,000	$7,740,000	$9,603,000	($11,522,000)
2025	-	$4,219,000	$1,803,000	$1,842,000	$7,864,000	$9,911,000	($9,475,000)
2026	Construct new transfer PS at Harris County WC&ID-Fondren Rd WWTP and transfer all plant flow to Blue Ridge West WWTP PS	$4,219,000	$1,991,000	$1,463,000	$7,673,000	$10,229,000	($6,919,000)

Year	Wastewater Improvements Project	Annual Debt Service Cost for WWTP Projects [1]	Total O&M Cost for Super-regional WWTP and Transfer PS Operation [2]	Total O&M Cost for Existing WWTP Operations [2]	Total Annual Cost for Wastewater Improvements and Operations	Total Annual Revenue for Utility Districts for WWTP Operations [3]	Cumulative Net Loss/Gain During Project
2027	Construct 4.0 MGD expansion at SB-FB WWTP	$4,219,000	$2,061,000	$1,515,000	$7,795,000	$10,557,000	($4,157,000)
2028	Construct new transfer PS at Fort Bend County MUD #1 WWTP and transfer all plant flow to Harris County WC&ID-Fondren Rd WWTP PS	$4,219,000	$2,039,000	$1,338,000	$7,596,000	$10,895,000	($858,000)
2029	-	$4,219,000	$2,111,000	$1,385,000	$7,715,000	$11,244,000	$2,671,000
2030	-	$4,219,000	$2,185,000	$1,434,000	$7,838,000	$11,604,000	$6,437,000
2031	Construct new transfer PS at Mustang Bayou WWTP and transfer all plant flow to Palmer Plantation WWTP PS	$4,219,000	$2,390,000	$0	$6,609,000	$11,976,000	$11,804,000
2032	-	$4,219,000	$2,474,000	$0	$6,693,000	$12,360,000	$17,471,000
2033	-	$4,219,000	$2,561,000	$0	$6,780,000	$12,756,000	$23,447,000
2034	-	$4,219,000	$2,651,000	$0	$6,870,000	$13,165,000	$29,742,000
2035	Construct 4.0 MGD expansion at SB-FB WWTP	$4,219,000	$2,316,000	$0	$6,535,000	$13,587,000	$36,794,000
2036	-	$4,219,000	$2,398,000	$0	$6,617,000	$14,022,000	$44,199,000
2037	-	$4,219,000	$2,482,000	$0	$6,701,000	$14,471,000	$51,969,000
2038	-	$4,219,000	$2,569,000	$0	$6,788,000	$14,935,000	$60,116,000
2039	-	$4,219,000	$2,659,000	$0	$6,878,000	$15,413,000	$68,651,000
2040	-	$4,219,000	$2,753,000	$0	$6,972,000	$15,907,000	$77,586,000
Total Debt Service (Principal and Interest)		**$122,351,000**					

Notes:
1 - This debt service cost is based on a 30-year payment period.
2 - This O&M cost includes a 3.5% annual cost escalation factor to account for anticipated increases in inflation in the future.
3 - The WWTP operations revenue based on allocating 75% of the annual wastewater revenue to WWTP operations. Revenue based on average utility district wastewater fee of $3.58 per 1,000 gallons. Revenue increases annually by approximately 3% due to increased development and growth in the City, resulting in a proportional increase in wastewater flows.

The total cost for all of the projects identified in the Study is $204,206,000. The table below shows all of the water and wastewater consolidation projects and their individual costs that are recommended in this Study.

Summary of Recommended Project Costs	
Project Description	**Cost**
Interconnects	$4,795,000
Elevated Storage	$22,302,000
Water Transmission	$16,540,000
Water Treatment	$77,880,000
Wastewater Conveyance / Treatment	$82,689,000
Total	**$204,206,000**

SECTION 5

Environmental Assessment (EA)

An EA was prepared for the projects that were identified and is included in Section 5 of the Study. Many of the components such as USGS Quad maps, FEMA maps, Aerial Photos and others are included, as well as a rudimentary discussion of each component of the EA per the Texas Water Development Board (TWDB) guidelines. These foundation elements of this EA will be valuable for future environmental investigations. However, the EA is only intended for a very preliminary planning level and is not intended to provide environmental clearance for any of the projects recommended herein. Additional environmental investigations should be conducted, as warranted, for those projects that proceed beyond the planning level of this Study.

SECTION 6

Project Funding and Consolidation

The Study identified various water projects for interconnects, ESTs, RWTP expansion and water transmission lines. The total cost for the recommended water projects is $121,517,000. The Study did not identify any stand-alone wastewater collection or conveyance projects that would benefit the Study area; however, the single recommendation to consolidate the existing WWTPs into a super-regional WWTP does include costs for conveyance and pumping to re-route wastewater flows and convey re-use water. The total cost for the super-regional WWTP project is $82,689,000. The total cost for all of the projects identified in the Study is $204,206,000.

Obviously not all of the funding would be needed at the same time but with the current tightening of the bond market and the fact that the requests for water and wastewater funding is always greater than the funding available, the identification of funding sources is crucial. Section 6 describes a variety of funding sources available from the TWDB in addition to private bonds and funding agreements.

The conclusions regarding the funding of consolidation or regional projects are listed below.

- Municipalities can typically issue bonds at lower interest rates than utility districts or IOUs.
- Using the Joint GRP financing model for the RWTP is applicable to the super-regional WWTP recommended in this Study.
- The smaller consolidation water distribution projects and interconnects are best financed via interlocal agreements between the affected utility districts.

Water Consolidation

In regard to regional water treatment and supply, the City and the utility districts have managed to achieve what was unthinkable just a few years ago with the agreement for the new RWTP. In response to requirements to reduce the usage of groundwater, the City and the utility districts agreed to fund, design and construct a surface WTP (SWTP) to provide surface water to a portion of the area. By converting a portion of the area to surface water, the entire region was able to meet the stringent groundwater reduction requirements that go into effect in 2013 with further reductions in 2025.

The City and the utility districts have successfully implemented the steps to achieve regionalization for water supply and treatment to meet the reduction in groundwater withdrawals. This living example of cooperation and success can and should be a model for future regionalization or consolidation efforts. There are still opportunities remaining for storage and pumping, especially as the distribution systems become mature and the use of hydro-pneumatic pressure tanks is lessened and elevated storage use is increased. The recommendation for ESTs may be met by resistance due to NIMBY – Not in My Back Yard; and, the fact that in the short-term, ESTs are more expensive than hydropnuematic tanks.

Wastewater Consolidation

The consolidation of any current wastewater treatment facilities will probably require a similar regulatory driver as the groundwater reduction requirements in the form of stricter TMDLs for the affected streams that receive discharge effluent from the WWTPs in the region. Overall, the concept of wastewater regionalization, or consolidation, is adverse to the development attitudes and practices of the Study area. However, from a long-term cost standpoint this Study has established the case for a single, super-regional WWTP at the Steep Bank-Flat Bank WWTP.

A total of over 60 scenarios were completed to evaluate capital, O&M and life-cycle costs. The result was surprising in that consolidation to a single, super-regional WWTP was the most cost effective scenario despite the costs for re-routing and pumping of flows from other service areas. The various methods of analysis and conclusions are discussed in detail in Section 4.

The recommended scenario of consolidating all flows to the Steep Bank-Flat Bank WWTP will have its share of challenges for the reasons listed below.

- Agreements and contracts among political subdivisions are much harder to complete once independent service areas are established.

- Determination of an overall rate structure for combined service areas is very difficult to establish once single-service areas and rate schedules have been established - especially when trying to consolidate an older utility district and a newer utility district that typically has a much higher debt service component.

- Individual Control. While costs are important, control is paramount. Generally speaking, the number one problem of regionalization involves the fear of losing autonomy, including concerns about loss of control or power by one group or another and not being able to control their own destiny.

- Occupational Resistance. With the proliferation of utility districts in the Study area and the nature of providing wastewater services, there are numerous professions involved in the industry through the operation and maintenance, billing, engineering, financial and legal services. In addition to resistance to regionalization by a utility district board due to control reasons, resistance is also encountered from those who work for the utility districts. With a reduced number of plants and plant owners through regionalization or consolidation, there may be the perception that the wastewater industry will turn into a "winner take all" system of engineering, financial, legal and maintenance contracts.

However, after exhaustive analyses of cost comparisons, it is the most cost effective alternative for the long-term wastewater treatment needs of the Study area.

The recommendation to establish a super-regional WWTP at Steep Bank-Flat Bank could follow the same model as the RWTP by allowing the various utility districts to retain their autonomy. However, the issues of costs to divert the flows, of control, and of how costs are apportioned in accordance with utility rates will play a major role in deciding whether or not a regional approach is taken. One thing is certain – 8 of the current WWTPs only have 5-10 years of life remaining. Subtract the time for permitting, design and possible acquisition of land necessary for expansion and a decision will have to be made in the very near future on which direction the small package plants will take.

SECTION 7

An implementation schedule for various water and wastewater consolidation projects that are identified in Sections 4 of this Study was prepared. The timing of the implementation for these projects was based on information from the utility districts and the inherent nature and characteristics of the projects. However, it should be noted that a number of factors can and will impact the schedule presented in the flow chart in Section 7.1 of this Study and is shown on the following page.

These include but are not limited to the following factors.

- The projects identified are at a pre-planning level at this point. Preliminary design may delay or accelerate the projects once begun.

- Implementation of the projects is dependent on available funding.

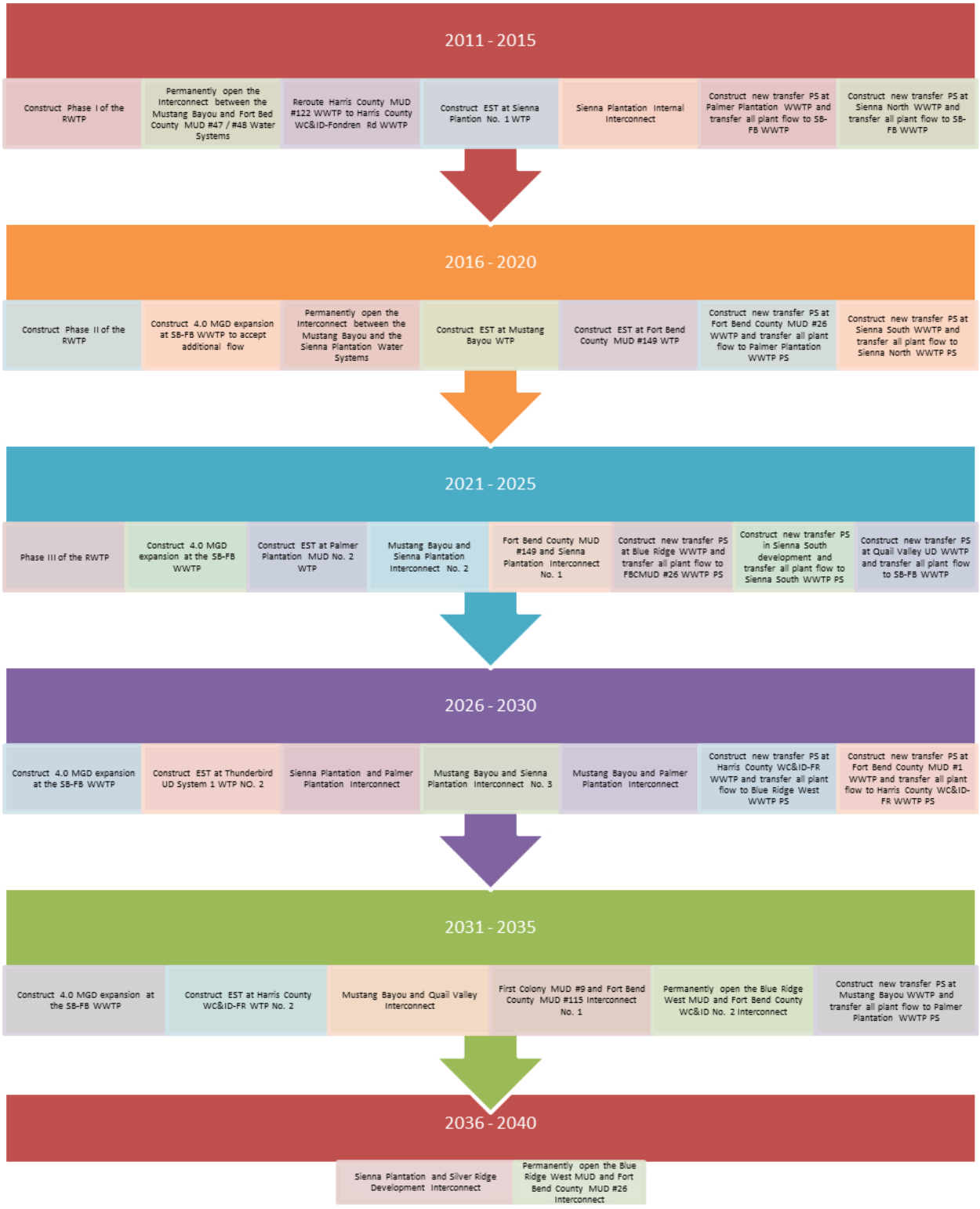
- Utility conflicts, Rights-Of-Way (ROW) and easement acquisition can substantially delay projects.

- Many of the recommended consolidation projects will involve agreements and contracts between the individual utility districts, including project costs and payment agreements. These negotiated agreements may delay implementation.

- A slow down or acceleration in projected growth within the Study area may impact the implementation schedule.

- Stricter water or wastewater treatment regulations could accelerate the implementation schedule.

Implementation Schedule



SECTION 8

Public Outreach

A key part of the Study's effort was coordination with the 30 utility districts within the Study area. Communication included retrieving existing information on their facilities, recommendations for consolidation projects and regional projects and a schedule of implementation, in addition to requesting comments on the overall Study. Four types of communication to facilitate this effort were utilized.

1. Three subconsultants were hired to assist with this Study that serve as the Engineer of Record for approximately 70% of the utility districts in the Study. This allowed rapid dissemination and gathering of information from a majority of the utility districts.

2. The utility districts were contacted directly for information and were provided the opportunity to review and comment on the information in the Study via the creation of FTP sites as the Study progressed.

3. On-site visits to the utility district water and wastewater treatment facilities were conducted.

4. Three public meetings were held and invitations were sent to each utility district requesting them to attend, in addition to the public posting of the meeting date and subject. One meeting was held at the start of the Study, a second meeting was held at the 50% completion level of the Study and a third meeting was held after the final draft of the report had been distributed.

Water Conservation Plan and Drought Contingency Plan (WCP/DCP)

The WCP/DCP has been drafted for the RWTP and is included in the appendices of this Study. The WCP/DCP is formatted per the TCEQ requirements. In addition to these basic requirements, the WCP/DCP also acknowledges the successive requirements by the raw water provider, GCWA, and the wholesale customer, Sienna. The current drafts are preliminary in that the Joint GRP, GCWA, the City and Sienna will need to fine tune the trigger points, stages and associated agreements and other WCP/DCP affected by the adoption of the WCP/DCP for the RWTP. The WCP/DCP will become a stand-alone document upon adoption prior to the start-up of the RWTP.

Section 1: Existing Conditions

1.1 Background

The City of Missouri City is located to the southwest of Houston with its boundaries primarily within Fort Bend County, but also within Harris County toward the northern border. The area began to be populated in the late 1800s as a railroad settlement. The settlement was officially registered in Texas in 1894. It became an important railroad shipping point for the Blue Ridge Oil Field and Salt Mine. In 1926, a gas pipeline was constructed through the area and the City became the first town in Fort Bend County to use natural gas. Growth was slow at first, with the official United States (US) Census count in 1940 showing only 100 residents.

However, as the automobile became more dependable, the area began to appeal to commuters who could work in Houston and live in the Missouri City area. As rumors grew of possible annexation by the City of Houston, a plan was developed to incorporate Missouri City itself. On March 13, 1956, voters approved the incorporation of the area as the City of Missouri City (City).

Currently, the City covers approximately 32 square miles (sq mi) of land and the extraterritorial jurisdiction (ETJ) covers approximately 25 sq mi. The estimated population within the City's planning area (both the incorporated limits and the ETJ) is 81,079 residents based on the 2010 US Census. As stipulated by Chapter 42 of the Texas Local Government Code, based on the City's population size, the City's ETJ extends 3.5 miles beyond the City limits, as referenced in Exhibit 1-1 found at the end of this Section. However, because other cities abut the City, the City's ETJ only exists primarily to the south.

Situated as it is on Texas' flat coastal plain, the City is a spread out community, separated in places by major highway and corridors established for rail, utilities and drainage. The City also developed over time as a community of numerous subdivisions and associated utility districts. Adjacent to the Brazos River, major watersheds include Mustang Bayou and Lower Oyster Creek.

The City is a rapidly growing community that encompasses a diverse range of built environments. Quiet cul-de-sacs and busy arterial transportation corridors exist in close proximity. Originating from the assemblage of multiple utility districts and straddling two counties, the City gains much of its character from the local political geography. The City was incorporated as a combination of many areas, and this background still produces areas of special character today. Currently, the City is widely known as a community of neighborhoods although it maintains a rapidly developing economic base. Additionally, it is important to note the major thoroughfares in the City and its ETJ: US 90-A; Beltway 8

(Sam Houston Tollway); State Highway (SH) 6; Farm-to-Market (FM) 2234 (Texas Parkway); FM 1092 (Murphy Road); and Fort Bend Parkway; as well as US Hwy 59 nearby.[1]

1.2 Project Scope

One of the primary functions of municipalities is to ensure public health and safety through the provision of basic utility services, particularly potable water and sanitary sewer. However, in the City's case, nearly all of its growth over the last 50 years, until the last decade or so, has been accommodated through utility districts associated with individual subdivision development and various master-planned developments. This method of utility service development has resulted in a very unusual and complex utilities situation.

The City's historical reliance on individual utility districts to provide basic water and wastewater services ensured more local oversight of utility operations and associated taxes and fees. However, this dispersed approach to utilities provision and management has also resulted in inevitable duplication and inefficiencies as the overall community has grown. For example, there are currently 24 ground WTPs (GWTPs) and 11 WWTPs operating in and around the City, whereas many similar-sized communities function efficiently and cost-effectively with only one large treatment facility for each type of service.

Such economies of scale in other communities provide benefits such as:

- More unified administration, operations, purchasing;
- Cost sharing for staff training and certification;
- Substantially reduced number of State discharge permits and points of effluent discharge into area waterways;
- Substantially reduced paperwork, monitoring, reporting and enforcement activity associated with each treatment plant; and,
- Typically much lower cost of treatment per gallon.

Additionally, the City's property tax rate applies on top of various other taxing and service providers with jurisdictions in the area (e.g., utility districts, levee improvement districts, county, etc.). Most residents also pay fees to their respective homeowners' associations for supplemental neighborhood services. A current rule of thumb in the City

[1] City of Missouri City Web Site

is that a residential property must reach a minimum value of $260,000 before it pays for itself in terms of tax revenue generated relative to the cost of necessary services.[2] The potential benefits of "regionalization" or "consolidation" of utility providers are important enough that unique opportunities should be monitored and pursued where they make sense and have a good chance to benefit all parties. Such opportunities will gradually come about as the overall community approaches build-out, as debt assumption becomes less of a factor, and through attrition as older systems face difficulties in meeting maintenance and rehabilitation needs or more stringent State and Federal regulatory mandates.

This Study addresses the fundamental questions of how particular consolidations might be accomplished and whether they are feasible when considering technical challenges and costs. The recommendations found in this Study should lead to technically sound engineering master plans to guide ongoing water and wastewater system investments and management activities by the City and others.

The proposed regional planning area in this Study includes both the incorporated limits and City's ETJ (refer to Exhibit 1-1). The tasks included in this Study are as follows:

Table 1-1
Study Tasks

Task	Description
Task I	Service Area Description
Task II	Determination of Water System Demands
Task III	Prepare Water Distribution System Alternatives
Task IV	Prepare Water Treatment System Alternatives
Task V	Water Operation Alternatives
Task VI	Determination of Sewerage System Flows
Task VII	Prepare Collection System Alternatives
Task VIII	Prepare Wastewater Treatment System Alternatives
Task IX	Wastewater Operation Alternatives
Task X	Implementation Schedule
Task XI	Determination of Costs and Recommendations
Task XII	Evaluation of Funding Options and Alternative District Consolidations/Regional Structure
Task XIII	Development of Regional Water Conservation and Drought Management Plans
Task XIV	Reports
Task XV	Environmental Assessment
Task XVI	Meetings

[2] Missouri City1997 Municipal Utility District Study

1.3 Participants

The Study area includes approximately 30 individual entities as planning participants that are listed in Table 1-2. See Exhibit 1-2 for a map of the Study area participants. On Exhibit 1-2 the City-owned districts, Mustang Bayou Utility Service Area (USA) and Northeast Oyster Creek USA, have been shown separately. Fort Bend County Municipal Utility District (MUD) #23 and Fort Bend County MUD #24 are not included since they are out of the City's ETJ, except for a very small section of Fort Bend County MUD #23. Fort Bend County Water Control & Improvement District (WC&ID) #2 was not included since it is under three controlling jurisdictions.

Table 1-2
Regional Planning Participants

Blue Ridge West MUD	Palmer Plantation MUD #2
City of Missouri City, Texas	Quail Valley Utility District
First Colony MUD #9	Sienna Plantation Management District
Fort Bend County MUD #26	Sienna Plantation MUD #1
Fort Bend County MUD #42	Sienna Plantation MUD #2
Fort Bend County MUD #46	Sienna Plantation MUD #3
Fort Bend County MUD #47	Sienna Plantation MUD #4
Fort Bend County MUD #48	Sienna Plantation MUD #5
Fort Bend County MUD #49	Sienna Plantation MUD #6
Fort Bend County MUD #115	Sienna Plantation MUD #7
Fort Bend County MUD #129	Sienna Plantation MUD #10
Fort Bend County MUD #149	Sienna Plantation MUD #12
Harris County MUD #122	Sienna Plantation MUD #13
Harris County WC&ID – Fondren Road	Southwest Harris County MUD #1
Meadowcreek MUD	Thunderbird Utility District
Palmer Plantation MUD #1	

1.4 Infrastructure Overview

City residents are supplied water by one of the many individual utility districts operating within the area. Historically, the source of raw water for these utility districts has been groundwater, though some utility districts also have the capability to purchase treated surface water from other utilities. In 2008, the Fort Bend County Subsidence District (FBCSD) issued a requirement to reduce groundwater usage in the City by a minimum of 30% by 2013 and a minimum of 60% by 2025.

To meet the FBCSD groundwater reduction goal for 2013, the City and a group of the utility districts joined together in a plan to construct the first phase of a new RWTP and begin the process of converting water supplies from groundwater to surface water. This consolidation plan will first convert the utility districts in the southern portion of the City and its ETJ to surface water by sending treated surface water to several utility district GWTPs, which will then be distributed through the City's system using the existing distribution system components.

The source of surface water for this initial phase of surface water conversion will be 15 million gallons per day (MGD) of raw water purchased from the Gulf Coast Water Authority (GCWA), which diverts water from the Brazos River. The RWTP is intended to be expanded in the future, as needed, to convert additional utility district entities within the City to surface water use.

The proposed future expansions of the RWTP and the increasing requirements for reduction of groundwater usage will require additional sources of surface water. The City has identified several possible options for developing necessary additional surface water sources with the City of Houston and the Brazos River Authority (BRA), and continues to explore options to develop other potential surface water sources. Information on potential water supply sources was taken from the City Joint Groundwater Reduction Plan (Joint GRP). An abbreviated copy of this Joint GRP without the associated contracts and agreements is contained in Appendix A of this Study.

City residents are also supplied wastewater service by individual utility districts within the area. Many of the existing WWTPs within the City only serve a single utility district; however, there are a few regional WWTPs within the City. The current existing conditions of the wastewater treatment systems adequately serve the area, but as the City grows, the ultimate goal is to focus on regionalization of wastewater treatment whenever feasible.

1.5 Current and Projected Connections

During the initial development of this Study, the current number of connections for each utility district was taken from the 2010 connection projections in the Joint GRP which

was prepared in 2008. When current connection counts were provided by the utility districts, the up-to-date connection totals were used in place of the Joint GRP projections. However, the assumptions of build-out timing from the Joint GRP are used and extended to the year 2040. Table 1-3 shows the projected connection counts for each district in five-year increments.

Table 1-3
Current and Projected Connection Counts

District	Current Connections (2010)	2015	2020	2025	2030	2035	2040	Build Out Connection Count
Sienna Plantation Management District	69	84	150	225	300	375	450	453
Sienna Plantation MUD #1	18	18	19	20	21	23	25	25
Sienna Plantation MUD #2	1,784	1,784	1,784	1,784	1,784	1,784	1,784	1,784
Sienna Plantation MUD #3	2,455	2,455	2,455	2,455	2,455	2,455	2,455	2,455
Sienna Plantation MUD #4, 5, 6, 7	0	600	2,600	5,600	8,600	10,000	10,000	10,000
Sienna Plantation MUD #10	1,376	1,796	1,996	2,196	2,396	2,433	2,433	2,433
Sienna Plantation MUD #12	151	235	547	1,087	1,423	1,439	1,439	1,439
Sienna Plantation MUD #13	0	0	165	440	715	990	1,194	1,194
Fort Bend County MUD #129	1,015	1,463	1,550	1,550	1,550	1,550	1,550	1,550
Fort Bend County MUD #149	125	970	1,700	1,700	1,700	1,700	1,700	1,700
Blue Ridge West MUD	2,494	2,503	2,507	2,507	2,507	2,507	2,507	2,509
First Colony MUD #9	2,677	2,727	2,777	2,827	2,877	2,927	2,977	3,300
Fort Bend County MUD #115	548	567	580	580	580	580	580	580
Fort Bend County MUD #26	1,484	1,484	1,490	1,500	1,510	1,520	1,530	2,145
Fort Bend County MUD #42	1,303	1,408	1,507	1,507	1,507	1,507	1,507	1,507
Fort Bend County MUD #46	771	960	1,035	1,035	1,035	1,035	1,035	1,073
Fort Bend County MUD #47	533	825	942	942	942	942	942	1,000
Fort Bend County MUD #48	634	641	716	837	957	1,077	1,197	1,370
Fort Bend County MUD #49	340	356	364	370	375	380	385	396
Meadowcreek MUD	888	933	943	953	963	973	983	985
Palmer Plantation MUD #1	599	680	702	707	712	717	722	798
Palmer Plantation MUD #2	813	872	894	904	914	924	934	1,000
Quail Valley Utility District	4,423	4,423	4,431	4,514	4,514	4,514	4,514	4,514
Thunderbird Utility District	1,916	1,916	1,922	1,932	1,942	1,952	1,962	1,986
Mustang Bayou USA	649	1,340	2,050	2,760	3,044	3,044	3,044	3,178
Mustang Bayou USA Phase 2	0	0	1,365	3,640	5,915	8,190	9,095	9,095
Harris County MUD #122	410	480	550	622	693	714	714	714
Southwest Harris County MUD #1	527	684	842	1,000	1,157	1,315	1,315	1,315
Harris County WC&ID - Fondren Road	1,017	1,128	1,252	1,409	1,534	1,566	1,566	1,566
Total Estimated Connections	**29,019**	**33,332**	**39,835**	**47,603**	**54,622**	**59,133**	**60,539**	**62,064**

1.6 Current and Projected Population

The Joint GRP assumption was "3.04 persons per connection (2000 Census total of 52,913 divided by a total of 17,481 housing units)". Many of the utility districts are using 3.00 persons per connection which is approximately the same estimate for their purposes. The 2010 Census data was recently released and the new totals for the City are 81,079 persons and 26,433 occupied housing units (including totals for both the Missouri City and Sienna Plantation areas), resulting in an updated population density of 3.07 persons per connection. For this Study, the current 3.07 rate was multiplied by the actual number of connections to determine the current population totals for each district. In order to verify that these assumptions are correct the population numbers were compared to the 2010 Census totals and the TWDB regional planning estimates. There were some notable differences between these estimates and the Census total which are discussed below.

- The totals included in the Joint GRP included Fort Bend County MUD #23 and #24. These MUDs were not included in this Study and therefore were removed from this estimate.

- Harris County MUD #122, Harris County WC&ID-Fondren Road, and Southwest Harris County MUD #1 were not included in the Joint GRP.

- There is a large section of Fort Bend County WC&ID #2 within the incorporated limits of the City. This district is not part of the Study and, therefore, was not accounted for in this estimate. It is assumed that the population within this area is accounted for in the TWDB estimates and in the Census count.

- The TWBD Region H estimates identify separate totals for First Colony MUD #9, Missouri City (Fort Bend County), Missouri City (Harris County), and Sienna Plantation MUD #2. These individual totals were summed to reach the numbers listed in Table 1-5. There were no other areas except for Sienna Plantation MUD #2 identified within the ETJ. Therefore it is not clear whether these numbers cover the entire ETJ included in this Study.

- The 2010 Census data used was for the City - listed as "Missouri City (City)" and the Sienna Plantation was listed with the qualifier "Census Designated Place (CDP)". Because the Census tract boundaries do not match directly with the Study area limits, there is likely to be additional population accounted for in these totals, which is not included in this Study.

Table 1-4
Current and Projected Population Counts

District	Current Population (2010)	2015	2020	2025	2030	2035	2040	Build Out Population Estimate
Sienna Plantation Management District	212	258	461	691	921	1,151	1,382	1,391
Sienna Plantation MUD #1	55	55	58	61	64	71	77	77
Sienna Plantation MUD #2	5,477	5,477	5,477	5,477	5,477	5,477	5,477	5,477
Sienna Plantation MUD #3	7,537	7,537	7,537	7,537	7,537	7,537	7,537	7,537
Sienna Plantation MUD #4, 5, 6, 7	0	1,842	7,982	17,192	26,402	30,700	30,700	30,700
Sienna Plantation MUD #10	4,224	5,514	6,128	6,742	7,356	7,469	7,469	7,469
Sienna Plantation MUD #12	464	721	1,679	3,337	4,369	4,418	4,418	4,418
Sienna Plantaion MUD #13	0	0	507	1,351	2,195	3,039	3,666	3,666
Fort Bend County MUD #129	3,116	4,491	4,759	4,759	4,759	4,759	4,759	4,759
Fort Bend County MUD #149	384	2,978	5,219	5,219	5,219	5,219	5,219	5,219
Blue Ridge West MUD	7,657	7,684	7,696	7,696	7,696	7,696	7,696	7,703
First Colony MUD #9	8,218	8,372	8,525	8,679	8,832	8,986	9,139	10,131
Fort Bend County MUD #115	1,682	1,741	1,781	1,781	1,781	1,781	1,781	1,781
Fort Bend County MUD #26	4,556	4,556	4,574	4,605	4,636	4,666	4,697	6,585
Fort Bend County MUD #42	4,000	4,323	4,626	4,626	4,626	4,626	4,626	4,626
Fort Bend County MUD #46	2,367	2,947	3,177	3,177	3,177	3,177	3,177	3,294
Fort Bend County MUD #47	1,636	2,533	2,892	2,892	2,892	2,892	2,892	3,070
Fort Bend County MUD #48	1,946	1,968	2,198	2,570	2,938	3,306	3,675	4,206
Fort Bend County MUD #49	1,044	1,093	1,117	1,136	1,151	1,167	1,182	1,216
Meadowcreek MUD	2,726	2,864	2,895	2,926	2,956	2,987	3,018	3,024
Palmer Plantation MUD #1	1,839	2,088	2,155	2,170	2,186	2,201	2,217	2,450
Palmer Plantation MUD #2	2,496	2,677	2,745	2,775	2,806	2,837	2,867	3,070
Quail Valley Utility District	13,579	13,579	13,603	13,858	13,858	13,858	13,858	13,858
Thunderbird Utility District	5,882	5,882	5,901	5,931	5,962	5,993	6,023	6,097
Mustang Bayou USA	1,992	4,114	6,294	8,473	9,345	9,345	9,345	9,756
Mustang Bayou USA Phase 2	0	0	4,191	11,175	18,159	25,143	27,922	27,922
Harris County MUD #122	1,259	1,474	1,689	1,910	2,128	2,192	2,192	2,192
Southwest Harris County MUD #1	1,618	2,100	2,585	3,070	3,552	4,037	4,037	4,037
Harris County WC&ID - Fondren Road	3,122	3,463	3,844	4,326	4,709	4,808	4,808	4,808
Total Estimated Population	**89,088**	**102,329**	**122,293**	**146,141**	**167,690**	**181,538**	**185,855**	**190,536**

The comparisons between population numbers from the various sources of population data are presented in Table 1-5. As shown in this table the population estimates only vary slightly from each other and the Census total; therefore, given the reasons for the differences as noted previously, the population numbers were assumed to be accurate.

Table 1-5
Comparison of Population Estimates

Population Source	2010	2015	2020	2025	2030	2035	2040
Joint GRP Population Estimate	94,100	110,796	127,887	147,732	166,282	N/A	N/A
TWDB Population Estimate[1]	97,432	N/A	119,825	N/A	140,479	N/A	161,405
Study Population Estimates	89,088	102,329	122,293	146,141	167,690	181,538	185,855
2010 Census Count	81,079						

Notes:
1 - TWDB Population Estimates were taken from the 2011 Regional Water Plan for Region H. Available online at http://www.twdb.state.tx.us/wrpi/rwp/rwp.asp

1.7 Current and Projected Water Demand

A key step in this Study is the development of population/water demands projections for each entity in the Study area. Data on existing water usage was collected from several sources to form the basis of the projections for future demand. Data from the Joint GRP was used, along with additional data acquired from the utility districts not participating in the Joint GRP, to prepare the existing and projected water demands within the Study area.

In using the same process as the Joint GRP, the average water usage per connection per month was multiplied by the total number of connections. The monthly water usage for all districts was summed and multiplied by 12 months to obtain the annual water usage. The data for the average water usage per connection was obtained from the Joint GRP, or directly from the utility districts, if provided.

Table 1-6
Current and Projected Monthly Water Demand

District	Average Usage Per Connection Per Month (Gallons)	Current Water Demand (2010)	2015	2020	2025	2030	2035	2040	Build Out Water Demand
Sienna Plantation Management District	64,350	4,440,150	5,405,400	9,652,500	14,478,750	19,305,000	24,131,250	28,957,500	29,150,550
Sienna Plantation MUD #1	81,425	1,465,650	1,465,650	1,547,075	1,628,500	1,709,925	1,872,775	2,035,625	2,035,625
Sienna Plantation MUD #2	14,618	26,078,512	26,078,512	26,078,512	26,078,512	26,078,512	26,078,512	26,078,512	26,078,512
Sienna Plantation MUD #3	14,618	35,887,190	35,887,190	35,887,190	35,887,190	35,887,190	35,887,190	35,887,190	35,887,190
Sienna Plantation MUD #4, 5, 6, 7	14,618	0	8,770,800	38,006,800	81,860,800	125,714,800	146,180,000	146,180,000	146,180,000
Sienna Plantation MUD #10	14,618	20,114,368	26,253,928	29,177,528	32,101,128	35,024,728	35,565,594	35,565,594	35,565,594
Sienna Plantation MUD #12	14,618	2,207,318	3,435,230	7,996,046	15,889,766	20,801,414	21,035,302	21,035,302	21,035,302
Sienna Plantation MUD #13	14,618	0	0	2,411,970	6,431,920	10,451,870	14,471,820	17,453,892	17,453,892
Fort County Bend MUD #129	22,008	22,338,120	32,197,704	34,112,400	34,112,400	34,112,400	34,112,400	34,112,400	34,112,400
Fort Bend County MUD #149	11,873	1,484,125	11,516,810	20,184,100	20,184,100	20,184,100	20,184,100	20,184,100	20,184,100
Blue Ridge West MUD	11,538	28,775,772	28,879,614	28,925,766	28,925,766	28,925,766	28,925,766	28,925,766	28,948,842
First Colony MUD #9	12,372	33,119,844	33,738,444	34,357,044	34,975,644	35,594,244	36,212,844	36,831,444	40,827,600
Fort Bend County MUD #115	22,008	12,060,384	12,478,536	12,764,640	12,764,640	12,764,640	12,764,640	12,764,640	12,764,640
Fort Bend County MUD #26	8,393	12,455,212	12,455,212	12,505,570	12,589,500	12,673,430	12,757,360	12,841,290	18,002,985
Fort Bend County MUD #42	12,825	16,710,975	18,057,600	19,327,275	19,327,275	19,327,275	19,327,275	19,327,275	19,327,275
Fort Bend County MUD #46	16,620	12,814,020	15,955,200	17,201,700	17,201,700	17,201,700	17,201,700	17,201,700	17,833,260
Fort Bend County MUD #47	12,783	6,813,339	10,545,975	12,041,586	12,041,586	12,041,586	12,041,586	12,041,586	12,783,000
Fort Bend County MUD #48	12,783	8,104,422	8,193,903	9,152,628	10,699,371	12,233,331	13,767,291	15,301,251	17,512,710

District	Average Usage Per Connection Per Month (Gallons)	Current Water Demand (2010)	2015	2020	2025	2030	2035	2040	Build Out Water Demand
Fort Bend County MUD #49	26,448	8,992,320	9,415,488	9,627,072	9,785,760	9,918,000	10,050,240	10,182,480	10,473,408
Meadowcreek MUD	8,762	7,780,656	8,174,946	8,262,566	8,350,186	8,437,806	8,525,426	8,613,046	8,630,570
Palmer Plantation MUD #1	26,448	15,842,352	17,984,640	18,566,496	18,698,736	18,830,976	18,963,216	19,095,456	21,105,504
Palmer Plantation MUD #2	14,003	11,384,439	12,210,616	12,518,682	12,658,712	12,798,742	12,938,772	13,078,802	14,003,000
Quail Valley Utility District	10,940	48,387,620	48,387,620	48,475,140	49,383,160	49,383,160	49,383,160	49,383,160	49,383,160
Thunderbird Utility District	10,344	19,819,104	19,819,104	19,881,168	19,984,608	20,088,048	20,191,488	20,294,928	20,543,184
Mustang Bayou USA	11,873	7,705,577	15,909,820	24,339,650	32,769,480	36,141,412	36,141,412	36,141,412	37,732,394
Mustang Bayou USA Phase 2	11,873	0	0	16,206,645	43,217,720	70,228,795	97,239,870	107,984,935	107,984,935
Harris County MUD #122	8,190	3,357,900	3,931,200	4,504,500	5,094,180	5,675,670	5,847,660	5,847,660	5,847,660
Southwest Harris County MUD #1	5,310	2,798,370	3,632,040	4,471,020	5,310,000	6,143,670	6,982,650	6,982,650	6,982,650
Harris County WC&ID - Fondren Road	6,750	6,864,750	7,614,000	8,451,000	9,510,750	10,354,500	10,570,500	10,570,500	10,570,500
Total Monthly Water Demand (Gallons)		**377,802,489**	**438,395,182**	**526,634,269**	**631,941,840**	**728,032,690**	**789,351,799**	**810,900,096**	**828,940,442**
Total Water Demand (MGD)		**12.4**	**14.4**	**17.3**	**20.8**	**23.9**	**26.0**	**26.7**	**27.3**

1.8 Current and Projected Wastewater Production

Wastewater production was estimated as a percentage of the average water demand and was assumed to remain at a constant rate through the Study period. To determine the percentage of wastewater returned to the collection system, the average daily flow of each WWTP was collected from the operators. This average daily flow was divided by the total number of connections served by each WWTP and converted to a monthly usage per connection. This was divided by the average water usage per connection previously used to determine the water demands. The wastewater demand was determined as a percentage of the water demand. These results are summarized in Table 1-7.

Table 1-7
Wastewater Demand as a Percentage of Water Demand

WWTP	Average Daily Wastewater Flow (MGD)	Current Connections Served	Wastewater Average Usage per Connection (GPD)	Wastewater Average Usage per Connection (Gallons/Month)	Water Average Usage per Connection (Gallons/Month)	Percentage of Wastewater Returned to Sewer System
Blue Ridge West MUD WWTP	0.725	2,494	291	8,721	11,538	76%
Fort Bend County MUD #26 WWTP	0.300	1,484	202	6,065	8,393	72%
Harris County MUD #122 WWTP	0.115	410	280	8,415	8,190	103%
Harris County WC&ID - Fondren Rd. WWTP	0.187	1,017	184	5,516	6,750	82%
Mustang Bayou Regional WWTP	0.325	1,816	179	5,369	11,873	45%
Palmer Plantation WWTP	0.325	1,752	186	5,565	22,300	25%
Quail Valley UD WWTP	1.500	7,227	208	6,227	10,015	62%
Sienna North WWTP	0.400	1,445	277	8,304	14,618	57%
Sienna South WWTP	1.100	4,408	250	7,486	14,618	51%
Steep Bank/Flat Bank Regional WWTP	1.500	6,439	233	6,989	16,285	43%
Southwest Harris County MUD #1 WWTP	0.100	527	190	5,693	5,310	107%
Total		**29,019**				
Average			**225**	**6,759**	**11,808**	**57%**

The average wastewater flow is approximately 60 percent of the water demand. This percentage was multiplied by the current and projected water demands from Table 1-6 to reach the current and projected wastewater demands. These wastewater demands are presented in Table 1-8.

Table 1-8
Current and Projected Monthly Wastewater Demand

District	% of Water Returned to Sewer Collection System	Current Wastewater Demand (2010)	2015	2020	2025	2030	2035	2040	Build Out Wastewater Demand
Sienna Plantation Management District	60	2,664,090	3,243,240	5,791,500	8,687,250	11,583,000	14,478,750	17,374,500	17,490,330
Sienna Plantation MUD #1	60	879,390	879,390	928,245	977,100	1,025,955	1,123,665	1,221,375	1,221,375
Sienna Plantation MUD #2	60	15,647,107	15,647,107	15,647,107	15,647,107	15,647,107	15,647,107	15,647,107	15,647,107
Sienna Plantation MUD #3	60	21,532,314	21,532,314	21,532,314	21,532,314	21,532,314	21,532,314	21,532,314	21,532,314
Sienna Plantation MUD #4, 5, 6, 7	60	0	5,262,480	22,804,080	49,116,480	75,428,880	87,708,000	87,708,000	87,708,000
Sienna Plantation MUD #10	60	12,068,621	15,752,357	17,506,517	19,260,677	21,014,837	21,339,356	21,339,356	21,339,356
Sienna Plantation MUD #12	60	1,324,391	2,061,138	4,797,628	9,533,860	12,480,848	12,621,181	12,621,181	12,621,181
Sienna Plantation MUD #13	60	0	0	1,447,182	3,859,152	6,271,122	8,683,092	10,472,335	10,472,335
Fort Bend County MUD #129	60	13,402,872	19,318,622	20,467,440	20,467,440	20,467,440	20,467,440	20,467,440	20,467,440
Fort Bend County MUD #149	60	890,475	6,910,086	12,110,460	12,110,460	12,110,460	12,110,460	12,110,460	12,110,460
Blue Ridge West MUD	60	17,265,463	17,327,768	17,355,460	17,355,460	17,355,460	17,355,460	17,355,460	17,369,305
First Colony MUD #9	60	19,871,906	20,243,066	20,614,226	20,985,386	21,356,546	21,727,706	22,098,866	24,496,560
Fort Bend County MUD #115	60	7,236,230	7,487,122	7,658,784	7,658,784	7,658,784	7,658,784	7,658,784	7,658,784
Fort Bend County MUD #26	60	7,473,127	7,473,127	7,503,342	7,553,700	7,604,058	7,654,416	7,704,774	10,801,791
Fort Bend County MUD #42	60	10,026,585	10,834,560	11,596,365	11,596,365	11,596,365	11,596,365	11,596,365	11,596,365
Fort Bend County MUD #46	60	7,688,412	9,573,120	10,321,020	10,321,020	10,321,020	10,321,020	10,321,020	10,699,956
Fort Bend County MUD #47	60	4,088,003	6,327,585	7,224,952	7,224,952	7,224,952	7,224,952	7,224,952	7,669,800
Fort Bend County MUD #48	60	4,862,653	4,916,342	5,491,577	6,419,623	7,339,999	8,260,375	9,180,751	10,507,626
Fort Bend County MUD #49	60	5,395,392	5,649,293	5,776,243	5,871,456	5,950,800	6,030,144	6,109,488	6,284,045
Meadowcreek MUD	60	4,668,394	4,904,968	4,957,540	5,010,112	5,062,684	5,115,256	5,167,828	5,178,342
Palmer Plantation MUD #1	60	9,505,411	10,790,784	11,139,898	11,219,242	11,298,586	11,377,930	11,457,274	12,663,302
Palmer Plantation MUD #2	60	6,830,663	7,326,370	7,511,209	7,595,227	7,679,245	7,763,263	7,847,281	8,401,800
Quail Valley Utility District	60	29,032,572	29,032,572	29,085,084	29,629,896	29,629,896	29,629,896	29,629,896	29,629,896
Thunderbird Utility District	60	11,891,462	11,891,462	11,928,701	11,990,765	12,052,829	12,114,893	12,176,957	12,325,910
Mustang Bayou USA	60	4,623,346	9,545,892	14,603,790	19,661,688	21,684,847	21,684,847	21,684,847	22,639,436
Mustang Bayou USA Phase 2	60	0	0	9,723,987	25,930,632	42,137,277	58,343,922	64,790,961	64,790,961
Harris County MUD #122	60	2,014,740	2,358,720	2,702,700	3,056,508	3,405,402	3,508,596	3,508,596	3,508,596
Southwest Harris County MUD #1	60	1,679,022	2,179,224	2,682,612	3,186,000	3,686,202	4,189,590	4,189,590	4,189,590
Harris County WC&ID - Fondren Road	60	4,118,850	4,568,400	5,070,600	5,706,450	6,212,700	6,342,300	6,342,300	6,342,300
Total Monthly Wastewater Demand (Gallons)		**226,681,493**	**263,037,109**	**315,980,561**	**379,165,104**	**436,819,614**	**473,611,079**	**486,540,058**	**497,364,265**
Total Wastewater Demand (MGD)		**7.5**	**8.6**	**10.4**	**12.5**	**14.4**	**15.6**	**16.0**	**16.4**

1.9 Existing Water Facilities

The existing water production and distribution facilities vary throughout the Study area. This is largely because each entity was created and developed at different times, with different growth rates, and with different design criteria. The various ages, technologies and design methods can also be attributed to these reasons. The data for the existing infrastructure described herein, was developed from information provided by each utility district, the City's GIS database and from the Texas Commission on Environmental Quality (TCEQ).

However, more detailed information on the age, condition and remaining useful life of the individual water plants and various distribution system components was not readily available during the development of this Study. The City is in the process of updating their GIS database with specific data on the age and capacity of all the existing components and it will be available in the future for more detailed master planning and design efforts. Data that was collected and considered on the existing water wells, WTPs and the various utility district distribution systems is presented in this section.

1.9.1 Existing Water Wells

The majority of the water supplied to the utility districts within the Study area comes from groundwater. Currently only a few of the northernmost utility districts are receiving surface water from the City of Houston, which include Harris County WC&ID - Fondren Road, Southwest Harris County MUD #1 and Harris County MUD #122. Almost all of the districts operate their own wells as a means to supply this groundwater. There are a total of 28 existing public wells within the Study area. Data on the wells was obtained from the Joint GRP and the utility districts and is presented in Table 1-9. A map of these wells is contained in Exhibit 1-3. The wells located in Fort Bend County are identified by the FBSD well number and the wells located in Harris County are identified by the TWDB state well number.

Table 1-9 Existing Water Wells							
	District	**Well #**	**Location**	**Drill Date**	**Depth**	**Tested GPM**	**Rated GPM**
1	Sienna Plantation MUD #1	812	Murray Ct.	N/A	N/A	N/A	N/A
2	"	958	McMahon Way	N/A	N/A	N/A	N/A
3	"	1194	Scanlan Trace	7/20/2005	1930	1200	1200
4	"	1078	Mckever Rd.	1/15/2004	1311	1566	1500
5	"	1258	7738 ½ Fallen Leaf	7/23/2008	1930	1520	1500
6	Blue Ridge West MUD	105	1415 FM 2234	1/10/1975	1262	1461	1400
7	"	106	903 Manor Glen	1980	772	542	500
8	First Colony MUD #9	279	Ringrose Dr.	5/15/1984	1205	2170	2100
9	Fort Bend MUD #115	1025	20425 University Blvd.	9/12/2001	923	1510	1905
10	Fort Bend MUD #149	1335	5603 1/2 Rising Walk Lane	11/18/2009	1140	0	1711
11	Fort Bend MUD #26	1228	1812 Fresh Meadows	1/9/2006	1150	1694	1600
12	Fort Bend MUD #42	234	1819 1/2 Lake Winds	10/23/1984	1092	1595	1700
13	Fort Bend MUD #46	170	4835 Thompson Ferry Rd.	5/17/1985	1065	1000	1000
14	Fort Bend MUD #47 & #48	149	Senior Rd.	10/24/1983	600	1000	1000
15	Meadowcreek MUD	944	3100 N. Park	9/11/2000	1106	815	800
16	Palmer Plantation MUD #1	264	4335 Crown Valley	5/13/1983	1225	1168	1000
17	Palmer Plantation MUD #2	867	1603 Lake Olympia Pkwy	1983	1225	1200	1200
18	Quail Valley Utility District	257	2935 Blue Lakes Ln.	1977	1320	1300	2100
19	"	258	2935 Blue Lakes Ln.	1969	1200	0	500
20	"	259	2143 Cartwright	1972	1077	1353	1400
21	"	260	1930 Rothwell	1978	1325	2252	2300
22	Thunderbird Utility District	261	6605 Highway 6	1972	1074	1170	1200
23	"	262	3003 Glenn Lakes Dr.	1976	1157	849	850
24	"	263	1455 Turtle Creek	1975	1314	674	800
25	Southwest Harris County MUD #1	6520912	7843 LaRochelle	5/13/1980	772	520	500
26	Harris County WC&ID - Fondren Road	6520909	11802 McClain	11/12/1970	1167	1234	1260
27	"	6520915	13455 Beltway 8	3/13/1987	980	855	850
28	Missouri City	1203	Watts Plantation Dr.	9/1/2005	1384	2163	2200

1.9.2 Existing Water Plants

There are currently 24 WTPs operating within the Study area. In addition to these plants, the City is currently constructing a RWTP located in Sienna Plantation. This plant will begin operations around the first of the year 2012. As the City works toward regionalizing water treatment in the southern part of the City as per the recommendations from the Joint GRP, some of the existing utility district GWTPs will convert from groundwater to surface water usage. It is intended that the converting utilities will still maintain operation of their respective GWTPs. However, instead of pumping and treating groundwater, the converting GWTPs will now receive treated surface water from the City's new RWTP, though the remaining storage and pumping efforts at each WTP will remain the same. Therefore, while the southern utility district WTPs will no longer operate on groundwater continuously, the administration and operation of these WTPs will still remain the responsibility of the existing utility districts. A detailed plan for the RWTP is presented in Section 2.1.1. Exhibit 1-4 shows the location of the existing WTPs within the Study area.

Table 1-10
Existing WTPs

Number	Name	Location	Current Permitted Capacity
1	Blue Ridge West MUD WTP #1	1415 FM 2234	3.168 MGD
2	Blue Ridge West MUD WTP #2	903 Manor Glen	
3	First Colony MUD #9 WTP	Ringrose Dr.	3.024 MGD
4	Fort Bend County MUD #26 WTP	1812 Fresh Meadows	2.728 MGD
5	Fort Bend County MUD #42 WTP	1819 1/2 Lake Winds	2.304 MGD
6	Fort Bend County MUD #46 WTP	4835 Thompson Ferry Rd.	1.440 MGD
7	Fort Bend County MUD #115 WTP	20425 Universtiy Blvd.	2.174 MGD
8	Fort Bend County MUD #149 WTP	Maverick Bend Ln.	0.648 MGD
9	Harris County WC&ID - Fondren Road WTP #1	11802 1/2 McClain Blvd.	3.760 MGD
10	Harris County WC&ID - Fondren Road WTP #2	9380 S. Sam Houston Pkwy. W.	
11	Meadowcreek MUD WTP	3100 N. Park	1.158 MGD
12	Mustang Bayou WTP	Watts Plantation	3.159 MGD
13	Palmer Plantation MUD #1 WTP	4335 Crown Valley	2.138 MGD
14	Palmer Plantation MUD #2 WTP	1603 Lake Olympia Pkwy.	1.728 MGD
15	Quail Valley Utility District WTP #1	2935 Blue Lakes Ln.	8.524 MGD
16	Quail Valley Utility District WTP #2	2143 Cartwright	
17	Quail Valley Utility District WTP #3	1930 Rothwell	

Number	Name	Location	Current Permitted Capacity
18	Sienna WTP #1	Murray Ct.	7.380 MGD
19	Sienna WTP #2	Mckeever	
20	Southwest Harris County MUD #1 WTP	7843 Larochelle Cr.	0.748 MGD
21	Thunderbird Utility District (System 1) WTP #1	6605 Highway 6	3.060 MGD
22	Thunderbird Utility District (System 1) WTP #2	3003 Glenn Lakes Dr.	
23	Thunderbird Utility District (System 2) WTP #1	1455 Turtle Creek	0.959 MGD
24	Vicksburg Joint Powers WTP	2775 Senior Rd.	1.440 MGD
Total Permitted Capacity = 49.540 MGD			

1.9.3 Existing Water Distribution System

The existing water distribution system throughout the Study area consists of approximately 410 miles of water transmission and distribution piping of various sizes, types and ages. Each utility district is responsible for construction and maintenance of its individual distribution system. Age, condition, type and sizing of water lines were evaluated in this Study only to the extent of determining necessary improvements when considering potential consolidation alternatives. Further evaluation of the individual systems would require the development of a City-wide system model, which was not included in the scope of this Study.

In addition to the normal distribution piping for each utility district water system, interconnections have been constructed between many of the existing distribution systems. These interconnections provide the capability to transfer treated water from one utility district to another. An interconnection to another utility district could be utilized as the main source of treated water for a district, or it could be utilized only in case of emergency. See Exhibit 1-4 for a map of the existing distribution lines and Exhibit 1-5 for the locations of existing system interconnections and major transmission lines throughout the Study area. Each interconnection on Exhibit 1-5 has been numbered and information about each interconnection can be found in Table 1-11.

Storage was also evaluated throughout the City's water system with regard to other potential improvements in efficiency and/or safety. The TCEQ has specific requirements with regard to minimum provided ground storage and elevated or pressure storage for water systems in Texas. TCEQ has a minimum requirement of 200 gallons of total storage per connection, with half of the storage capacity (100 gallons per connection) being provided either as elevated storage (from an elevated storage tank) or as pressure storage (from a hydropneumatic tank).

Two issues were observed in the review of water storage in the existing utility district WTPs located throughout the Study area. The first issue is that insufficient ground storage was available at several of the WTPs though construction and active operation of interconnections with nearby systems can alleviate the demand for individual ground storage in many cases.

A second issue is the observation that almost all of the existing WTPs in the Study area utilize pressure storage via hydropneumatic tanks, which tend to be energy-intensive to operate, whereas ESTs require very little energy to operate. Currently, only the Blue Ridge West MUD and Quail Valley UD own and operate EST tanks. Further discussion of ground and pressure/elevated storage is included in Section 2.

Table 1-11
Existing Water System Interconnects

	District		District	Metered Connection (Y or N)	Valved Connection (Y or N)	Valve Position (Open or Closed)	Size	Water Type
1	Mustang Bayou USA	to	Fort Bend County MUD #47 & #48	Y	Y	Closed	12"	GW
2	Mustang Bayou USA	to	Sienna Plantation MUD #1	Y	Y	Closed	24"	GW
3	Fort Bend County MUD #129	to	Fort Bend County MUD #149	N	Y	Open	12"	GW
4	Fort Bend County MUD #129	to	Fort Bend County MUD #149	N	Y	Open	12"	GW
5	Fort Bend County MUD #49	to	Palmer Plantation MUD #1 & #2	N	N	Open	12"	GW
6	Fort Bend County MUD #129	to	Fort Bend County MUD #115	N	Y	Open	12"	GW
7	Fort Bend County MUD #46	to	Palmer Plantation MUD #1 & #2	N	Y	Closed	8"	GW
8	Palmer Plantation MUD #1 & #2	to	Thunderbird Utility District	N	Y	Closed	10"	GW
9	Palmer Plantation MUD #1 & #2	to	Thunderbird Utility District	N	Y	Closed	12"	GW
10	Quail Valley Utility District	to	Thunderbird Utility District #1	N	Y	Closed	12"	GW
11	Quail Valley Utility District	to	Palmer Plantation MUD #1 & #2	N	Y	Closed	12"	GW
12	Palmer Plantation MUD #1 & #2	to	Quail Valley Utility District	N	Y	Closed	8"	GW
13	Palmer Plantation MUD #1 & #2	to	Quail Valley Utility District	N	Y	Closed	12"	GW
14	Quail Valley Utility District	to	Thunderbird Utility District #2	N	Y	Closed	8"	GW
15	Quail Valley Utility District	to	Thunderbird Utility District #2	N	Y	Closed	8"	GW
16	Quail Valley Utility District	to	Thunderbird Utility District #2	N	Y	Closed	6"	GW
17	Quail Valley Utility District	to	Thunderbird Utility District #1	N	Y	Closed	8"	GW
18	Quail Valley Utility District	to	Thunderbird Utility District #1	N	Y	Closed	8"	GW
19	Quail Valley Utility District	to	Thunderbird Utility District #1	N	Y	Closed	6"	GW
20	Thunderbird Utility District	to	First Colony MUD #9	N	Y	Open	12"	GW
21	Fort Bend County MUD #46	to	Fort Bend County MUD #115	N	Y	Open	12"	GW

	District		District	Metered Connection (Y or N)	Valved Connection (Y or N)	Valve Position (Open or Closed)	Size	Water Type
22	Fort Bend County MUD #115	to	First Colony MUD #9	N	Y	Open	12"	GW
23	First Colony MUD #9	to	City of Sugar Land	N	Y	Open	12"	GW
24	Quail Valley Utility District	to	Fort Bend WC&ID No. 2	N	Y	Closed	8"	SW
25	Fort Bend County MUD #42	to	First Colony MUD #9	N	Y	Open	12"	GW
26	Meadowcreek MUD	to	Quail Valley Utility District	N	Y	Closed	8"	GW
27	Meadowcreek MUD	to	Quail Valley Utility District	N	Y	Closed	12"	GW
28	Meadowcreek MUD	to	Quail Valley Utility District	N	Y	Closed	12"	GW
29	Meadowcreek MUD	to	Fort Bend County MUD #26	N	Y	Closed	8"	GW
30	Fort Bend County MUD #26	to	Thunderbird Utility District	N	Y	Closed	8"	GW
31	Fort Bend County MUD #26	to	Blue Ridge West MUD	Y	Y	Closed	12"	GW
32	Blue Ridge West MUD	to	Fort Bend County MUD #26	Y	Y	Closed	12"	GW
33	Fort Bend County MUD #42	to	Quail Valley Utility District	N	Y	Closed	12"	GW
34	Fort Bend County MUD #42	to	Quail Valley Utility District	N	Y	Closed	8"	GW
35	Fort Bend County MUD #42	to	Quail Valley Utility District	N	Y	Closed	12"	GW
36	Fort Bend County MUD #42	to	First Colony MUD #9	N	Y	Open	12"	GW
37	Blue Ridge West MUD	to	Fort Bend County WC&ID No. 2	Y	Y	Closed	10"	SW
38	Harris County MUD #122	to	Fort Bend County WC&ID No. 2	Y	Y	Open	12"	SW
39	Harris County MUD #122	to	City of Houston	Y	Y	Closed	12"	SW
40	Southwest Harris County MUD #1	to	Harris County WC&ID - Fondren Road	N	Y	Closed	6"	GW
41	Southwest Harris County MUD #1	to	City of Houston	Y	Y	Open	12"	SW
42	Harris County WC&ID - Fondren Road	to	City of Houston	Y	Y	Open	12"	SW
43	Southwest Harris County MUD #1	to	Harris County WC&ID - Fondren Road	Y	Y	Closed	8"	GW

As more systems change from groundwater sources to surface water sources, the interconnects between the systems should be evaluated. Fort Bend County WC&ID #2 has recently converted from groundwater sources to surface water sources, and the City of Sugar Land is in the process of converting to surface water sources. The disinfection residual in the distribution system for systems using surface water sources is generally chloramines. Many of the systems that utilize groundwater sources use free chlorine in their distribution system. An interconnection between a distribution system utilizing free chlorine with one utilizing chloramines is not advisable since the disinfection residual in the distribution system can no longer be tracked correctly once the chemicals are mixed.

Therefore, interconnects to either Fort Bend County WC&ID #2 or City of Sugar Land would be advisable only with systems that utilize chloramines in their distribution system. Section 2 will include further discussion on the potential disinfection conversion from free chlorine to chloramines at some of the utility districts within the Study area, including the associated costs for conversion.

1.10 Existing Wastewater Facilities

The wastewater infrastructure is similar to the water infrastructure in that each utility district constructs and maintains its own wastewater collection system. However, not all utility districts have an independent WWTP. Some utility districts share capacity in regional WWTPs that are identified in the discussions below.

1.10.1 Existing Wastewater Collection System

The existing wastewater collection system throughout the City consists of approximately 360 miles of gravity lines and 35 miles of force mains. Each utility district is responsible for construction and maintenance of its collection system. Because some of the utility districts share capacity in regional WWTPs, several systems are interconnected. Some of the interconnections are direct gravity lines to a WWTP and some are force mains that transfer wastewater flows from one utility district's lift station into another utility district's collection system to ultimately travel to a regional WWTP. See Exhibit 1-6 for a map of the existing wastewater collection system lines, lift stations and existing system interconnections.

Age, condition, type and sizing of wastewater lines were evaluated in this Study only to the extent of determining necessary improvements when considering potential consolidation alternatives. As with the water systems, further evaluation of the individual wastewater systems would require the development of a City-wide system model, which was not included in the scope of this Study.

One concern brought to our attention during the course of this Study was regarding excessive nutrient loading to the WWTPs. Excessive nutrient loading to WWTPs generally occur in one of two ways. The most common cause of excessive nutrient loading comes from agricultural, commercial and/or industrial wastewater producers, who discharge wastewater with concentrations of nutrients far exceeding those of normal residential wastewater producers. Therefore, when it is determined that a non-residential wastewater producer is discharging wastewater with excessive nutrient loads, either onsite pretreatment requirements should be mandated to that producer, or a pretreatment surcharge needs to be developed for that user, to account for the increased cost of treatment to the specific WWTP as a result of handling that wastewater.

In addition, the TCEQ typically requires a utility-wide pretreatment program to be developed when a utility's wastewater production increases above 5 MGD. In the case of

the City, a pre-treatment program would not be required unless multiple utility district WWTPs were consolidated into a single facility. However, since the current total daily wastewater produced within the Study area already exceeds 5 MGD, development of a pretreatment program by the City and coordinated with the various utility districts may help address excessive nutrient loadings in the wastewater system if the excessive nutrient loading is coming from individual wastewater producers.

The second most common cause of excessive nutrient loading in a wastewater system occurs due to overly conservative pipeline design. When designing gravity collection pipelines, a fine balance must be maintained between sizing large enough to handle projected maximum design flows and ensuring that pipelines provide sufficient velocity at lower flow. A minimum pipeline velocity of 2.0 feet per second (ft/s) or greater (per TCEQ Chapter 217 design criteria) usually keeps all of the solids in the wastewater stream entrained in the liquid stream. If solids dropout occurs due to insufficient velocity, the normal nutrient load in the liquid stream is reduced, which makes the WWTP acclimate to a lower loading rate. When flows increase (frequently during the day or during storm events), the solids that had previously dropped out in the pipelines are now moved downstream to the WWTP which results in a nutrient overload at the WWTP.

1.10.2 Existing Wastewater Lift Stations

Wastewater lift stations have been constructed, where needed, to transfer wastewater flows to the various regional WWTPs from service areas that are not feasible for gravity flow to a WWTP. There are a total of 87 wastewater lift stations currently within the Study area. The City owns 8 lift stations throughout the Study area and the remaining lift stations are owned by the utility districts. Age, condition, type and sizing of wastewater lift stations were evaluated in this Study only to the extent of determining necessary improvements when considering potential consolidation alternatives.

1.10.3 Existing WWTPs

There are 11 existing WWTPs within the Study area. Two of the regional WWTPs are owned by the City (Steep Bank-Flat Bank and Mustang Bayou). The remaining WWTPs are owned by utility districts. Refer to Table 1-12 for a list of these WWTPs and their current permitted capacities. The service area for each WWTP is shown on Exhibit 1-7.

As with many other developer-planned and constructed WWTPs, the majority of the WWTPs in the Study area consist of package treatment plants. Package WWTPs are typically used for small flow (less than 1 MGD) and allow for rapid design and construction. Because package plants are usually designed for a small service area, they are not well suited for larger WWTP demands since multiple treatment trains are usually required for larger demands. For example, the Sienna South Regional WWTP is currently rated for an average flow of 1.2 MGD, though it is based on the operation of 4 simultaneously-operated 0.3 MGD package treatment plants. As a result, the existing

Sienna South WWTP has fairly limited treatment flexibility and requires substantially higher than normal daily operation and maintenance (O&M) efforts.

In addition, package treatment plants typically have much shorter operating lives than more conventional or advanced treatment facilities. Most conventional treatment facilities are designed based on using concrete structures, which typically have a 40-50 year operating life, and equipment is designed for 30-40 years of operation. However, in package treatment plants, the anticipated operating life are frequently intended only for 10-20 years, especially when structures are designed using painted carbon steel.
Each WWTP was evaluated in this Study with respect to rated capacity versus average loading, treatment performance, remaining useful life of structures and equipment, treatment and potential expansion capabilities, potential for reuse, and observed level of annual O&M efforts. Summary tables comparing current conditions at each WWTP within the Study area are provided. Table 1-12 provides an overview of each WWTP. Table 1-13 contains WWTP process summaries of each WWTP. Table 1-14 lists the current operating parameters at each WWTP.

Table 1-12
Existing WWTPs General Summary

Name	General Location	Adjacent WWTPs	WWTP Age (years)	Operating Entity
Blue Ridge West MUD WWTP	Independence Blvd.	None	25	Southwest Water Company (SWWC)
Fort Bend County MUD #26 WWTP	Lazy Spring Dr	Blue Ridge West MUD WWTP	30	Quail Valley UD
Harris County MUD #122 WWTP	Sunset Lane	None	20	Severn Trent Services
Harris County WC&ID - Fondren Road WWTP	East Hampton Cr	Southwest Harris County MUD #1 WWTP	30	Quail Valley UD
Mustang Bayou Regional WWTP	Trammel Fresno Rd	None	20	SWWC
Palmer Plantation WWTP	Lake Olympia Parkway	Steep Bank / Flat Bank WWTP	25	Quail Valley UD
Quail Valley UD/Thunderbird UD WWTP	Blue Lakes Lane	None	35	Quail Valley UD
Sienna North WWTP	Discovery Lane	None	10	SWWC
Sienna South WWTP	Waters Lake Blvd	None	20	SWWC
Southwest Harris County MUD #1 WWTP	Hwy 90a	Harris County WC&ID	20	Severn Trent Services
Steep Bank/Flat Bank Regional WWTP	Oil Field Rd	Palmer Plantation WWTP	10	Quail Valley UD

Table 1-13
Existing WWTP Treatment Process Summary

Name	Process Type	Solids Handling Type	Effluent Reuse Potential[1] (acre-ft per year)	Recent Rehabilitative Work
Blue Ridge West MUD WWTP	Contact stabilization Package[3]	Aerobic digestion, off-site liquid sludge hauling[2]	1,064	None
Fort Bend County MUD #26 WWTP	Conventional Complete-Mix Activated Sludge (CMAS) Package	Aerobic digestion and off-site liquid sludge hauling[2]	336	Emergency conversion to CMAS
Harris County MUD #122 WWTP	CMAS Package	Aerobic digestion and off-site liquid sludge hauling[2]	224	Cleaning & minor repairs
Harris County WC&ID - Fondren Road WWTP	CMAS Package	Aerobic digestion and off-site liquid sludge hauling[2]	112	Cleaning & minor repairs
Mustang Bayou Regional WWTP	3 CMAS Package Trains	Aerobic digestion and off-site liquid sludge hauling[2]	448	New CMAS train added
Palmer Plantation WWTP	CMAS Conventional	Aerobic digestion and off-site liquid sludge hauling[2]	336	None
Quail Valley UD/Thunderbird UD WWTP	Pure O_2	Belt filter press & off-site dewatering sludge hauling[4]	1,232[5]	Cleaning & minor repairs
Sienna North WWTP	3 CMAS Package Trains	Aerobic digestion and off-site liquid sludge hauling[2]	336	None
Sienna South WWTP	4 CMAS Package Trains	Aerobic digestion and off-site liquid sludge hauling[2]	1,232	None
Southwest Harris County MUD #1 WWTP	CMAS Package	Aerobic digestion and off-site liquid sludge hauling[2]	112	Cleaning & minor repairs
Steep Bank/Flat Bank Regional WWTP	Extended aeration conventional	Belt filter press & off-site dewatering sludge hauling[4]	1,680	Expansion from 1.5-3.0 MGD

Notes:
1 - Available amount listed does not include evaporative losses.
2 - This process is energy and O&M intensive.
3 - TCEQ prohibits contact-stabilization process for nitrification.
4 - This process has low energy and O&M usage.
5 - Currently 0.4 MGD is used via Section 210 authorization for golf course irrigation.

Table 1-14
Existing WWTP Operating Parameters

Name	Current Permitted Capacity (MGD)[1,2]	Current Average Loading (MGD)[3]	Treatment Efficiency[4]
Blue Ridge West MUD WWTP	1.3	0.75	58%
Fort Bend County MUD #26 WWTP	0.5	0.3	60%
Harris County MUD #122 WWTP	0.25	0.1	40%
Harris County WC&ID - Fondren Road WWTP	0.6	0.2	33%
Mustang Bayou Regional WWTP	0.95	0.4	40%
Palmer Plantation WWTP	0.6	0.3	50%
Quail Valley UD/Thunderbird UD WWTP	4.0	1.5	38%
Sienna North WWTP	0.9	0.3	33%
Sienna South WWTP	1.2	1.1+	92%
Southwest Harris County MUD #1 WWTP	0.4	0.1	25%
Steep Bank/Flat Bank Regional WWTP	3.0	1.5	50%
Total	**13.75**	**6.55**	

Notes:
1 - Current permitted design capacity based on current average flow rating from TPDES discharge permit on file with TCEQ. However, in some cases, the permitted treatment capacity may be above the actual treatment capability of a specific WWTP.
2 - The permitted effluent limitations for all WWTPs are 10 milligrams per liter (mg/L) biochemical oxygen demand (BOD), 15 mg/L total suspended solids (TSS) and 2-4 mg/L ammonia (NH_3) (ammonia limit added in this permit cycle for several of the WWTPs). NH_3 limit is anticipated to be tightened to 2 mg/L or less for all WWTPs.
3 - Current average loading based on average daily flow rates to each WWTP. Typical peaking factor for influent flows ranges from 1.5-2.0.
4 - The Treatment Efficiency is based on the percentage of the rated capacity. Optimal efficiency (in utilizing operator effort and in energy and chemical usage) is 60-80% of the plant capacity.

Table 1-15
Projected Life of Existing WWTP

Name	Remaining Life of Structures (years)	Remaining Life of Equipment (years)	Remaining Life of WWTP[1, 2] (years)
Blue Ridge West MUD WWTP	10-15	5-10	5-10
Fort Bend County MUD #26 WWTP	10-15	5-10	5-10
Harris County MUD #122 WWTP	5-10	5-10	5-10
Harris County WC&ID - Fondren Road WWTP	10-15	5-10	5-10
Mustang Bayou Regional WWTP	10-15	10-15	10-15
Palmer Plantation WWTP	10-15	5-10	5-10
Quail Valley UD/Thunderbird UD WWTP	5-10	5-10	5-10
Sienna North WWTP	10-15	10-15	10-15
Sienna South WWTP	5-10	5-10	5-10
Southwest Harris County MUD #1 WWTP	10-15	5-10	5-10
Steep Bank/Flat Bank Regional WWTP	30-40	25-30	25-30

Notes:
1 - Overall WWTP useful life without major WWTP rehabilitation or replacement. Limiting factor for package plants with concrete structures is the equipment. Limiting factors for package plants with steel structures are both the structure and the equipment.
2 - Remaining useful life of each existing WWTP listed above does not take into account capability to meet current and/or future permit limits. For example, Harris County MUD #122 WWTP will likely become noncompliant with its new ammonia permit limit once that permit limit goes into effect next summer. So the remaining useful life for that WWTP is actually shorter than what is shown above.

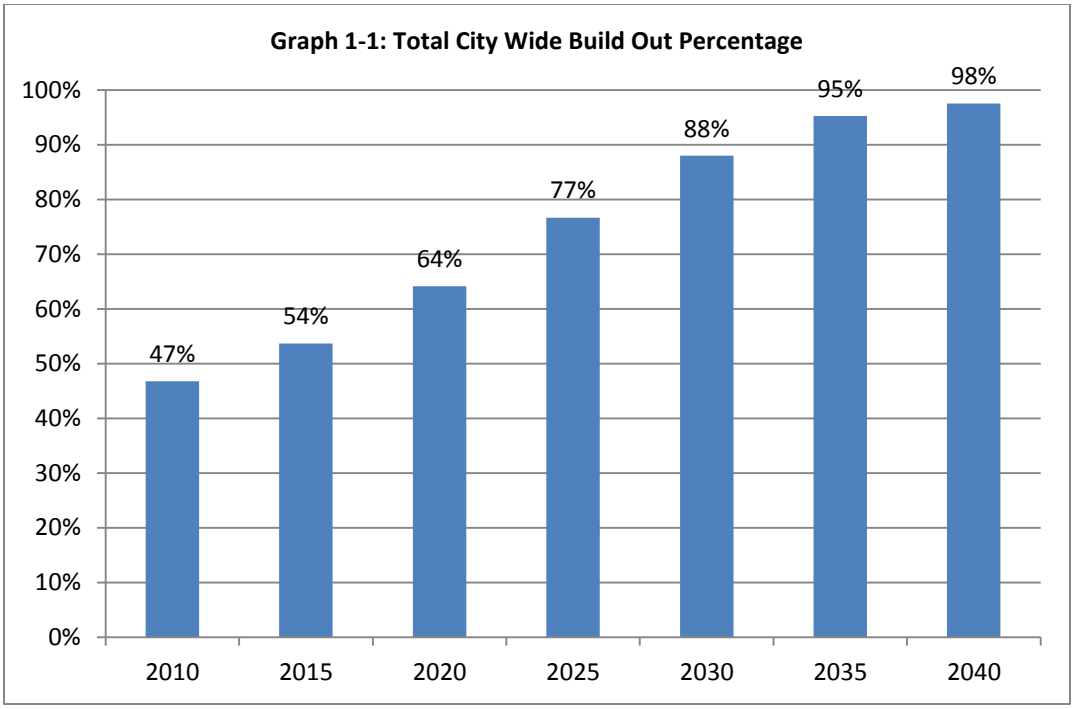
1.11 Projected Growth Patterns

As previously discussed, the City is considered a community of neighborhoods. While many of the older neighborhoods in the northern portions of the City are already built out, many of the southern neighborhoods are still rapidly growing. The City Planning Department has established Development Ordinances along with the City's Zoning and Subdivision Ordinances, which set the guidelines for future growth and redevelopment within the City. The Planning Department has developed a Comprehensive Plan which designates the pattern and intended character of future development. Table 1-16 presents the projected land area of each character district.

Table 1-16 Missouri City Future Land Use & Character		
Designation	**Acreage**	**Percent of Total**
Rural	1,120.6	6.8%
Estate	2,048.7	12.4%
Suburban Residential	2,989.8	18.1%
Single-Family Residential	2,703.4	16.4%
Multi-Family Residential	324.2	2.0%
Suburban Commercial	1,005.4	6.1%
Commercial	1,067.3	6.5%
Urban	98.8	0.6%
Business Park	2,213.9	13.4%
Community Facility	486.5	2.9%
Park & Recreation	1,326.1	8.0%
Water	1,144.3	6.9%
Total	**16,529**	**100.0%**

The majority of the future development within the City will occur in the southern portion of the City within three major subdivisions. These subdivisions are Riverstone, Sienna Plantation and the Sienna South development. These developments have adopted individual master plans in accordance with the City's Comprehensive Plan. In order to estimate areas of future development for each of the Study's five year increments, copies of these master plans were obtained along with traffic impact analyses and discussions with the City's Planning Department Staff. Using this information, Exhibit 1-8 was prepared, which shows the project growth areas throughout the City.

A graphic representation of the City-wide build out percentage was also put together based on the projected connection counts presented in Table 1-3. The build out percentage was determined by dividing the build out connection count by each of the five year planning study increments. The current build out percentage of the City is 46% and is estimated to reach 96% by the year 2040. Complete results are presented in Graph 1-1.

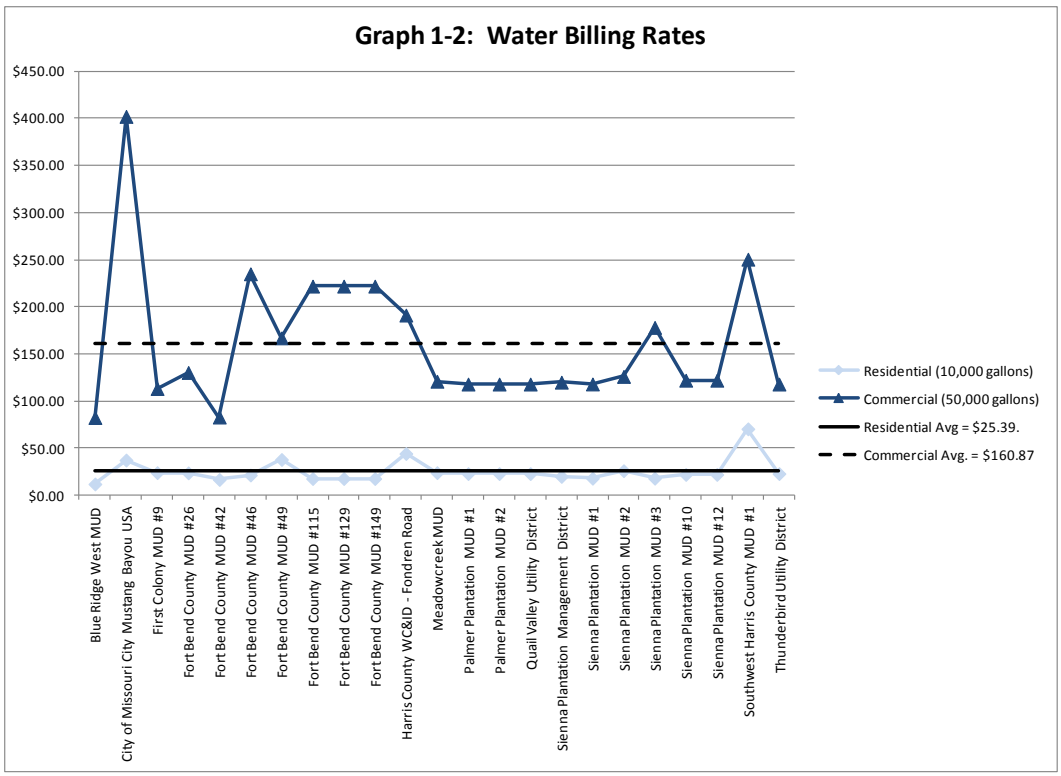


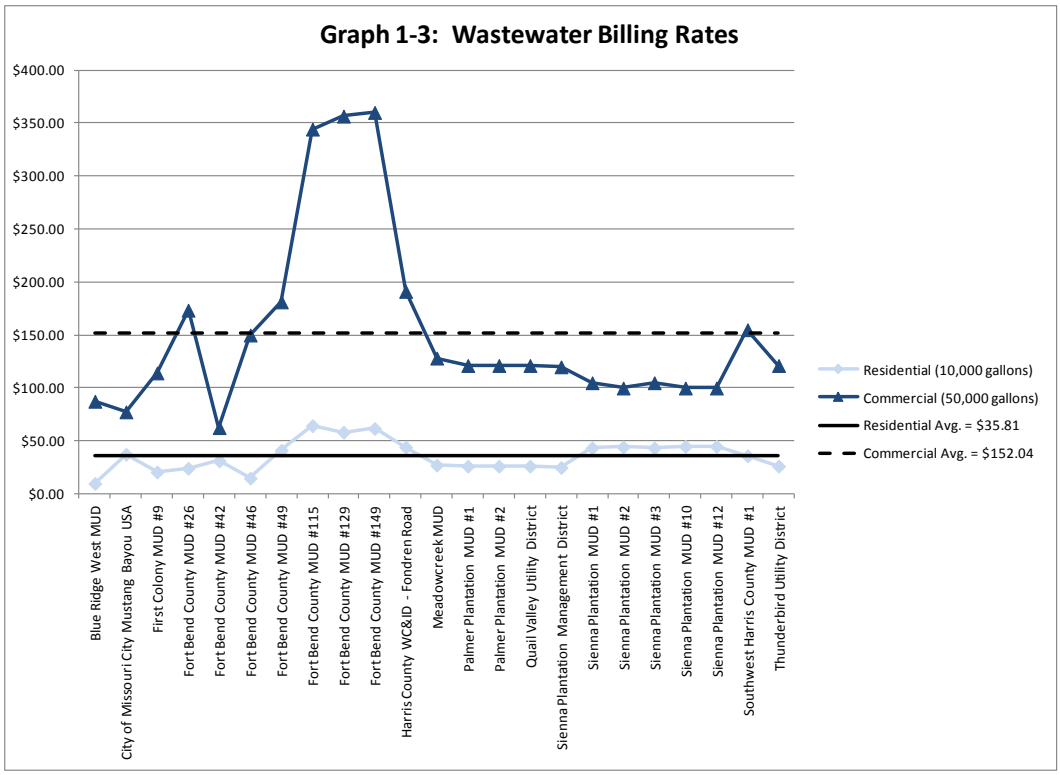
1.12 Current Billing Rates

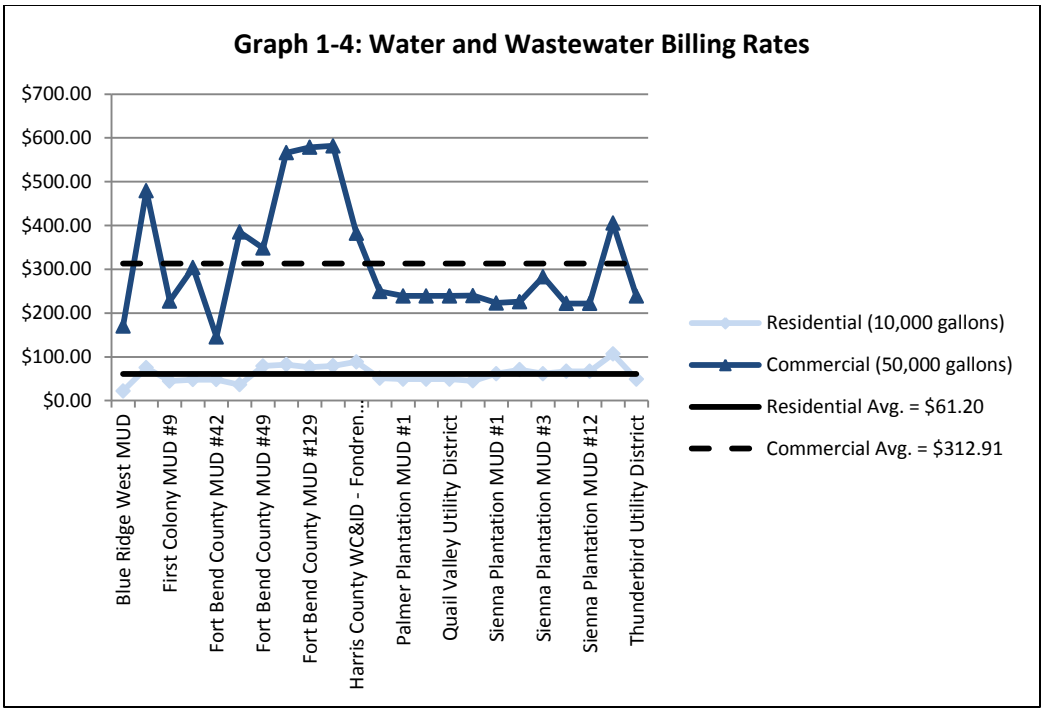
Each utility district individually sets its rates for water and sewer service. Because each district is currently at a different stage of build out, the rates paid by customers vary within the Study area. Newer utility districts that are still constructing additional facilities as they grow and are also continuing to pay back debt on recently constructed facilities have higher rates than the older utility districts which have been completely built out and have repaid all or a large portion of their debt. Each utility district provided its billing rates from water and wastewater, as well as their average monthly usage and amount billed.

1.12.1 Average Water and Wastewater Billed Usage

The average monthly water and wastewater usage throughout the Study area was calculated as 10,000 gallons per month for a residential connection and 50,000 gallons per month for a commercial connection. Using the current billing rates for each utility district, the monthly cost for the average usage was calculated to use as a comparison between individual districts. Graph 1-2 and Graph 1-3 show the varying costs in each district for water and wastewater billing rates, respectively. Graph 1-4 shows the combined water and wastewater billing rates for each district.


Graph 1-2: Water Billing Rates
$450.00
$400.00
$350.00
$300.00
$250.00
$200.00
$150.00
$100.00
$50.00
$0.00
Blue Ridge West MUD
City of Missouri City Mustang Bayou USA
First Colony MUD #9
Fort Bend County MUD #26
Fort Bend County MUD #42
Fort Bend County MUD #46
Fort Bend County MUD #49
Fort Bend County MUD #115
Fort Bend County MUD #129
Fort Bend County MUD #149
Harris County WC&ID - Fondren Road
Meadowcreek MUD
Palmer Plantation MUD #1
Palmer Plantation MUD #2
Quail Valley Utility District
Sienna Plantation Management District
Sienna Plantation MUD #1
Sienna Plantation MUD #2
Sienna Plantation MUD #3
Sienna Plantation MUD #10
Sienna Plantation MUD #12
Southwest Harris County MUD #1
Thunderbird Utility District
Residential (10,000 gallons)
Commercial (50,000 gallons)
Residential Avg = $25.39.
Commercial Avg. = $160.87


Graph 1-3: Wastewater Billing Rates
$400.00
$350.00
$300.00
$250.00
$200.00
$150.00
$100.00
$50.00
$0.00
Blue Ridge West MUD
City of Missouri City Mustang Bayou USA
First Colony MUD #9
Fort Bend County MUD #26
Fort Bend County MUD #42
Fort Bend County MUD #46
Fort Bend County MUD #49
Fort Bend County MUD #115
Fort Bend County MUD #129
Fort Bend County MUD #149
Harris County WC&ID - Fondren Road
Meadowcreek MUD
Palmer Plantation MUD #1
Palmer Plantation MUD #2
Quail Valley Utility District
Sienna Plantation Management District
Sienna Plantation MUD #1
Sienna Plantation MUD #2
Sienna Plantation MUD #3
Sienna Plantation MUD #10
Sienna Plantation MUD #12
Southwest Harris County MUD #1
Thunderbird Utility District
Residential (10,000 gallons)
Commercial (50,000 gallons)
Residential Avg. = $35.81
Commercial Avg. = $152.04


Graph 1-4: Water and Wastewater Billing Rates
$700.00
$600.00
$500.00
$400.00
$300.00
$200.00
$100.00
$0.00
Blue Ridge West MUD
First Colony MUD #9
Fort Bend County MUD #42
Fort Bend County MUD #49
Fort Bend County MUD #129
Harris County WC&ID - Fondren...
Palmer Plantation MUD #1
Quail Valley Utility District
Sienna Plantation MUD #1
Sienna Plantation MUD #3
Sienna Plantation MUD #12
Thunderbird Utility District
Residential (10,000 gallons)
Commercial (50,000 gallons)
Residential Avg. = $61.20
Commercial Avg. = $312.91