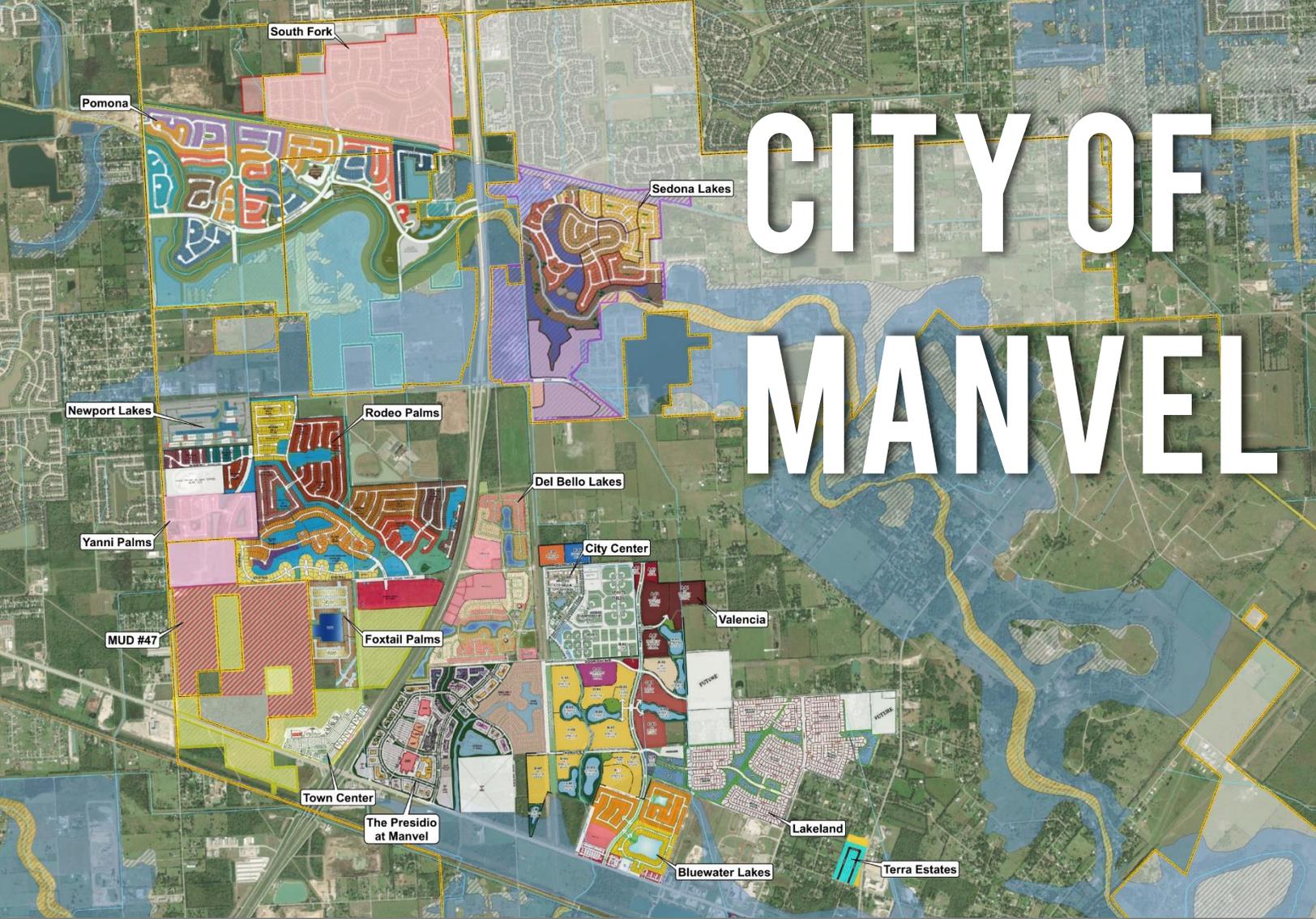


CITY OF MANVEL



2022 MASTER WASTEWATER PLAN UPDATE

PREPARED FOR:

City of Manvel

PREPARED BY:

Freese and Nichols, Inc.
11200 Broadway St., Suite 2320
Pearland, Texas 77584
832-456-4700



 **FREESE
AND
NICHOLS**

ORDINANCE NO. 2022-O-05

AN ORDINANCE OF THE CITY OF MANVEL, TEXAS, AMENDING CHAPTER 50. *PLANNING AND DEVELOPMENT*, ARTICLE III. *COMPREHENSIVE PLAN*, BY APPROVING THE 2022 MASTER WASTEWATER PLAN UPDATE DOCUMENT AS THE 2022 MASTER WASTEWATER PLAN; AMENDING SECTION 50-55. *MASTER WASTEWATER PLAN* INTEGRATING THE CITY'S 2022 MASTER WASTEWATER PLAN INTO THE CITY'S COMPREHENSIVE PLANS; PROVIDING FOR CONFORMITY OF ALL WASTEWATER REGULATIONS TO THE MASTER WASTEWATER PLAN; PROVIDING A PENALTY IN AN AMOUNT NOT TO EXCEED \$2,000.00 PER DAY FOR EACH DAY OF VIOLATION OF ANY PROVISION HEREOF; AND PROVIDING FOR SEVERABILITY; AND PROVIDING A SEVERANCE CLAUSE AND EFFECTIVE DATE.

WHEREAS, in 2017 the City of Manvel approved a new master wastewater plan for the city; and

WHEREAS, in 2020 the city commissioned a master wastewater plan update to be prepared by Freese & Nichols; and

WHEREAS, the master wastewater plan update is now in final form and has been presented to the City for adoption; and

WHEREAS, the City Council hereby adopts the 2022 Master Wastewater Plan Update document prepared by Freese & Nichols as the new 2022 Master Wastewater Plan, and integrates it into Chapter 50 of The City Code as a plan and policy for the city; **now, therefore,**

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF MANVEL, TEXAS:

Section 1. Chapter 50. *Planning and Development* of the Code of Ordinances of the City of Manvel is hereby amended by adopting a new master wastewater plan and amending section 50-55. *Master wastewater plan* in Article III to read and provide as follows:

“CHAPTER 50. PLANNING AND DEVELOPMENT

...

ARTICLE III. COMPREHENSIVE PLAN

...

Sec. 50-55. Master wastewater plan.

(a) The city council hereby adopts the [2017] 2022 Master Wastewater Plan (“Master Wastewater Plan”), a true and correct copy of which shall remain on file in the office of the city secretary. The Master Wastewater Plan shall be the plan and policy for wastewater matters within the city and, to the extent permitted by law, the extra-territorial jurisdiction of the City of Manvel.

(b) All wastewater and related regulations and requirements of The City Code, including, but not limited to, Chapter 62. *Subdivisions*, shall conform to the Master Wastewater Plan. If there is any conflict between an ordinance, rule or regulation of The City Code and the Master Wastewater Plan, the Master Wastewater Plan shall control.”

Section 2. Penalty. Any person who shall intentionally, knowingly, recklessly, or with criminal negligence violate any provision of this chapter shall be deemed guilty of a misdemeanor and, upon conviction, shall be fined in an amount not to exceed \$2,000.00. Each day of violation shall constitute a separate offense.

Section 3. Repealer. All ordinances or parts of ordinances inconsistent or in conflict herewith, are, to the extent of such inconsistency or conflict, hereby repealed.

Section 4. Severability. In the event any clause, phrase, provision, sentence, or part of this Ordinance or the application of the same to any person or circumstance shall for any reason be adjudged invalid or held unconstitutional by a court of competent jurisdiction, it shall

not affect, impair, or invalidate this Ordinance as a whole or any part or provision hereof other than the part declared to be invalid or unconstitutional; and the City Council of the City of Manvel, Texas, declares that it would have passed each and every part of the same notwithstanding the omission of any such part thus declared to be invalid or unconstitutional, whether there be one or more parts.

PASSED AND APPROVED on first reading this 7 day of February, 2022.

PASSED, APPROVED, AND ADOPTED on second and final reading this February 22, 2022.



Debra Davison
Debra Davison, Mayor

Attest:
Tammy Bell
Tammy Bell, City Secretary

APPROVED AS TO FORM:
Robert Gervais
Robert Gervais, City Attorney

2022 MASTER WASTEWATER PLAN UPDATE

Prepared for:

City of Manvel



Richard Weatherly

FREESE AND NICHOLS, INC.
TEXAS REGISTERED
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Ishita Rahman

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FNI Project No.: MNV20623

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EXECUTIVE SUMMARY

1.0 INTRODUCTION

The City of Manvel (City) is located on Highway 6 east of State Highway (SH) 288, in northern Brazoria County, Texas. The City currently provides wastewater service to 1,635 equivalent single family connections (ESFCs) within the city limits. There are also approximately 5,148 existing ESFCs outside the City's existing wastewater served area. Manvel is experiencing a rapid growth within the city limits and extraterritorial jurisdiction (ETJ) and is anticipating an increase in the wastewater service area ESFCs to approximately 32,000. This will result in approximately 10 MGD of total average daily flow in the future wastewater service area.

The City completed a *Master Wastewater Plan* in 2017 that developed wastewater system improvements recommendations. As the growth and development patterns change in the City, Manvel identified the need to update to the *2017 Master Wastewater Plan*. Freese and Nichols, Inc. (FNI) was retained by the City of Manvel in 2020 to update the City's existing *Master Wastewater Plan* incorporating recent updates to the City's land use projections. The purpose of this *2022 Master Wastewater Plan Update* is to provide the City of Manvel with an updated planning tool that will serve as a guide for short-term and long-term (20-year) improvements to the wastewater collection system and treatment infrastructure. The results from this study were utilized during the 2021 water and wastewater impact fee update study for Manvel.

2.0 EXISTING WASTEWATER SYSTEM INFRASTRUCTURE

The City of Manvel owns and operates a wastewater collection system consisting of eight lift stations and associated force mains, a network of manholes and gravity mains, and one wastewater treatment plant (at Corporate Drive). The City recently constructed an expansion to increase the total average annual daily flow (AADF) treatment capacity at this plant to 0.5 MGD, and to increase the peak 2-hour flow capacity to 1,389 gpm (2.0 MGD). This expansion is permitted under the City's current Texas Pollutant Discharge Elimination System (TPDES) permit no. WQ0013872001.

In addition to the City of Manvel (Corporate Drive) wastewater treatment plant, there are four existing Municipal Utility District (MUD) WWTPs within the city limits and ETJ that serve the **Southfork**, **Sedona Lakes**, **Pomona**, **Rodeo Palms**, **Foxtail Palms**, **Newport Lake Estates**, and **Yanni Palms** developments.

3.0 LAND USE AND GROWTH PROJECTIONS

As of 2021, there are approximately 1,635 wastewater equivalent single family connections (ESFCs) currently served by the City’s wastewater collection system. These represent residential and commercial wastewater customers. Each ESFC represents a wastewater flow (gallons/day) that must be conveyed and treated by the wastewater system. The City utilizes ESFCs to project wastewater flows and to determine the sizing and location of wastewater system infrastructure. FNI worked with City staff to develop growth projections for the City of Manvel and also utilized information collected from the existing and upcoming developments within the city limits and ETJ.

The growth in residential and commercial wastewater connections will inform the location, sizing, and timing of future wastewater infrastructure. FNI received information on projected ESFCs from the City, developers, and reports for the anticipated developments. The developers of each anticipated development supplied projected buildout connections and an approximate growth per year. For developments where a phasing plan was unavailable, FNI worked with the City staff to develop growth assumptions. In addition to the anticipated developments, growth projections were also developed for select areas within the wastewater service area identified as having potential for growth (infill areas) within the 20-year planning period. The total projected wastewater ESFCs for the **existing**, **5-year**, **10-year**, and **20-year** planning periods are shown in **Table ES-1**.

Table ES-1: Projected Wastewater ESFCs

Year	Projected Wastewater ESFCs		
	City Limits	ETJ	Total
2021	3,628 ⁽¹⁾	3,155	6,783
2026	8,904	5,876	14,780
2031	13,311	6,530	19,841
2041	25,412	6,541	31,953

(1) Includes existing wastewater connections in developments within city limits that are not currently served by the City.

4.0 WASTEWATER FLOWS

Planning for future wastewater infrastructure is dependent on the amount of average daily and peak wastewater flow that must be collected, conveyed, and treated. Wastewater treatment plants are sized

based on average daily flows, while the collection system infrastructure, including lift stations, is sized to convey peak wastewater flows.

The City’s existing wastewater system consists of a single wastewater service area that collects wastewater flows and conveys them to the City of Manvel (Corporate Drive) WWTP. For the City’s future wastewater system, FNI delineated six distinct wastewater service areas that will each convey wastewater flows to regional wastewater treatment facilities. These six wastewater service areas are:

1. Central Wastewater Service Area
2. East Wastewater Service Area
3. West Wastewater Service Area
4. Sedona Lakes Wastewater Service Area
5. South Wastewater Service Area
6. Meridiana Wastewater Service Area (the portion of Meridiana within Manvel city limits)

The City of Manvel’s design criteria for average daily wastewater flow per equivalent single family connection (ESFC) is 315 gallons. This was utilized to calculate average day wastewater flows during this study. For peak wet weather flows, FNI recommends using a peaking factor of 4.0, based on TCEQ guidelines in the absence of site specific data (30 TAC §217.32 (a)(2)). The planning criteria used for developing average day and peak wastewater flows for this *2022 Master Wastewater Plan Update* are shown in **Table ES-2**.

Table ES-2: Wastewater Flow Design Criteria

Wastewater Connection Unit	Average Day Wastewater Flow	Peak Wastewater Flow
ESFC ⁽¹⁾	315 gallons per day	4.0 x 315 gallons per day

(1) Equivalent Single Family Connection

FNI calculated future wastewater flows based on the projected equivalent single family connections and wastewater flow design criteria. The total projected average day and peak wet weather wastewater flows for each planning year are shown in **Table ES-3**.

Table ES-3: Projected Wastewater Flows

Year	Projected Wastewater ESFCs			Average Daily Flow (ADF) (MGD)			Peak Wet Weather Flow (MGD)		
	City Limits	ETJ	Total	City Limits	ETJ	Total	City Limits	ETJ	Total
2021	3,628 ⁽¹⁾	3,155	6,783	1.14	0.99	2.1	4.57	3.98	8.5
2026	8,904	5,876	14,780	2.80	1.85	4.7	11.22	7.40	18.6
2031	13,311	6,530	19,841	4.19	2.06	6.2	16.77	8.23	25.0
2041	25,412	6,541	31,953	8.00	2.06	10.1	32.02	8.24	40.3

(1) Includes existing wastewater connections in developments within city limits that are not currently served by the City.

5.0 WASTEWATER MODEL UPDATE

The City’s existing wastewater hydraulic model was developed by FNI during the *2017 Master Wastewater Plan* using InfoSewer® software by Innovyze. This software has Geographic Information System (GIS) interoperability and makes use of engineering equations and mathematical algorithms to determine the flows and velocities that would occur in a collection system under a specified set of conditions. During this study, the model was updated with recently completed wastewater infrastructure and updated wastewater flow projections. The updated model was utilized during the development of collection system capital improvement projects to improve the existing system and accommodate projected wastewater flows through 2041.

6.0 WASTEWATER SYSTEM ANALYSES

FNI developed wastewater system improvements to accommodate the projected flows from residential and commercial growth. Hydraulic analyses were conducted to develop these improvements into a phased capital improvements plan to convey and treat the projected wastewater flows over the 20-year period through 2041. In order to serve the projected 20-year growth and develop regionalized wastewater treatment facilities, the City of Manvel should consider the following:

- Construct a new phased Central wastewater treatment plant that would expand the treatment capacity in the Central region. This new Central WWTP would be phased over time to accommodate the anticipated 20-year growth in wastewater flows (this project currently in preliminary design phase)

- Construct regional transfer infrastructure to pump wastewater flows from the East Service Area to the Central Service Area
- Construct a new wastewater treatment plant in the South service area
- Construct consolidation infrastructure and expand treatment capacity in the West Service Area
- Extend wastewater service via gravity lines, lift stations, and force mains to areas of growth where little or no infrastructure currently exists

Recommended capacities were developed for the regional wastewater treatment and conveyance infrastructure based on the 20-year projected average day wastewater flows presented in **Table ES-3**.

Table ES-4 presents a summary of the existing and proposed City of Manvel wastewater treatment facilities including the MUD WWTPs and permitted capacities by planning period. The Meridiana and Sedona Lakes service areas currently have existing MUD WWTPs, which are anticipated to eventually be part of the City’s wastewater system.

Table ES-4: WWTP Capacities by Planning Period

Planning Period	Average Daily Flow Permitted Capacity (MGD)								
	Central Regional WWTP ⁽¹⁾	West Regional WWTP ⁽¹⁾	South Regional WWTP ⁽¹⁾	Town Center WWTP ⁽¹⁾	Sedona Lakes WWTP ⁽²⁾⁽⁴⁾	Meridiana WWTP ⁽²⁾⁽⁴⁾	Rodeo Palms WWTP ⁽²⁾⁽⁵⁾	Pomona WWTP ⁽²⁾⁽⁶⁾	Southfork WWTP ⁽²⁾⁽⁶⁾
2021	0.5	-	-	-	0.3	0.399	0.45	0.25	0.48
2026	1.5	-	-	0.15 ⁽⁷⁾	0.6	by MUD	by MUD	by MUD	by MUD
2031	2.0 ⁽³⁾	-	-	by MUD	0.6	by MUD	by MUD	by MUD	by MUD
2041	4.0	4.0	1.1	<i>Decommissioned and Flow Transferred to West WWTP</i>	0.6	by MUD	<i>Ownership Transfer to City as West Regional WWTP</i>	<i>Decommissioned and Flow Transferred to West WWTP</i>	<i>Decommissioned and Flow Transferred to West WWTP</i>

(1) City-owned WWTPs

(2) MUD WWTPs not currently owned and operated by the City.

(3) Decommission the existing 0.5 MGD package plant.

(4) Sedona Lakes WWTP and Meridiana WWTP are planned to be owned by the City in future (beyond 2041)

(5) Rodeo Palms Brazoria County MUD #29 WWTP ownership and operation to be transferred to the City as the West Regional WWTP.

(6) Pomona WWTP and Southfork WWTP are recommended to be decommissioned and served by the West Regional WWTP by 2041.

(7) Town Center WWTP is under construction as of December 2021.

7.0 WASTEWATER TREATMENT PLANT EFFLUENT REUSE

The City of Manvel does not currently have a wastewater reuse system. As the City continues to grow, the water demand on the City's existing and future potable water sources will continue to increase. The City is considering a wastewater reuse system to alleviate the need for additional water supply as the projected population and water demands increase. As part of the *2022 Master Wastewater Plan Update*, FNI summarized the steps involved in the implementation of a reuse program.

The steps include identifying reuse system goals, reuse options, reuse considerations, compliance with reuse regulations, reuse water quality and quantity. FNI recommends the City to perform an in-depth Reuse Study to evaluate the options for potential potable and non-potable reuse. If the City decides to implement reuse, the wastewater treatment facilities will need to be upgraded to produce effluent at the required water quality standards.

8.0 WASTEWATER SYSTEM CAPITAL IMPROVEMENTS PLAN

A wastewater system capital improvements plan (CIP) was developed for the City of Manvel. The CIP projects consist of collection system conveyance and wastewater treatment for the projected growth over the 20-year planning period in this study. These projects allow for regionalization of the City's wastewater collection system and treatment infrastructure and provide the City with a phased CIP for collection system and treatment as the City grows.

Capital costs were calculated for all recommended improvements and do not include individual service connections or subdivision lines. The costs are provided as estimates based on previous similar engineering experience in 2021 dollars and include allowances for contingencies and engineering and surveying.

Table ES-5 summarizes the cost of the Capital Improvements Plan by phase and project type (Treatment or Conveyance). **Table ES-6** summarizes the individual projects in the wastewater system CIP.

Table ES-5: Wastewater CIP Summary (by Phase and Project Type)

Phase	CIP	Cost
5 Year (by 2026)	Treatment	\$26,948,900
	Conveyance	\$14,801,800
	Sub-total	\$41,750,700
10 Year (by 2031)	Treatment	\$15,904,500
	Conveyance	\$1,555,200
	Sub-total	\$17,459,700
20-Year (by 2041)	Treatment	\$98,182,000
	Conveyance	\$59,758,700
	Sub-total	\$157,940,700
Total 20-Year Wastewater CIP Cost		\$217,151,100

Table ES-6: Wastewater Capital Improvements Plan Summary (by Project)

Phase	Project Number	Project Name	Cost (In 2021 Dollars)
5-Year (by 2026)	1	1.0 MGD Central Regional Wastewater Treatment Plant (Phase 1)	\$26,948,900
	2	New 4.0 MGD Pollard Blvd Lift Station and 18-inch Force Main (Phase 1)	\$5,494,800
	3	12/15/18/30-inch Lines through Valencia Development (Central Service Area Interceptor and Gravity System)	\$8,553,200
	4	8-inch Gravity Main along McCoy Road and Lewis Lane	\$753,800
			Total 2021 - 2026
10-Year (by 2031)	5	Expansion of the Central Regional Wastewater Treatment Plant to 2.0 MGD Capacity (Phase 2)	\$15,904,500
	6	12-inch Del Bello SPUR Gravity Main	\$1,555,200
			Total 2027 - 2031
20-Year (by 2041)	7	15-inch Gravity Main Along Masters Road	\$1,796,700
	8	Large Avenue Lift Station Expansion to 1.8 MGD and 10-inch Force Main	\$3,211,800
	9	New 1.1 MGD South Regional Wastewater Treatment Plant (Phase 1)	\$26,688,000
	10	Expansion of the Central Region Wastewater Treatment Plant to 4.0 MGD Capacity (Phase 3)	\$30,840,000
	11	New Pollard Boulevard Lift Station Expansion to 6.5 MGD	\$2,150,100
	12	Del Bello Lift Station Expansion to 1.3 MGD	\$582,500
	13	15/24-inch South Region Gravity Main	\$6,069,700
	14	12/15-inch Central Region Gravity Main	\$2,442,600
	15	New 4.0 MGD East Regional Lift Station and 14-inch Force Main	\$8,877,000
	16	12-inch Gravity Main along Highway 6	\$2,071,000
	17	West Regional Wastewater Treatment Plant Expansion to 4.0 MGD	\$40,654,000
	18	West Service Area Wastewater Treatment Plant Consolidation and Gravity Main (Phase 1)	\$18,201,600
	19	West Service Area Wastewater Treatment Consolidation (Phase 2)	\$3,954,300
	20	21/24-inch Gravity Main along Mustang Bayou	\$6,224,300
	21	New 1.0 MGD Lift Station, 8-inch Force Main and 15-inch Gravity Line	\$4,177,100
		Total 2032 - 2041	\$157,940,700
Total Capacity Wastewater CIP Cost			\$217,151,100

1.0 INTRODUCTION

The City of Manvel (City) is located on Highway 6 east of State Highway (SH) 288, in northern Brazoria County, Texas. The City currently provides wastewater service to 1,635 equivalent single family connections (ESFCs) within the city limits. There are also approximately 5,148 existing ESFCs outside the City's existing wastewater served area. Manvel is experiencing a rapid growth within the city limits and extraterritorial jurisdiction (ETJ) and is anticipating an increase in the wastewater service area ESFCs to approximately 32,000. This will result in approximately 10 MGD of total average daily flow in the future wastewater service area.

The City completed a *Master Wastewater Plan* in 2017 that developed wastewater system improvements recommendations. As the growth and development patterns change in the City, Manvel identified the need to update to the *2017 Master Wastewater Plan*. Freese and Nichols, Inc. (FNI) was retained by the City of Manvel in 2020 to update the City's existing *Master Wastewater Plan* incorporating recent updates to the City's land use projections. The purpose of this *2022 Master Wastewater Plan Update* is to provide the City of Manvel with an updated planning tool that will serve as a guide for short-term and long-term (20-year) improvements to the wastewater collection system and treatment infrastructure. The results from this study were utilized during the 2021 water and wastewater impact fee update study for Manvel.

1.1 SCOPE OF WORK

The goals of the *2022 Master Wastewater Plan Update* were to incorporate the new City Center and more recent projections from existing and proposed developments, conduct wastewater system analyses, and update wastewater system improvement recommendations for collection system and treatment projects. The major elements of the scope of this project included:

- Update Connection and Wastewater Flow Projections
- Conduct Hydraulic Analyses and Wastewater System Evaluation
- Develop Wastewater System Capital Improvements Plan (CIP) and prepare a Master Plan Report

1.2 LIST OF ABBREVIATIONS

Table 1-1: List of Abbreviations

Abbreviation	Actual
AADF	Average Annual Daily Flow
ADF	Average Daily Flow
CBOD ₅	5-Day Carbonaceous Biochemical Oxygen Demand
CIP	Capital Improvement Plan
DMR	Daily Monitoring Reports
ETJ	Extraterritorial Jurisdiction
ECHO	Enforcement and Compliance History Online
ESFC	Equivalent Single Family Connection
FM	Farm to Market
FNI	Freese and Nichols, Inc.
ft	foot
GIS	Geographic Information System
gpm	Gallons per Minute
Hwy	Highway
I/I	Inflow and Infiltration
LF	Linear Feet
LS	Lift Station
MGD	Million Gallons per Day
MUD	Municipal Utility District
OPCC	Opinion of Probable Construction Cost
PVC	Polyvinyl Chloride
SH	State Highway
TCEQ	Texas Commission on Environmental Quality
TIN	Triangular Irregular Network
TPDES	Texas Pollutant Discharge Elimination System
WWTP	Wastewater Treatment Plant

2.0 EXISTING WASTEWATER SYSTEM INFRASTRUCTURE

The City of Manvel’s existing wastewater collection system consisting of eight (8) lift stations and associated force mains, a network of manholes and gravity mains, and one wastewater treatment plant (WWTP). Manvel’s existing wastewater system infrastructure is shown on **Figure 2-1**.

2.1 CITY OF MANVEL WASTEWATER TREATMENT PLANT

The City of Manvel owns and operates a 0.5 MGD WWTP located at 7315 Corporate Drive north of Highway 6. The plant effluent outfalls into Brazoria County Flood Control Ditch No. 12, which then flows to Chocolate Bayou. The City completed an expansion at this WWTP in 2019 that increased the total average annual daily flow (AADF) treatment capacity to 0.5 MGD from 0.25 MGD and increased the peak 2-hour flow capacity to 1,389 gpm (2.0 MGD). This expansion is permitted under the City’s current Texas Pollutant Discharge Elimination System (TPDES) permit no. WQ0013872001 provided as **Appendix C**.

Table 2-1: City of Manvel Wastewater Treatment Plant Information

WWTP Name - TPDES Permit No.	Phase	ADF ⁽¹⁾ Permit (MGD)	Peak 2- Hour ⁽¹⁾ Permit (MGD)	Peaking Factor	Discharge Water(s) ⁽¹⁾
City of Manvel - WQ0013872001	-	0.50	2.0	4.0	Brazoria County Flood Control Ditch No. 12; thence to Chocolate Bayou Above Tidal in Segment No. 1108 of the San Jacinto River Basin

(1) ADF = Average Daily Flow; Permitted flow and discharge information from TCEQ TPDES Permits.

2.2 LIFT STATIONS

The City completed construction of two new lift stations and one lift station improvement and relocation since 2017. FNI received the as-built plans for these three lift stations from the City and compiled all available information to update City’s lift station inventory. A summary of the known information is presented in **Table 2-2**. The full lift station inventory is included in **Appendix B**.

Table 2-2: Existing Lift Stations

Lift Station Name (No.)	No. of Pumps	Firm Capacity (gpm)	Horse Power	TDH (ft)	Wet Well Diameter (ft)	Wet Well Depth (ft)
Corporate Drive (No. 1) <i>WWTP Influent Lift Station</i>	3	950	10	67	8	19.6
McCoy Road (No. 3)	2	317	2	45	3	10
Large Avenue ^(a) (No. 4)	2	300	15	49	8	24.2
Rogers Road (No. 5)	2	433	10	79	10	23
Lewis Lane (No. 6)	2	200	5	30.5	10	24
Lakeland ^(b) (No. 7) <i>In Lakeland Subdivision</i>	3	550 ^(c) 716 ^(d)	7.5	25.6	10	30.3
Bluewater ^(e) (No. 8)	2	287	5	38	10	27.9
Del Bello Lakes ^(f) (No. 9)	2	525	15	61	10	29

(a) Information based on bid plans for lift station expansion (Plans dated January 9, 2017)

(b) Information based on plans dated January 28, 2010

(c) Initial (existing) condition - duplex pump setup

(d) Final (future) condition - triplex pump setup

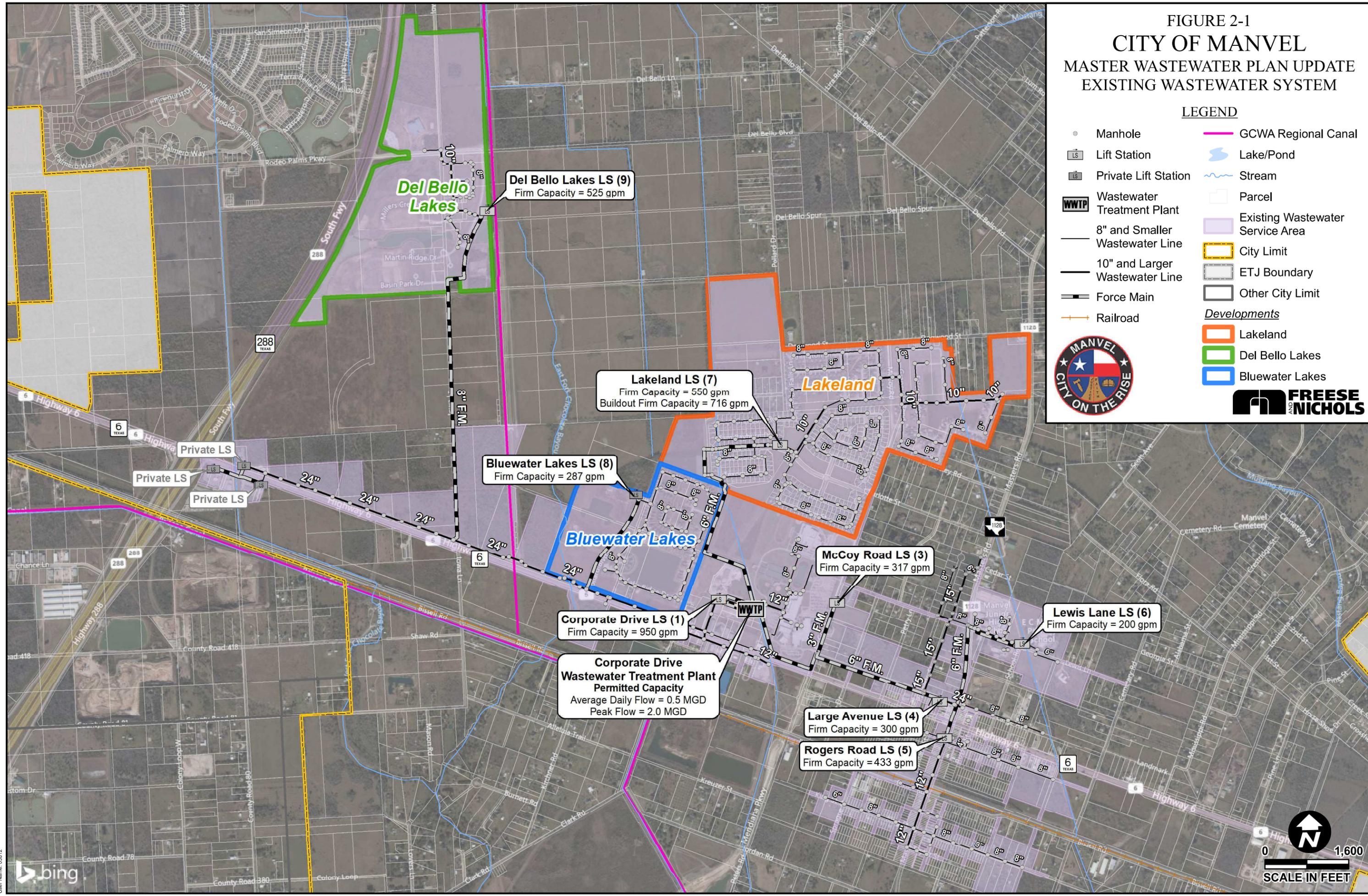
(e) Information based on lift station construction plans (Plans dated February 2, 2017)

(f) Information based on lift station construction plans (Plans dated March 7, 2019)

FIGURE 2-1
CITY OF MANVEL
 MASTER WASTEWATER PLAN UPDATE
 EXISTING WASTEWATER SYSTEM

LEGEND

- Manhole
 - LS Lift Station
 - Private Lift Station
 - WWTP Wastewater Treatment Plant
 - 8" and Smaller Wastewater Line
 - 10" and Larger Wastewater Line
 - Force Main
 - Railroad
 - GCWA Regional Canal
 - Lake/Pond
 - Stream
 - Parcel
 - Existing Wastewater Service Area
 - City Limit
 - ETJ Boundary
 - Other City Limit
- Developments*
- Lakeland
 - Del Bello Lakes
 - Bluewater Lakes
- 
- 



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2.3 COLLECTION SYSTEM

The City of Manvel’s existing wastewater collection system consists of approximately 17 miles of gravity lines and approximately 5 miles of force mains. Wastewater gravity line diameters range from 4-inches to 24-inches. The majority of the collection system network is comprised of 8-inch wastewater lines. **Figure 2-2** illustrates the percentage of pipe length by diameter based on the City’s geographic information system (GIS) database. Most of the known wastewater line material is Polyvinyl chloride (PVC), as illustrated on **Figure 2-3**. **Figure 2-4** shows the percentage of pipe length by installation decade where information was available. Most of the City’s gravity lines were installed after 2013.

Figure 2-2: Gravity Line Length by Diameter

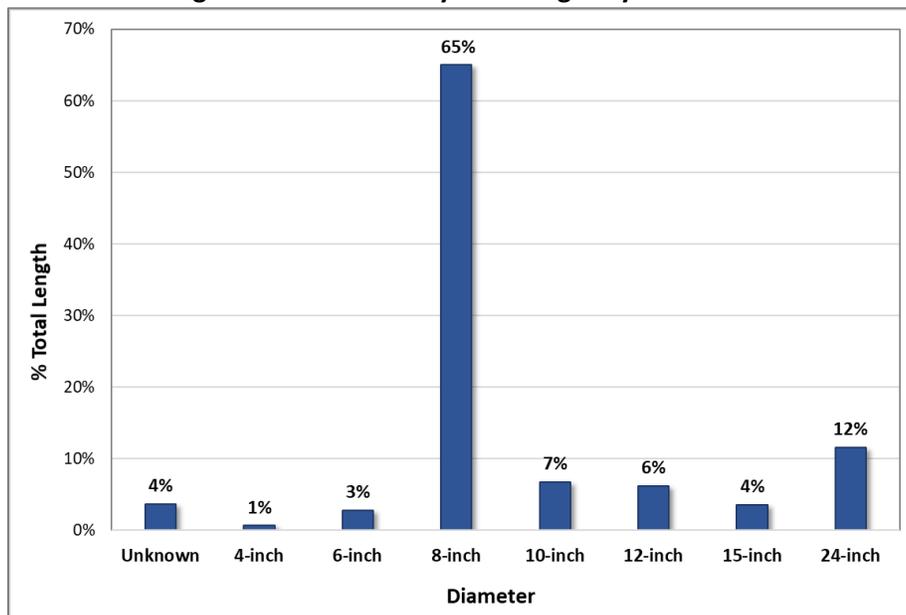


Figure 2-3: Gravity Pipe Length by Material

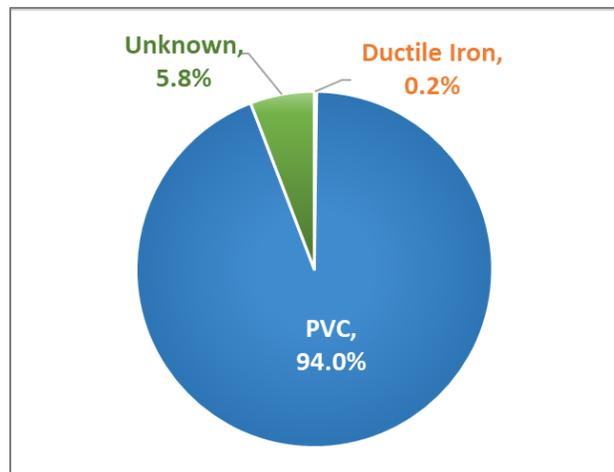
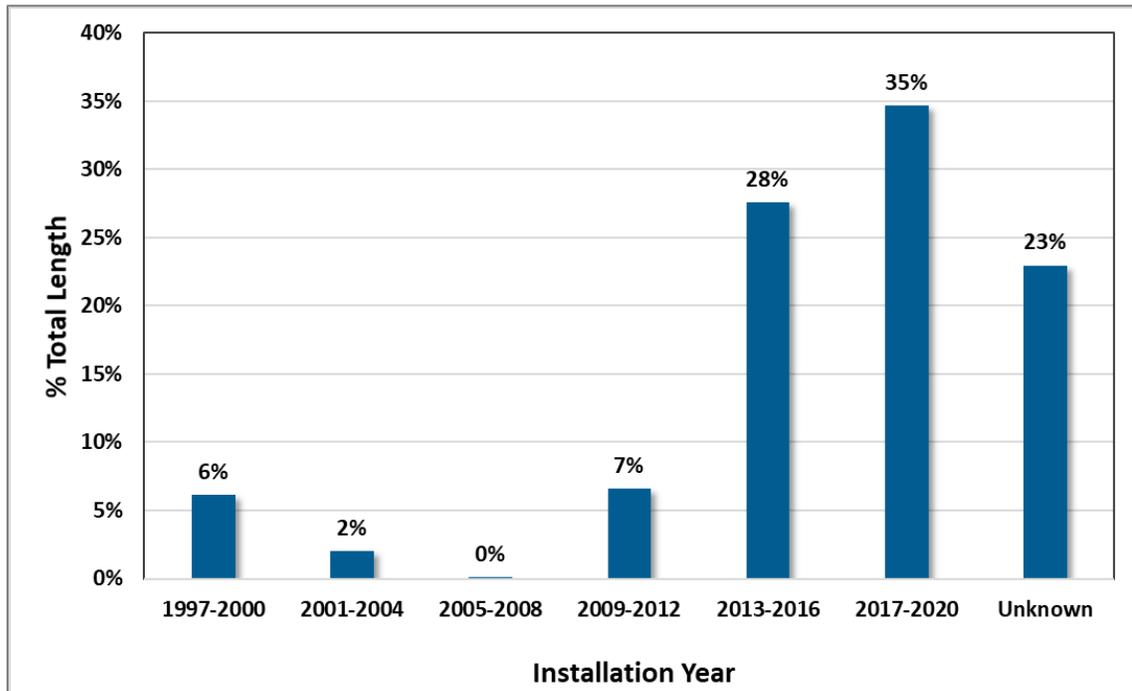




Figure 2-4: Gravity Pipe Length by Installation Year



The City recently completed construction of wastewater lines along Palmetto Street and Large Avenue. The GIS shapefiles and above figures have been updated to include the recently constructed lines per as-built plans or record drawings received from the City. These plans include:

- Large Avenue Sanitary Sewer Plan (2017)
- Terra Estates Sanitary Sewer Construction Plans (2020)

2.4 MUNICIPAL UTILITY DISTRICT (MUD) WASTEWATER TREATMENT PLANTS

In addition to the City of Manvel (Corporate Drive) wastewater treatment plant, there are four existing Municipal Utility District (MUD) WWTPs within the city limits and ETJ that serve the **Southfork**, **Sedona Lakes**, **Pomona**, **Rodeo Palms**, **Foxtail Palms**, **Newport Lake Estates**, and **Yanni Palms** developments. Information for these WWTPs, including the existing and future permitted average daily flow (ADF) and peak 2-Hour capacities are shown in **Table 2-3**.

Table 2-3: MUD Wastewater Treatment Plant Information

WWTP Name (Development) - TPDES Permit No.	Phase	ADF ⁽¹⁾ Permit (MGD)	Peak 2-Hour ⁽¹⁾ Permit (MGD)	Peaking Factor	Parcel Size (Acres)	Discharge ⁽¹⁾ Water(s)
Southfork - WQ0014322001	Interim II	0.48	1.90	4.0	5.8	American Canal in Segment No. 1100 of the San Jacinto-Brazos Coastal Basin
	Final	0.75	2.22	3.0		
Sedona Lakes - WQ0014756001	Interim I	0.15	0.6	4.0	4.58	Mustang Bayou
	Interim II	0.30⁽²⁾	1.2⁽²⁾	4.0		
	Final	0.60	2.4	4.0		
Pomona - WQ0014641001	Interim I	0.125	0.5	4.0	3.7	Mustang Bayou
	Interim II	0.25⁽³⁾	1.0⁽³⁾	4.0		
	Interim III	0.375	1.5	4.0		
	Final	0.50	2.0	4.0		
Rodeo Palms - WQ0014253001	Interim I	0.225	0.64	4.0	0.84	Brazoria County Drainage District No. 4 ditch E102-00-00, thence to Chocolate Bayou
	Interim II	0.375	1.12	3.0		
	Final	0.450⁽⁴⁾	1.27⁽⁴⁾	2.8		

(1) Permitted flow and discharge information from TCEQ TPDES Permits (Appendix C)

(2) Sedona Lakes has completed the first permitted expansion to 0.30 MGD ADF, and 1.2 Peak 2-Hour Flow

(3) Pomona has completed the first permitted expansion to 0.25 MGD ADF, and 1.0 Peak 2-Hour Flow

(4) Rodeo Palms has completed the final permitted expansion to 0.450 MGD ADF, and 1.27 Peak 2-Hour Flow. This WWTP serves Rodeo Palms, Foxtail Palms, Newport Lake Estates, and Yanni Palms developments.

3.0 LAND USE AND GROWTH PROJECTIONS

Land use and growth projections are important elements in the analysis of wastewater collection systems. Wastewater loads are dependent on the residential population and commercial development served by the system and affect the sizing and location of system infrastructure. FNI worked with City staff to develop growth projections for Manvel and also utilized information collected from the existing and upcoming developments within the city limits and ETJ. These growth projection assumptions were utilized throughout the *2022 Master Wastewater Plan Update*.

3.1 WASTEWATER SERVICE AREA

The City's existing wastewater collection system extends along Highway 6 from State Hwy 288 to the east and includes service to customers in **Lakeland**, **Bluewater Lakes**, and **Del Bello Lakes** development as well as additional connections within the city limits. The current wastewater service area covers approximately 2.3 square miles and is shown in **purple** on **Figure 3-1**.

There are three MUD WWTPs and associated collection system infrastructure within the **Rodeo Palms**, **Pomona**, and **Southfork** developments that serve customers west of SH 288 within Manvel city limits and ETJ and a fourth MUD WWTP to the north at **Sedona Lakes** development. These MUD WWTPs are independent from the City's collection system. This master plan incorporates a 20-year planning period, during which the City plans to assume ownership and operation of the independent wastewater systems to the west of SH 288 discussed above as well as extend wastewater service to additional customers within the city limits. The 20-year wastewater service area for this master plan covers approximately 30 square miles and is shown in **green** on **Figure 3-1**.

Future Developments

FNI worked with City staff to identify future developments as shown on **Figure 3-2**. This includes the existing and anticipated development in the Manvel ETJ including Rodeo Palms, Pomona, Southfork, Town Center, Foxtail Palms, Newport Lake Estates, Yanni Palms, MUD 47 and Avellino Palms, Presidio, Valencia, Terra Estates, Manvel City Center, Sedona Lakes, and Meridiana. Additional information on these developments is provided in the following sub-sections of this report.

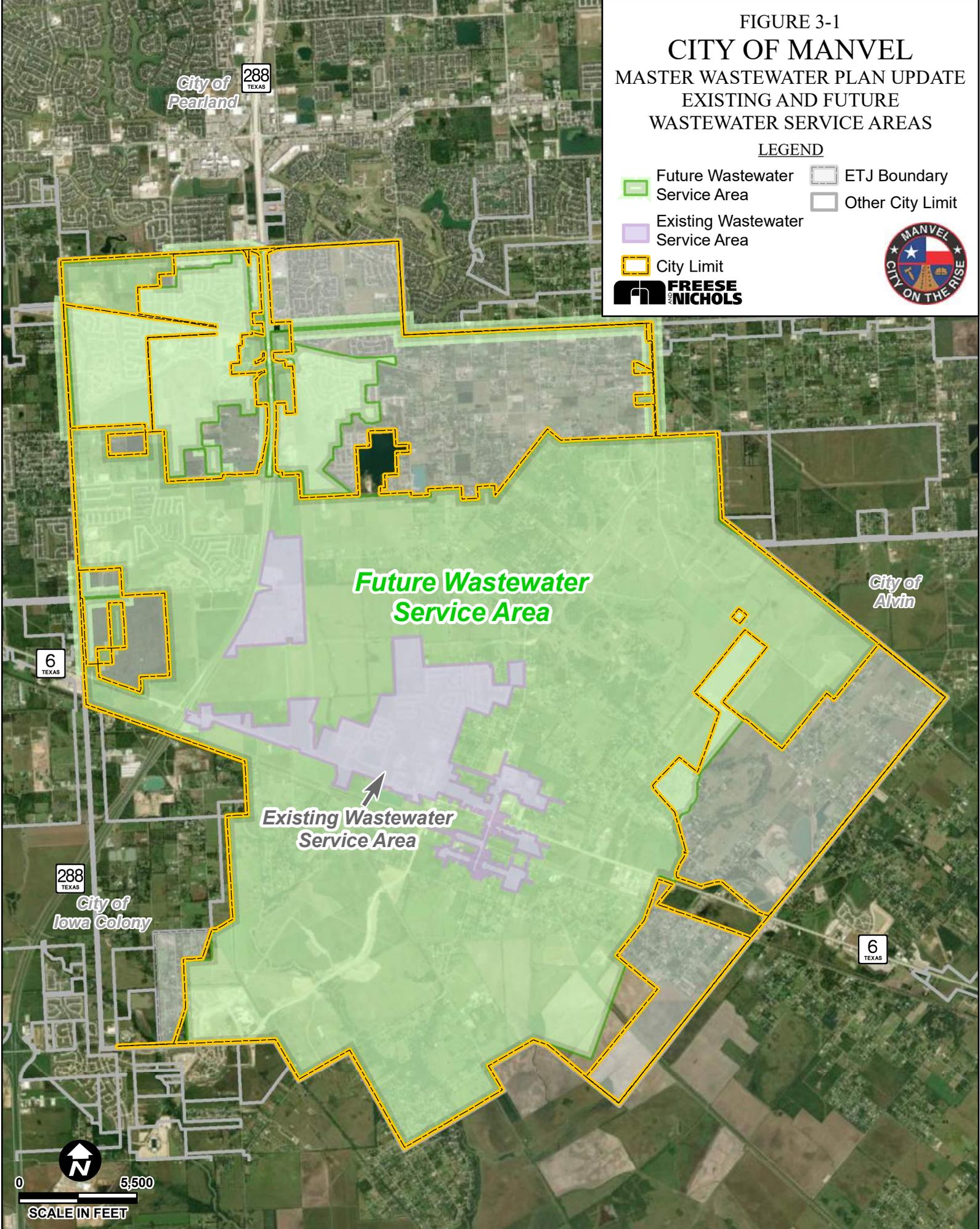
Infill Areas

Infill projections were developed for parcels not already identified as an anticipated development. This allows the City to plan for wastewater service to these additional areas with the potential to develop within the city limits. Based on the general location, these are referred to as City Central, City East, City West, and City South infill areas in this master plan.

FIGURE 3-1
CITY OF MANVEL
 MASTER WASTEWATER PLAN UPDATE
 EXISTING AND FUTURE
 WASTEWATER SERVICE AREAS

LEGEND

- Future Wastewater Service Area
- Existing Wastewater Service Area
- City Limit
- ETJ Boundary
- Other City Limit



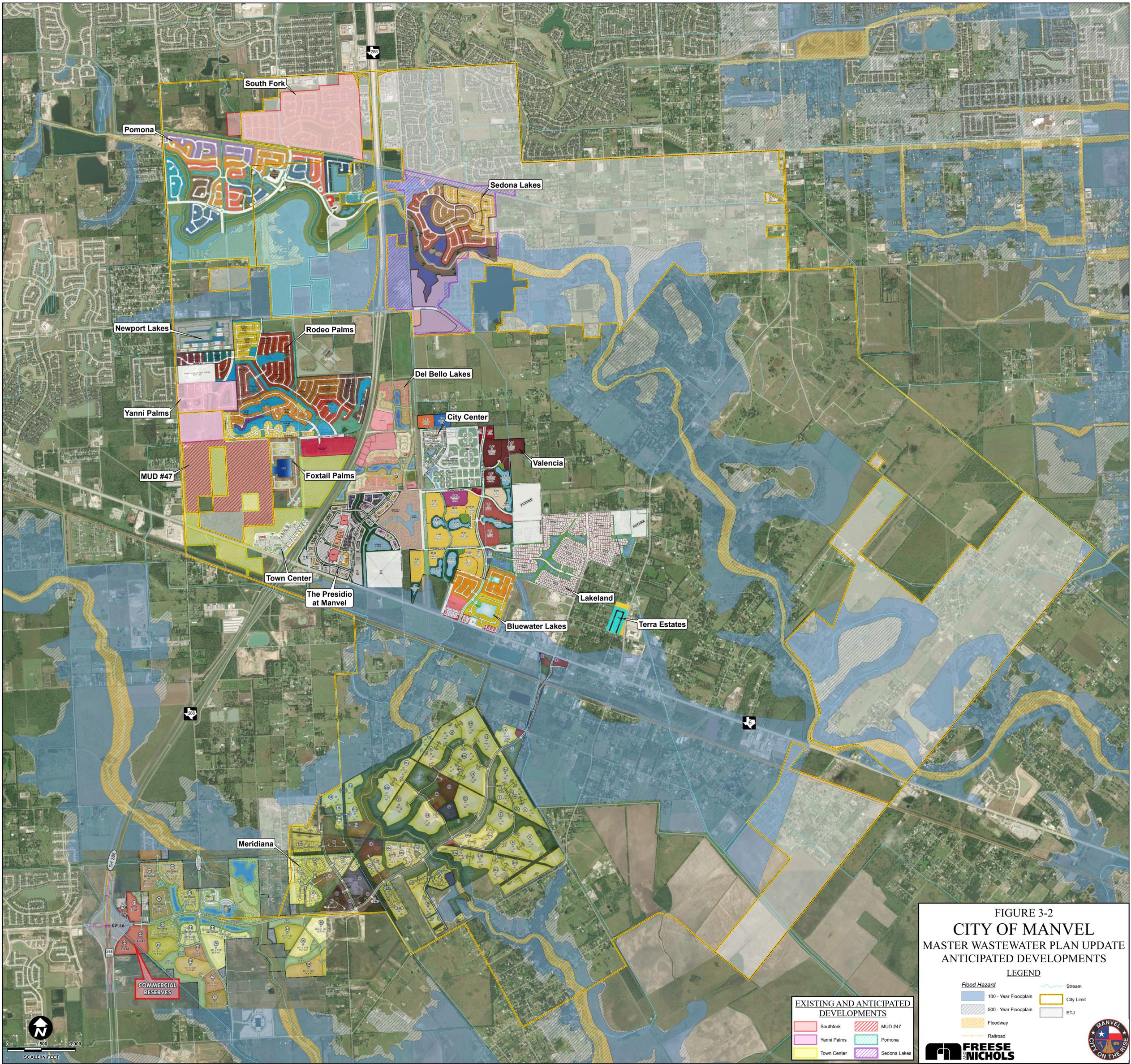


FIGURE 3-2
CITY OF MANVEL
 MASTER WASTEWATER PLAN UPDATE
 ANTICIPATED DEVELOPMENTS

LEGEND

100 - Year Floodplain	Stream
500 - Year Floodplain	City Limit
Floodway	ETJ
Railroad	

EXISTING AND ANTICIPATED DEVELOPMENTS

Southfork	MUD #47
Yannii Palms	Pomona
Town Center	Sedona Lakes

0 1,500 3,000
 SCALE IN FEET

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3.2 GROWTH PROJECTIONS

The growth in residential and commercial wastewater connections will inform the location, sizing, and timing of future wastewater infrastructure. Projecting residential and commercial growth is challenging, especially for small geographic areas such as individual cities because it can be difficult to predict how fast or slow development will occur when there are a variety of circumstances that can impact it. A thorough analysis of projected growth in the wastewater service area provides the basis for future wastewater loads and infrastructure recommendations.

3.2.1 Existing Wastewater Connections

The City utilizes equivalent single family connections (ESFCs) to project wastewater loads and to determine the sizing and location of wastewater system infrastructure. These represent residential and commercial wastewater customers. Each ESFC represents a wastewater load (gallons/day) that must be conveyed and treated by the wastewater system. The City of Manvel Utility Billing Department provided information on existing number of water meters and their corresponding sizes. Utilizing this data and additional information received from the City, it was calculated that as of July 2021, Manvel served 1,635 ESFCs in their wastewater system.

3.2.2 Projected Wastewater Connections

FNI developed projected wastewater ESFCs for the **5-year**, **10-year**, and **20-year** planning periods for this *2022 Master Wastewater Plan Update*. During this study, FNI received future projection information from the City, developers, and available development documents for the anticipated developments shown on **Figure 3-2**. The developers of each anticipated development supplied projected buildout connections and an approximate growth per year. For developments where a phasing plan was unavailable, FNI worked with the City staff to develop growth assumptions. In addition to the known developments, growth projections were also developed for select areas within the wastewater service area identified as having potential for growth (infill areas) within the 20-year planning period. A summary of data sources utilized during wastewater ESFCs projections are provided below:

- Information from development engineers for known developments (where available)
- Input from City Staff
- Developed lot counts from recent aerial photography

- Assumptions for timing of development, connections/acre, and city infill based on developer information and related project experience

The total projected ESFCs by planning year are presented in **Table 3-1** and on **Figure 3-3**. Planning year ESFCs for individual developments as well as infill areas are shown on **Figure 3-4**. Detailed information on projected wastewater connections for each development are included in **Table 3-2**.

Table 3-1: Projected Wastewater ESFCs

Year	Projected Wastewater ESFCs		
	City Limits	ETJ	Total
2021	3,628 ⁽¹⁾	3,155	6,783
2026	8,904	5,876	14,780
2031	13,311	6,530	19,841
2041	25,412	6,541	31,953

(1) Includes existing wastewater connections in developments within city limits that are not currently served by the City.

Figure 3-3: Projected Wastewater ESFCs

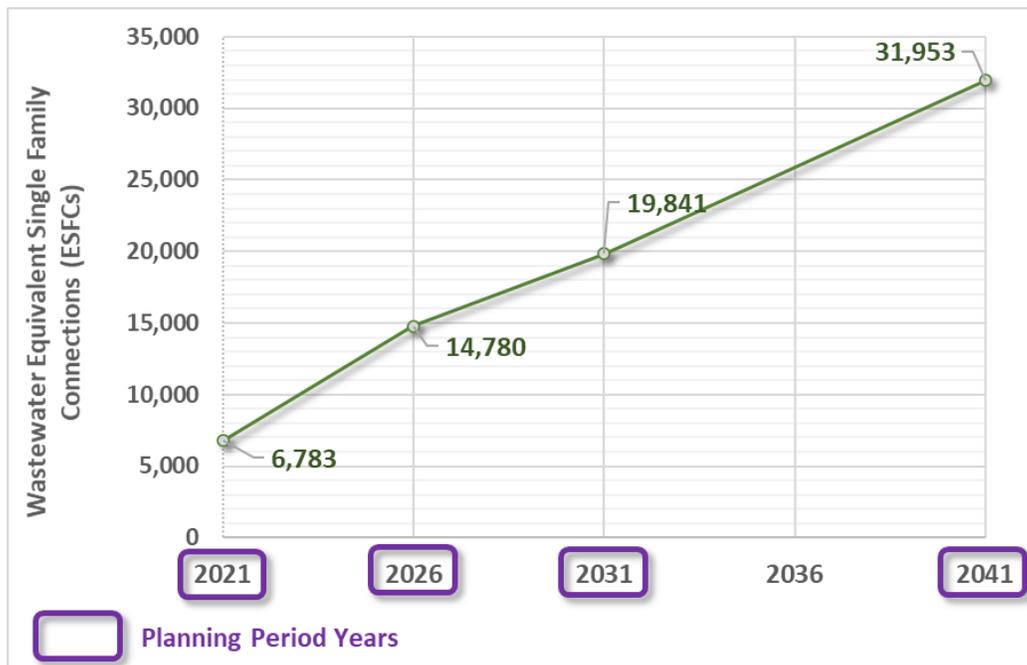


FIGURE 3-4

CITY OF MANVEL

MASTER WASTEWATER PLAN UPDATE

ANTICIPATED DEVELOPMENTS AND PROJECTED ESFCs

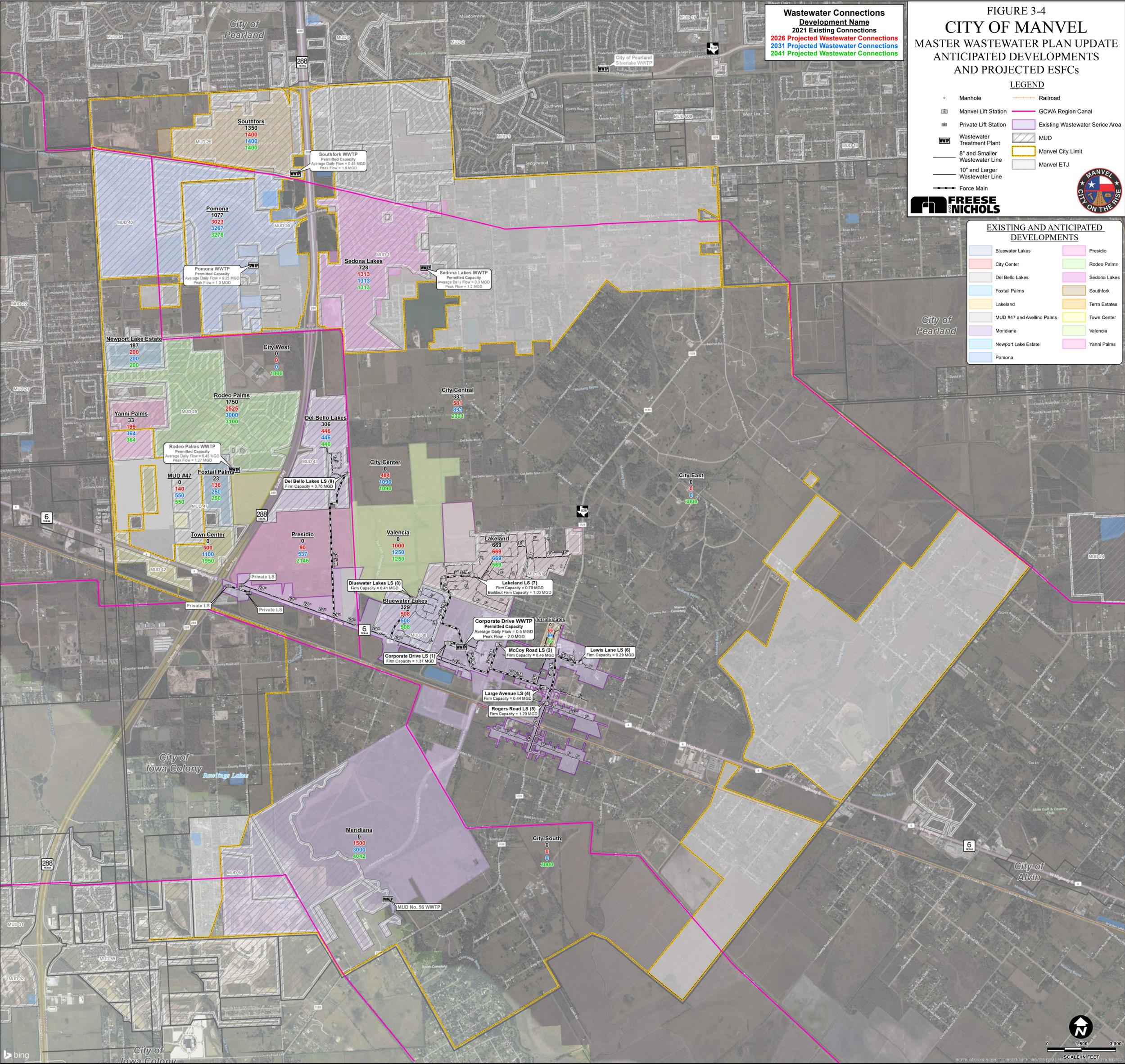
Wastewater Connections
Development Name
2021 Existing Connections
2026 Projected Wastewater Connections
2031 Projected Wastewater Connections
2041 Projected Wastewater Connections

LEGEND

- Manhole
- ▣ Manvel Lift Station
- ▣ Private Lift Station
- ▣ Wastewater Treatment Plant
- 8" and Smaller Wastewater Line
- 10" and Larger Wastewater Line
- Force Main
- Railroad
- GCWA Region Canal
- ▣ Existing Wastewater Service Area
- ▣ MUD
- ▣ Manvel City Limit
- ▣ Manvel ETJ

EXISTING AND ANTICIPATED DEVELOPMENTS

- Bluewater Lakes
- City Center
- Del Bello Lakes
- Foxtail Palms
- Lakeland
- MUD #47 and Avellina Palms
- Meridiana
- Newport Lake Estate
- Pomona
- Presidio
- Rodeo Palms
- Sedona Lakes
- Southfork
- Terra Estates
- Town Center
- Valencia
- Yanni Palms



City of Manvel Master Wastewater Plan Update



Table 3-2: Projected Wastewater ESFCs per Development

Development/Area	BC MUD #	ESFCs		Buildout Year	Notes on Projected ESFCs and Growth Rate	
		2021	2041 ⁽¹⁾			
West Basin	Rodeo Palms	MUD #29	1,750	3,100	2033	Received from Developer
	Pomona	MUD #39 and #40	1,077	3,278	2032	Received from Developer
	Southfork	MUD #25	1,350	1,400	2024	Received from Developer
	Town Center	MUD #42	0	1,950	2039	Received from Developer
	Foxtail Palms	MUD #29	23	250	2031	Buildout information from Developer
	Newport Lake Estates		187	200	2022	Existing and buildout information, and buildout year from City
	Yanni Palms		33	364	2031	Buildout information from Developer
	MUD 47 and Avellino Palms	MUD #47	0	550	2031	Buildout information from Developer; assuming Avellino Palms Buildout by 2026
	City West	-	0	1,000	Beyond 2041	Assumed 100 ESFCs added to the City's collection system per year beyond 10-years (starting 2032).
Central Basin	Del Bello Lakes	MUD #43	306	446	2022	Existing and buildout information, and buildout year from City
	Presidio	MUD #30	0	2,146	2041	Buildout projections from developer; to be completed in 5-15 years; master plan projections assuming starts in 2026; 25% Buildout by 2031, 50% Buildout by 2036, 100% Buildout by 2041.
	Valencia	-	0	1,250	2027	Buildout ESFCs of from Developer; Projected to start construction in 2022 per City; projected buildout year from developer.
	Manvel City Center	-	0	1,090	2031	Calculated wastewater ESFCs based on approved Mancel City Center Scheme B; projected to start in 2023 and buildout by 2031 per City
	Bluewater Lakes	MUD #66	329	508	2022	Existing and buildout information, and buildout year from City
	Lakeland	MUD #61	669	669	2021	Buildout information from City
	Terra Estates		0	66	2023	Buildout information from City
	City Central	-	331	2,331	Beyond 2041	Applied 2.0 connections/acre for all land (including currently developed) in the Central Basin not in a currently identified development, in the 100-year floodplain, on the selected WWTP parcels, or in the ETJ. Assumed 50 connections/year through 2031. Assumed 150 connections/year everywhere through 2041.
East Basin	City East	-	0	3,000	Beyond 2041	Applied 2.0 connections/acre for all land (including currently developed) in the East Basin not in a currently identified development, in the floodplain, on the selected WWTP parcels, or in the ETJ. Assumed 300 ESFCs added per year beyond 2031.
South Basin	City South	-	0	3,000	Beyond 2041	Applied 2.0 connections/acre for all land (including currently developed) in the South Basin not in a currently identified development, in the floodplain, on the selected WWTP parcels, or in the ETJ. Assumed 300 ESFCs added per year beyond 2031.
	Sedona Lakes	MUD #1	728	1,313	2025	Received from Developer
	Meridiana	MUD # 56 and #57	0	4,042	2035	Received from City

(1) All projections end at the 20-Year planning period (2041)

4.0 WASTEWATER FLOWS

Planning for future wastewater infrastructure is dependent on the amount of average daily and peak wastewater flow that must be collected, conveyed, and treated. Wastewater treatment plants are sized based on average daily flows, while the collection system infrastructure, including lift stations, is sized to convey peak wastewater flows.

In this master plan update, FNI documented the existing City of Manvel (Corporate Drive) WWTP historical wastewater flows and the City’s wastewater flow design criteria. FNI also developed wastewater service areas for regional wastewater conveyance and treatment infrastructure, and projected average day and peak wastewater flows for the existing, **5-year**, **10-year**, and **20-year** planning periods in this study. These flows were utilized in the hydraulic modeling and system planning to develop future wastewater collection and treatment system improvements.

4.1 HISTORICAL WASTEWATER FLOWS

The City provided FNI with monthly average wastewater effluent data from July 2009 to June 2020. More recent annual average flows for the City of Manvel (Corporate Drive) WWTP were obtained from Texas Commission on Environmental Quality (TCEQ) Texas Pollutant Discharge Monitoring Reports (DMRs). The City of Manvel WWTP was permitted for 0.25 MGD of annual average daily flow (AADF) until January 2019 when the permitted AADF was increased to 0.5 MGD and the plant was expanded. The historical WWTP flows are shown in **Table 4-1**.

Table 4-1: Historical City of Manvel WWTP Flows

Year	Annual Average Daily Flow ⁽¹⁾ (MGD)
2016	0.18
2017	0.16
2018	0.12
2019	0.16
2020	0.19
2021	0.26
Average	0.18
Maximum	0.26

(1) Data from TCEQ website

4.2 REGIONAL WASTEWATER TREATMENT PLANT SERVICE AREAS

The City's existing wastewater system consists of a single wastewater service area that collects wastewater flows and conveys them to the City of Manvel (Corporate Drive) WWTP. For the City's future wastewater system, FNI delineated six distinct wastewater service areas that will each convey wastewater flows to regional wastewater treatment facilities.

1. Central Wastewater Service Area

The City currently owns and operates the wastewater treatment plant located at 7315 Corporate Drive. This WWTP was expanded to an average day capacity to 0.5 MGD in 2019. The City also owns approximately 6.5 acres of land near the existing WWTP site that has been selected for a regional wastewater treatment facility that will expand the total treatment capacity for the Central region.

The City's existing wastewater treatment plant serves residential and commercial City connections, as well as the **Lakeland**, **Bluewater Lakes**, and **Del Bello Lakes** developments, as of July 2021. The Central Wastewater Service Area is also planned to include all projected wastewater flows from the **Presidio**, **Valencia**, **Terra Estates**, and **Manvel City Center** developments. The capital improvements plan (discussed in **Section 8.0**) identifies infrastructure to treat and convey wastewater flows from the Central Service Area to a regional WWTP in the Central Wastewater Service Area for treatment. The proposed **Central** Wastewater Service Area is shown on **Figure 4-1**.

2. East Wastewater Service Area

The City does not currently have wastewater infrastructure in the eastern portions of the Manvel city limits but anticipates extending wastewater service to customers in these areas in the future. Existing residential and commercial properties in these areas are primarily rural, and there are large portions of vacant, developable land. The East service area will be part of the Mustang Bayou watershed north of the Bissel Road, and the topography in this area slopes generally from the northwest to the southeast. This study recommends a new East Service Area Regional Lift Station to pump wastewater flows generated in these areas to the **Central** WWTP. This lift station is proposed to be located near Mustang Bayou and Hwy 6. The proposed **East** Wastewater Service Area is shown on **Figure 4-1**.



3. West Wastewater Service Area

There are eight (8) existing and anticipated developments west of State Highway (SH) 288 that are inside the City's ETJ and/or city limits. There are three MUD WWTPs in this area. The MUD WWTPs at **Southfork** and **Pomona** serve the respective developments. The MUD WWTP at **Rodeo Palms** serve Rodeo Palms **Foxtail Palms**, **Newport Lake Estates**, **Yanni Palms**, and plan to serve **MUD 47** and **Avellino Palms** developments. The service is to be established by a development agreement. The upcoming **Town Center** development is currently undergoing construction of a WWTP for the development. The City's *2017 Master Wastewater Plan* proposed a regional WWTP to the west of SH 288 due to the difficulty and cost associated with transferring wastewater flows across the highway. This regional WWTP is planned to serve the **West** Wastewater Service Area (shown on **Figure 4-1**) and allow for the consolidation of all of the MUD plants West of SH 288.

The first phase of the West Regional WWTP is scheduled to be under design as of December 2021 in the vicinity of the **Rodeo Palms** development for an annual average day flow capacity of 2.0 MGD. This study includes recommendation of a future expansion of this WWTP to eventually serve all the wastewater flows generated in this service area.

4. Sedona Lakes Wastewater Service Area

The **Sedona Lakes** development in the Manvel ETJ has an existing MUD WWTP that serves the flows generated within the development. Due to the general location of this development and potential cost of infrastructure to transfer flows to other service areas, it is recommended that Sedona Lakes continue to be served as its own service area. It is also recommended that the City takes over the operation of this WWTP and continue operating this as the Sedona Lakes Service Area WWTP. The proposed **Sedona Lakes** Wastewater Service Area is shown on **Figure 4-1**.

5. South Wastewater Service Area

The area within the city limits south of Bissel Road is identified as the **South** service area. Existing residential and commercial properties in these areas are primarily rural, and there are large portions of vacant, developable land. This study includes recommendation of a new South Area Regional Wastewater Treatment Plant to treat wastewater flows generated in this area. The proposed **South** Wastewater Service Area is shown on **Figure 4-1**.



6. Meridiana Wastewater Service Area (Manvel City Limits)

The **Meridiana** development spans portions of the City of Iowa Colony and the City of Manvel. The portion of Meridiana within the City of Manvel is located in Brazoria County MUDs 56 and 57. This development is planning to have its own collection system infrastructure and WWTP (currently under construction). There will be potential for future consolidation of the Meridiana WWTP and conveying the flows to the South Regional WWTP in future beyond the scope of this study. FNI quantified the projections from the Meridiana development within the Manvel city limits separately from the South service area and these projections are shown under **Meridiana** Wastewater Service Area on **Figure 4-1**.

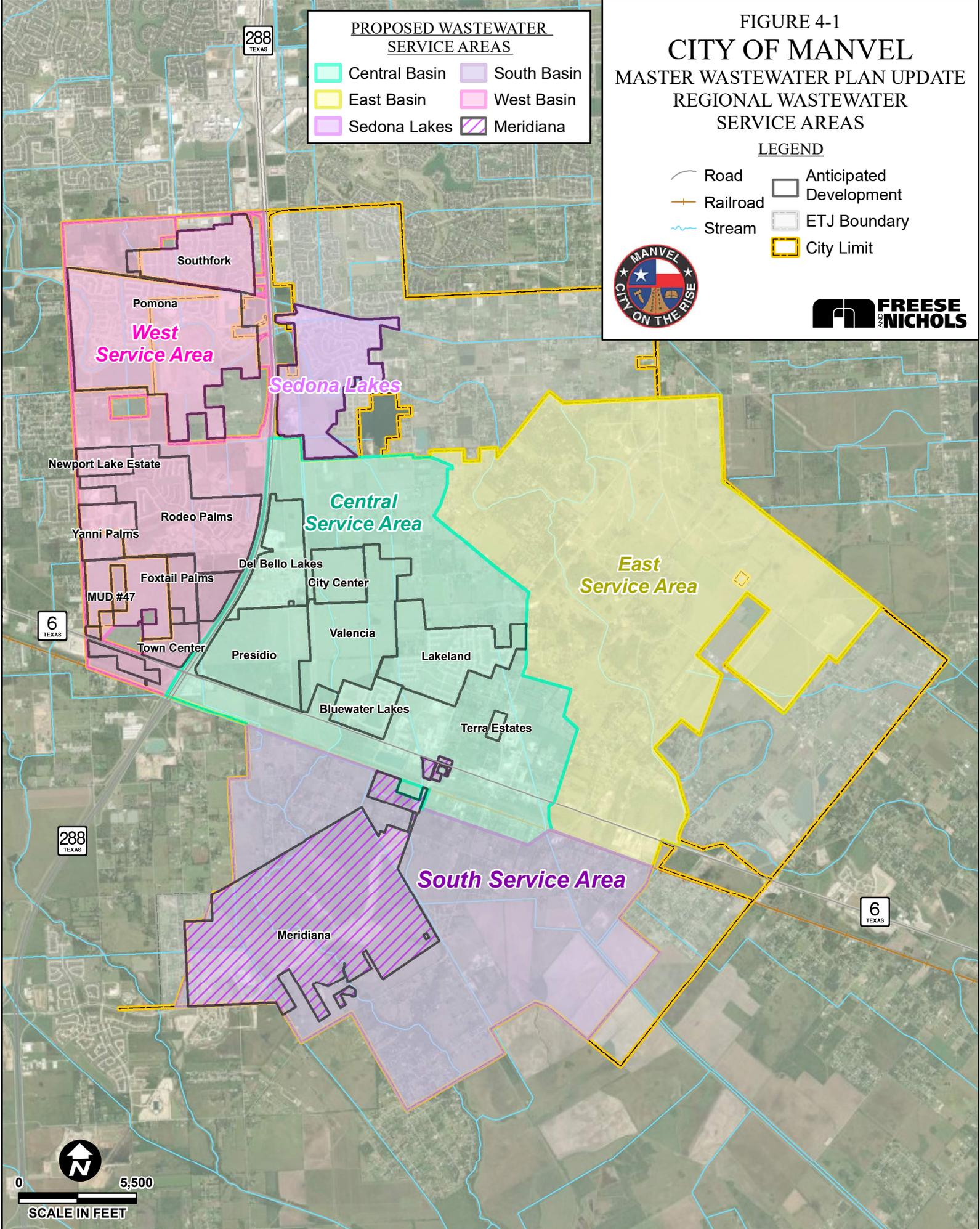
FIGURE 4-1
CITY OF MANVEL
 MASTER WASTEWATER PLAN UPDATE
 REGIONAL WASTEWATER
 SERVICE AREAS

PROPOSED WASTEWATER SERVICE AREAS

 Central Basin	 South Basin
 East Basin	 West Basin
 Sedona Lakes	 Meridiana

LEGEND

	Road		Anticipated Development
	Railroad		ETJ Boundary
	Stream		City Limit



6 TEXAS

288 TEXAS

6 TEXAS



0 5,500
SCALE IN FEET

4.3 WASTEWATER FLOW PROJECTIONS

4.3.1 Wastewater Flow Design Criteria

The City of Manvel utilizes a design criteria of 315 gallons per day of wastewater flow per equivalent single family connection (ESFC). Based on the historical WWTP flows, FNI recommends applying this design criteria to all projected wastewater ESFCs in this Master Plan to calculate average day wastewater flows. For peak flows, FNI recommends using a peaking factor of 4.0, based on TCEQ guidelines in the absence of site specific data (30 TAC §217.32 (a)(2)). The planning criteria used for developing all projected average day and peak wastewater flows for this Master Plan is shown in **Table 4-2**.

Table 4-2: Wastewater Flow Design Criteria

Wastewater Connection Unit	Average Day Wastewater Flow	Peak Wastewater Flow
ESFC ⁽¹⁾	315 gallons per day	4.0 x 315 gallons per day

(1) Equivalent Single Family Connection

4.3.2 Projected Wastewater Flows

FNI calculated future wastewater flows based on the projected equivalent single family connections and wastewater flow design criteria. The projected average day and peak wet weather wastewater flows for the wastewater service area (**Figure 3-1**) for each planning year are shown in **Table 4-3**. The existing and projected wastewater flows are shown graphically on **Figure 4-2**.

Table 4-3: Projected Wastewater Flows

Year	Projected Wastewater ESFCs			Average Daily Flow (ADF) (MGD)			Peak Wet Weather Flow (MGD)		
	City Limits	ETJ	Total	City Limits	ETJ	Total	City Limits	ETJ	Total
2021	3,628 ⁽¹⁾	3,155	6,783	1.14	0.99	2.1	4.57	3.98	8.5
2026	8,904	5,876	14,780	2.80	1.85	4.7	11.22	7.40	18.6
2031	13,311	6,530	19,841	4.19	2.06	6.2	16.77	8.23	25.0
2041	25,412	6,541	31,953	8.00	2.06	10.1	32.02	8.24	40.3

(1) Includes existing wastewater connections in developments within city limits not currently served by the City.

Table 4-4 summarizes the projected ESFCs, average day wastewater flows, and peak wet weather wastewater flows for each development and WWTP Service Area for each planning year.

Table 4-4: Projected Wastewater Flows by Service Area

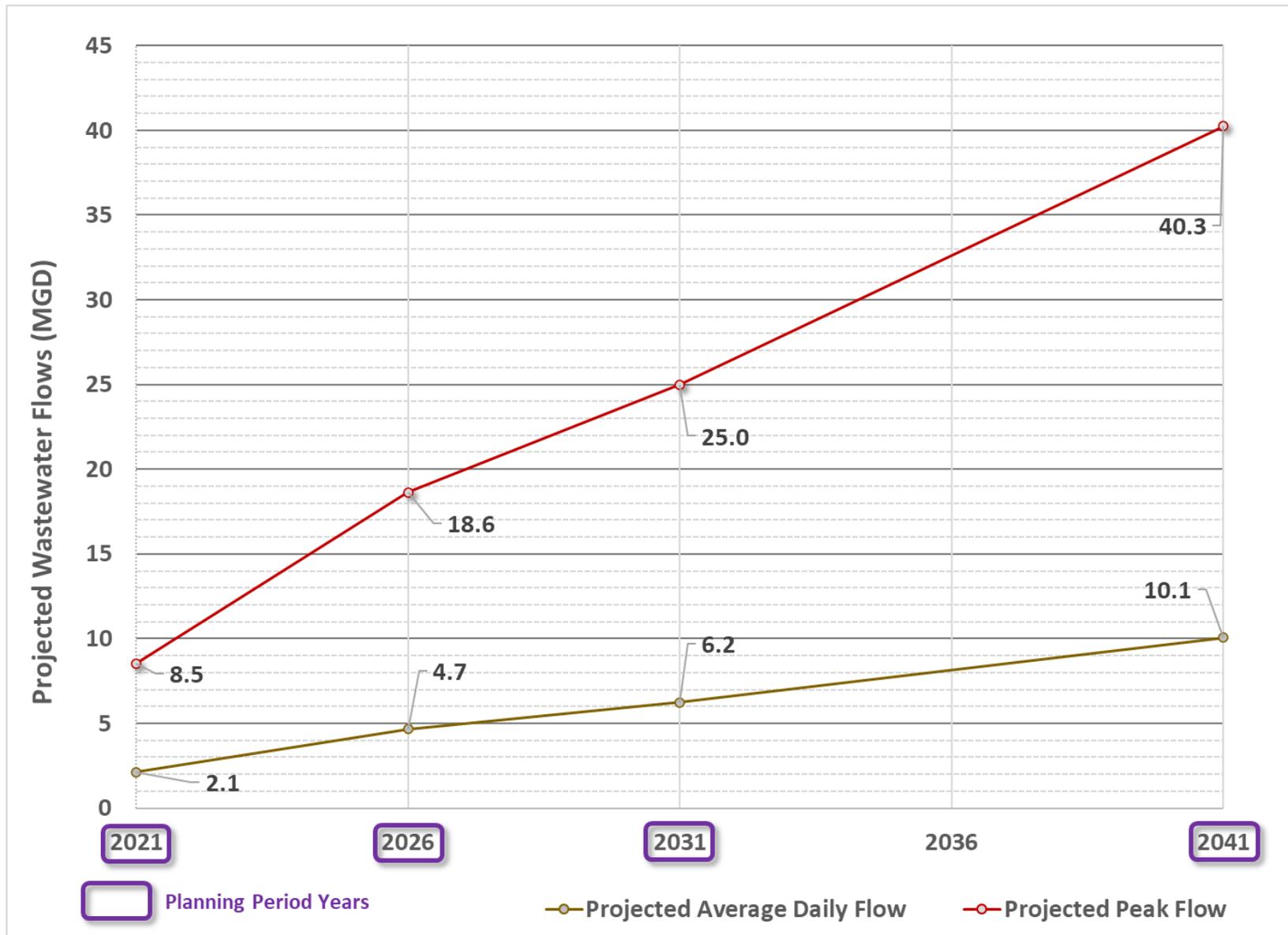
Development/Area		2021 (Existing)				2026 (5-year)				2031 (10-year)				2041 (20-year)			
		ESFCs ⁽¹⁾	%	ADF	Peak	ESFCs ⁽¹⁾	%	ADF	Peak	ESFCs ⁽¹⁾	%	ADF	Peak	ESFCs ⁽¹⁾	%	ADF	Peak
West Basin	Rodeo Palms	1,750	56%	0.55	2.2	2,525	81%	0.80	3.2	3,000	97%	0.95	3.8	3,100	100%	0.98	3.9
	Pomona	1,077	33%	0.34	1.4	3,023	92%	0.95	3.8	3,267	100%	1.03	4.1	3,278	100%	1.03	4.1
	Southfork	1,350	96%	0.43	1.7	1,400	100%	0.44	1.8	1,400	100%	0.44	1.8	1,400	100%	0.44	1.8
	Town Center	0	0%	0.00	0.0	500	26%	0.16	0.6	1,100	56%	0.35	1.4	1,950	100%	0.61	2.5
	Foxtail Palms	23	9%	0.01	0.0	136	54%	0.04	0.2	250	100%	0.08	0.3	250	100%	0.08	0.3
	Newport Lake Estates	187	86%	0.06	0.2	200	100%	0.06	0.3	200	100%	0.06	0.3	200	100%	0.06	0.3
	Yanni Palms	33	9%	0.01	0.0	199	55%	0.06	0.3	364	100%	0.11	0.5	364	100%	0.11	0.5
	MUD 47 and Avellino Palms	0	0%	0.00	0.0	140	25%	0.04	0.2	550	100%	0.17	0.7	550	100%	0.17	0.7
	City West	0	-	0.00	0.0	0	-	0.00	0.0	0	-	0.00	0.0	1,000	-	0.32	1.3
	West Basin Subtotal	4,420	-	1.4	5.6	8,123	-	2.6	10.2	10,131	-	3.2	12.8	12,092	-	3.8	15.2
Central Basin	Del Bello Lakes	306	69%	0.10	0.4	446	100%	0.14	0.6	446	100%	0.14	0.6	446	100%	0.14	0.6
	Presidio	0	0%	0.00	0.0	90	4%	0.03	0.1	537	25%	0.17	0.7	2,146	100%	0.68	2.7
	Valencia	0	0%	0.00	0.0	1,000	80%	0.32	1.3	1,250	100%	0.39	1.6	1,250	100%	0.39	1.6
	Manvel City Center	0	0%	0.00	0.0	484	44%	0.15	0.6	1,090	100%	0.34	1.4	1,090	100%	0.34	1.4
	Bluewater Lakes	329	65%	0.10	0.4	508	100%	0.16	0.6	508	100%	0.16	0.6	508	100%	0.16	0.6
	Lakeland	669	100%	0.21	0.8	669	100%	0.21	0.8	669	100%	0.21	0.8	669	100%	0.21	0.8
	Terra Estates	0	0%	0.00	0.0	66	100%	0.02	0.1	66	100%	0.02	0.1	66	100%	0.02	0.1
	City Central	331	-	0.10	0.4	581	-	0.18	0.7	831	-	0.26	1.0	2,331	-	0.73	2.9
	Central Basin Subtotal	1,635	-	0.5	2.1	3,844	-	1.2	4.8	5,397	-	1.7	6.8	8,506	-	2.7	10.7
Sedona Lakes	728	55%	0.23	0.9	1,313	100%	0.41	1.7	1,313	100%	0.41	1.7	1,313	100%	0.41	1.7	
City East	0	-	0.00	0.0	0	-	0.00	0.0	0	-	0.00	0.0	3,000	-	0.95	3.8	
City South	0	-	0.00	0.0	0	-	0.00	0.0	0	-	0.00	0.0	3,000	-	0.95	3.8	
Meridiana	0	0%	0.00	0.0	1,500	37%	0.47	1.9	3,000	74%	0.95	3.8	4,042	100%	1.27	5.1	
Total	6,783	-	2.1	8.5	14,780	-	4.7	18.6	19,841	-	6.2	25.0	31,953	-	10.1	40.3	

(1) Equivalent Single Family Connection (ESFC). One ESFC = 315 Gallons of wastewater flow/day

(2) Percent Developed based on [ESFCs/2041 ESFCs]

(3) Peak Flow = 4.0 x Average Day Flow (ADF)

Figure 4-2: Projected Wastewater Flows



5.0 WASTEWATER MODEL UPDATE

The City's existing wastewater hydraulic model was developed during the *2017 Master Wastewater Plan* utilizing the InfoSewer® software by Innovyze. This software has GIS interoperability and makes use of engineering equations and mathematical algorithms to determine the flows and velocities that would occur in a collection system under a specified set of conditions.

During this 2021 update, the model was updated with recently completed wastewater infrastructure and updated flow projections. The updated model was utilized during the development of collection system capital improvement projects to improve the existing system and accommodate projected wastewater flows through 2041.

Various combinations of improvements and system modifications were investigated to assess options for conveying projected flows to regional wastewater treatment plants. Parameters used in developing the capital improvements plan included increasing system reliability, simplifying system operations, conveying peak wet weather flows and reducing the likelihood of surcharging and sanitary sewer overflows.

5.1 MODELED INFRASTRUCTURE

All wastewater gravity lines with diameters of 10-inches or larger, existing force mains and active lift station in the planning period were included in the model utilizing the latest wastewater GIS shapefile. The modeled infrastructure was updated to incorporate the following recently constructed projects based on the as-built plans:

- Large Avenue Sanitary Sewer Plan (2017)
- Terra Estates Sanitary Sewer Construction Plans (2020)
- Bluewater Lakes Lift Station No. 1 (2017)
- Del Bello Lakes Lift Station No. 1 (2019)

In this model, any missing manhole rim elevations were populated using as-built data (where available) or interpolated ground elevations from a triangular irregular network (TIN) of two-foot contours. For missing gravity line invert data, Texas Commission on Environmental Quality (TCEQ) minimum slopes were assigned to the wastewater lines, beginning at the last known invert elevation. The wet well and pumping



facilities were manually added to the model based on as-built drawings, information provided by the City, and engineering judgment.

The proposed collection system infrastructure, including manholes, gravity mains, force mains and lift stations, were added to the model as part of the system analysis. The model consists of approximately 225 links (gravity lines and force mains), 240 nodes (manholes and wet wells and including three outfalls), 14 lift stations, and 19 pumps.

6.0 WASTEWATER SYSTEM ANALYSES

FNI developed wastewater system improvements to accommodate the projected flows from residential and commercial growth. Hydraulic analyses were conducted to develop these improvements into a phased capital improvements plan to convey and treat the projected wastewater flows over the 20-year period through 2041. In order to serve the projected 20-year growth and regionalize wastewater treatment facilities, the City of Manvel should consider the following:

- Construct a new phased Central wastewater treatment plant expanding the existing Central region wastewater treatment capacity and eventually building future capacity (currently in preliminary design phase)
- Construct regional transfer infrastructure to pump wastewater flows from the East Service Area to the Central Service Area
- Construct a new wastewater treatment plant in the South service area
- Construct consolidation infrastructure and expand treatment capacity in the West Service Area
- Extend wastewater service via gravity lines, lift stations, and force mains to areas of growth where little or no infrastructure currently exists

6.1 GRAVITY LINE AND LIFT STATION DESIGN CRITERIA AND ANALYSES

The Texas Commission on Environmental Quality (TCEQ) provides specific design criteria for new wastewater gravity lines and lift stations. FNI utilized these design criteria for the recommended wastewater system improvements.

6.1.1 Design Criteria for Gravity Lines

When determining the size of proposed wastewater lines, TCEQ §217.53 (a)(1) dictates that the collection system must be designed to transport the peak wet weather flows. Per TCEQ §217.53 (l)(1), collection systems must also be designed to maintain a minimum velocity of 2 feet/second when flowing at full capacity. Maintaining these velocities discourages the settling of solids. In accordance with this, TCEQ has established minimum slope guidelines in §217.53 (l)(2)(A). These are shown in **Table 6-1**. TCEQ §217.55 (g) Table C.3 provides maximum manhole spacing based on pipeline diameter. These are provided in **Table 6-2**. The recommended gravity lines were sized based the above TCEQ criteria.

Table 6-1: TCEQ Minimum Slopes

Diameter of Pipe ⁽¹⁾ (in)	Minimum Slope (ft/ft)
6	0.00500
8	0.00335
10	0.00250
12	0.00200
15	0.00150
18	0.00115
21	0.00095
24	0.00080
27	0.00070
30	0.00060
33	0.00055
36	0.00045
39	0.00040

(1) For pipes greater than 39 inches in diameter, the slope is determined by Manning’s formula to maintain a velocity greater than 2.0 feet per second and less than 10.0 feet per second when flowing full.

Table 6-2: TCEQ Maximum Manhole Spacing

Diameter of Pipe (in)	Manhole Diameter (in)	Maximum Manhole Spacing (ft)
6-12	48	500
15	60	500
18-24	60	800
27-30	72	800
36-48	72	1,000
54 or larger	72	2,000

6.1.2 Design Criteria for Lift Stations and Force Mains

TCEQ design criteria §217.61 (c) states “The firm pumping capacity of a lift station must handle the peak flow.” Firm pumping capacity is defined as the maximum pumping capacity with the largest pumping unit out of service. TCEQ §217.67 (a) also states that force mains shall be sized to convey the lift station

pumping capacity at a minimum velocity of 3 feet/second for duplex lift stations and 2 feet/second with one pump operating at a lift station with three or more pumps. Recommended lift station firm pumping capacities and force main sizes are based on these TCEQ criteria. Where applicable, the existing lift station wet well capacities were calculated using TCEQ minimum pump cycle times to evaluate expansion needs. These cycle times are listed in **Table 6-3**. The proposed Lift Station projects are discussed in detail in **Section 8.0**.

Table 6-3: TCEQ Minimum Pump Cycle Times

Pump Horsepower	Minimum Cycle Times (minutes)
< 50	6
50 – 100	10
> 100	15

6.1.3 System Analysis Model Results

All proposed gravity lines, lift stations, and force mains were added to the hydraulic model. The locations of existing and proposed wastewater treatment plants were modeled as system outfalls. The hydraulic model was utilized to perform system analyses on the proposed collection system under peak wet weather flow conditions. The timing and size of the recommended improvements were adjusted in order to convey the projected peak wet weather flows without surcharging.

6.2 WASTEWATER TREATMENT PLANT CAPACITY EVALUATION

Anticipating the need for future wastewater treatment capacity and planning for the physical space and location of this treatment is one of the most important steps the City can take in preparation for rapid growth. The City currently owns and operates the City of Manvel (Corporate Drive) WWTP within the Central Service Area and the City has already acquired land for the construction of the **Central** Service Area regional wastewater treatment plant as well as future expansions at this location. The City also acquired land for the future **South** WWTP identified as part of a treatment facility siting study conducted in 2021.

Recommended capacities were developed for Manvel's regional wastewater treatment plant based on the 20-year projected average day wastewater flows discussed in **Section 4.0** and the TCEQ regulatory criteria. The projected average day wastewater flows and associated treatment capacities for each of the regional service areas are shown on **Figure 6-1, Figure 6-2, Figure 6-3, Figure 6-4, and Figure 6-5**. Where applicable, the flows are broken down by developments and City connections.

6.2.1 75/90 Rule (TCEQ §305.126)

Lines showing the recommended **permitted average daily flow (ADF)**, **90% of the permitted ADF capacity**, and **75% of the permitted ADF capacity** are shown on **Figure 6-1, Figure 6-2, Figure 6-3, and Figure 6-4**. These lines are based on TCEQ §305.126, commonly referred to as the 75/90 rule, which requires a WWTP permit holder to begin planning for expansion of the treatment facility when the average day or average annual flow reaches 75% of the permitted capacity for three consecutive months. When the average day or average annual flow reaches 90% of the permitted capacity, the permit holder shall obtain necessary authorization from the commission to commence construction of the necessary additional treatment facilities.

Figure 6-1: Central Service Area WWTP Capacity Analysis (including East Flows)

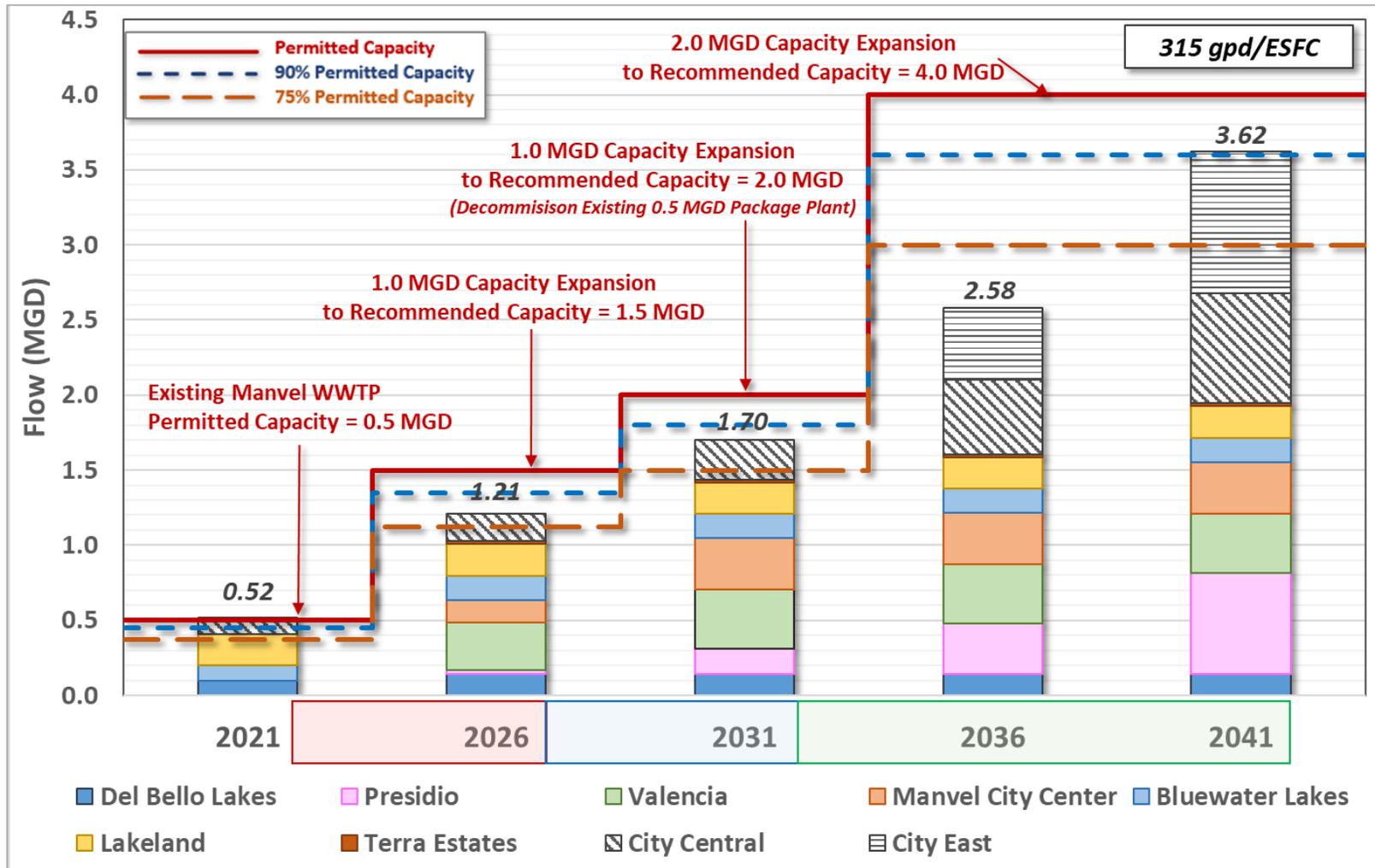


Figure 6-2: West Service Area WWTP Capacity Analysis

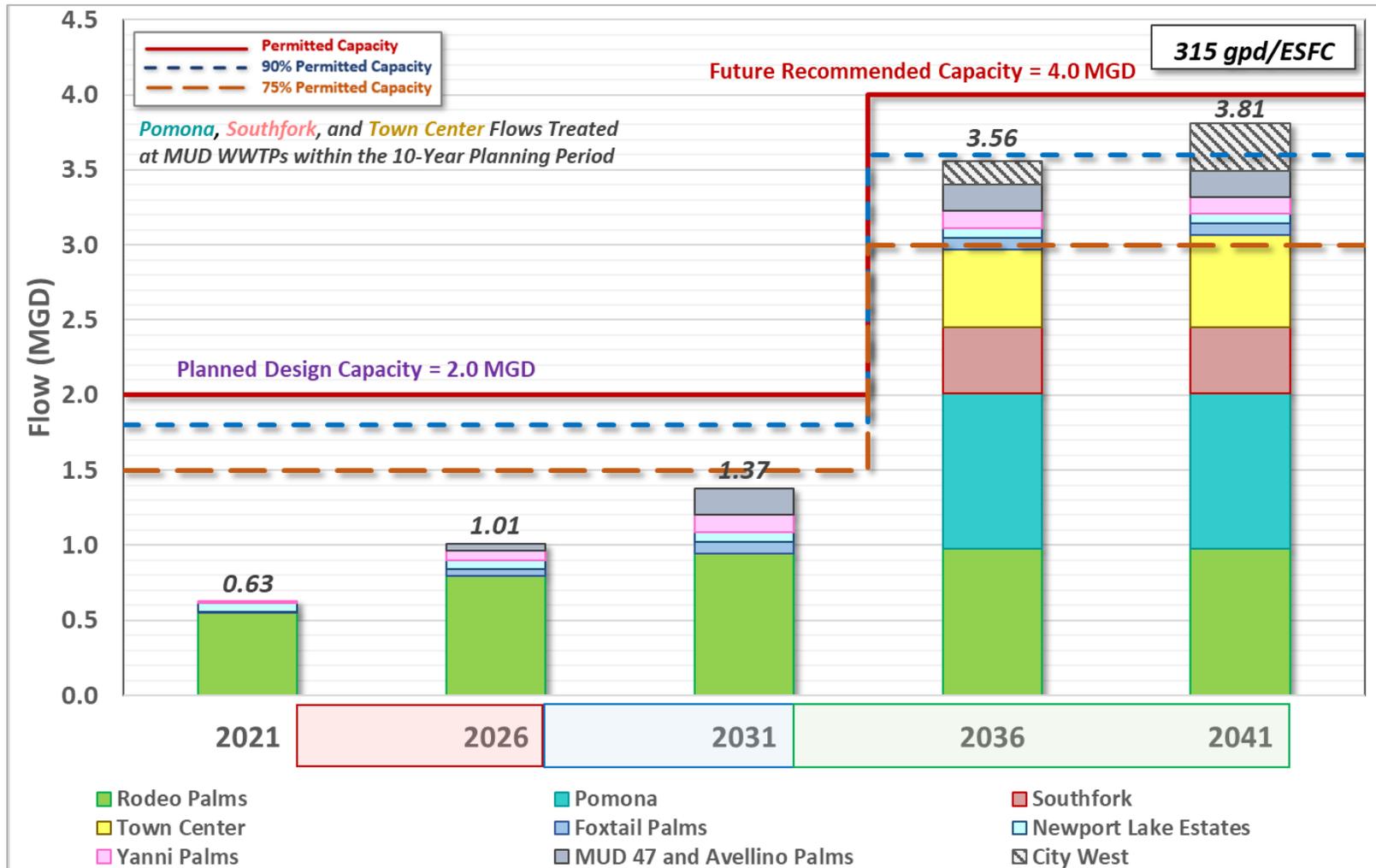


Figure 6-3: Sedona Lakes Service Area WWTP Capacity Analysis

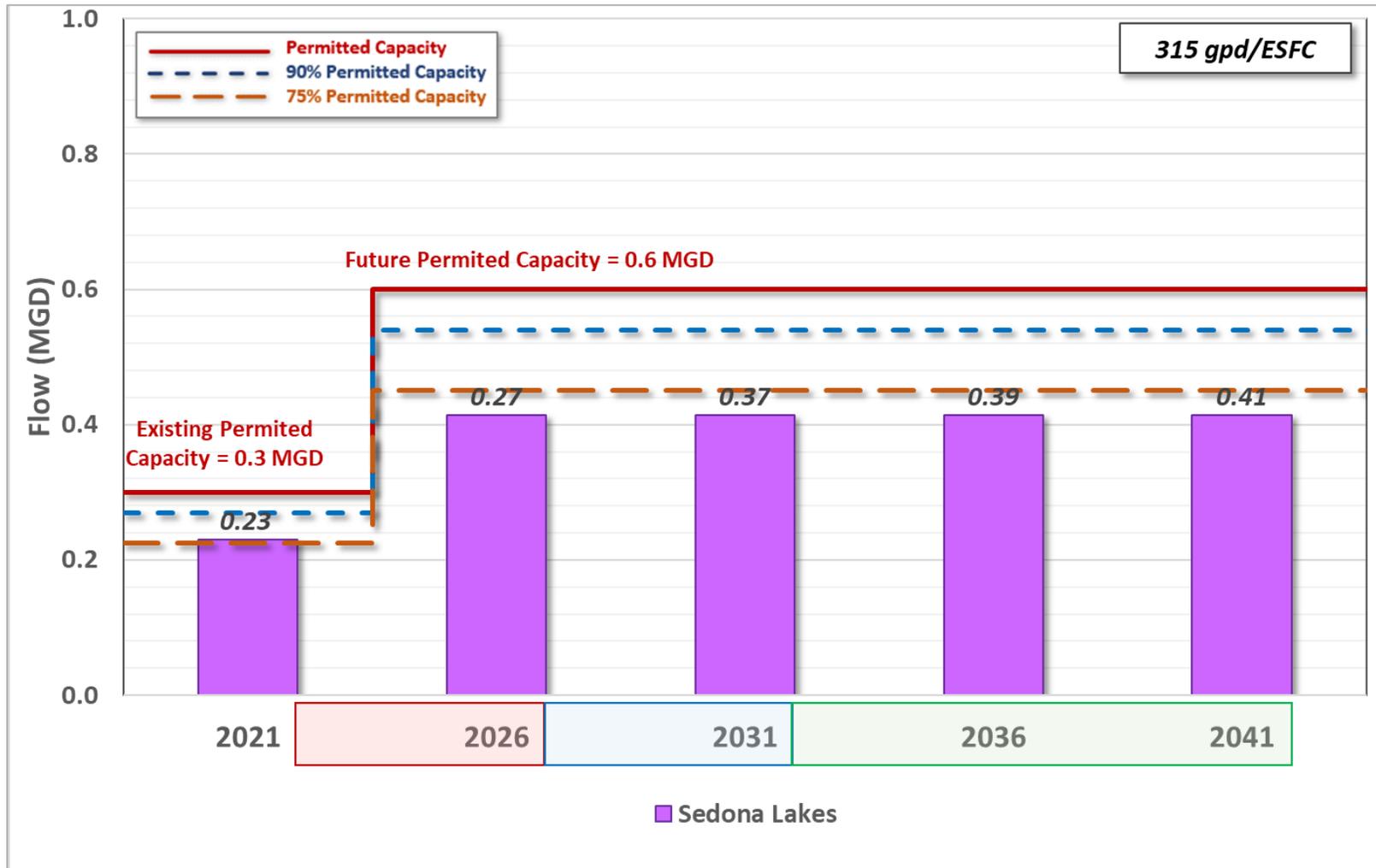


Figure 6-4: South Service Area WWTP Capacity Analysis

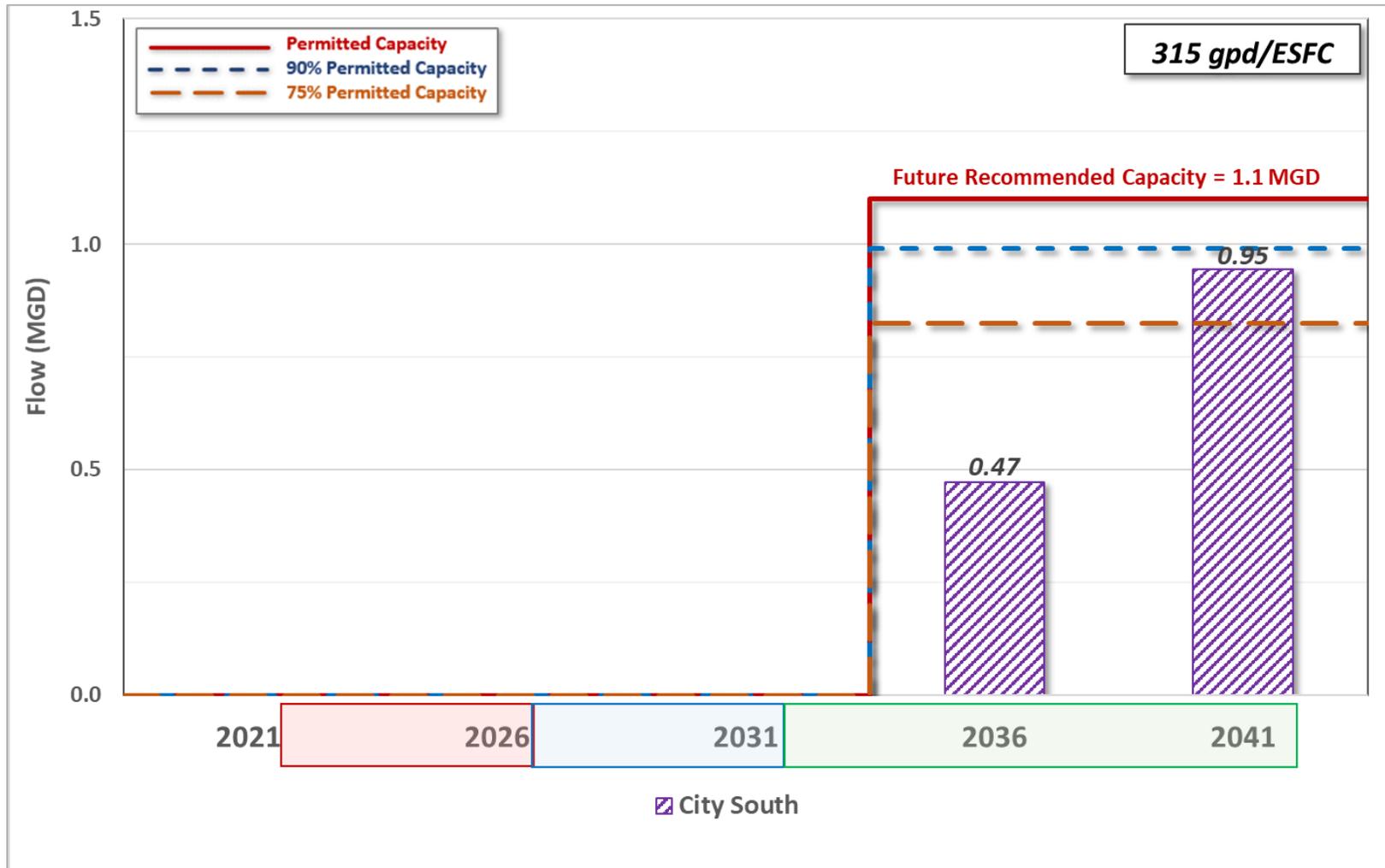
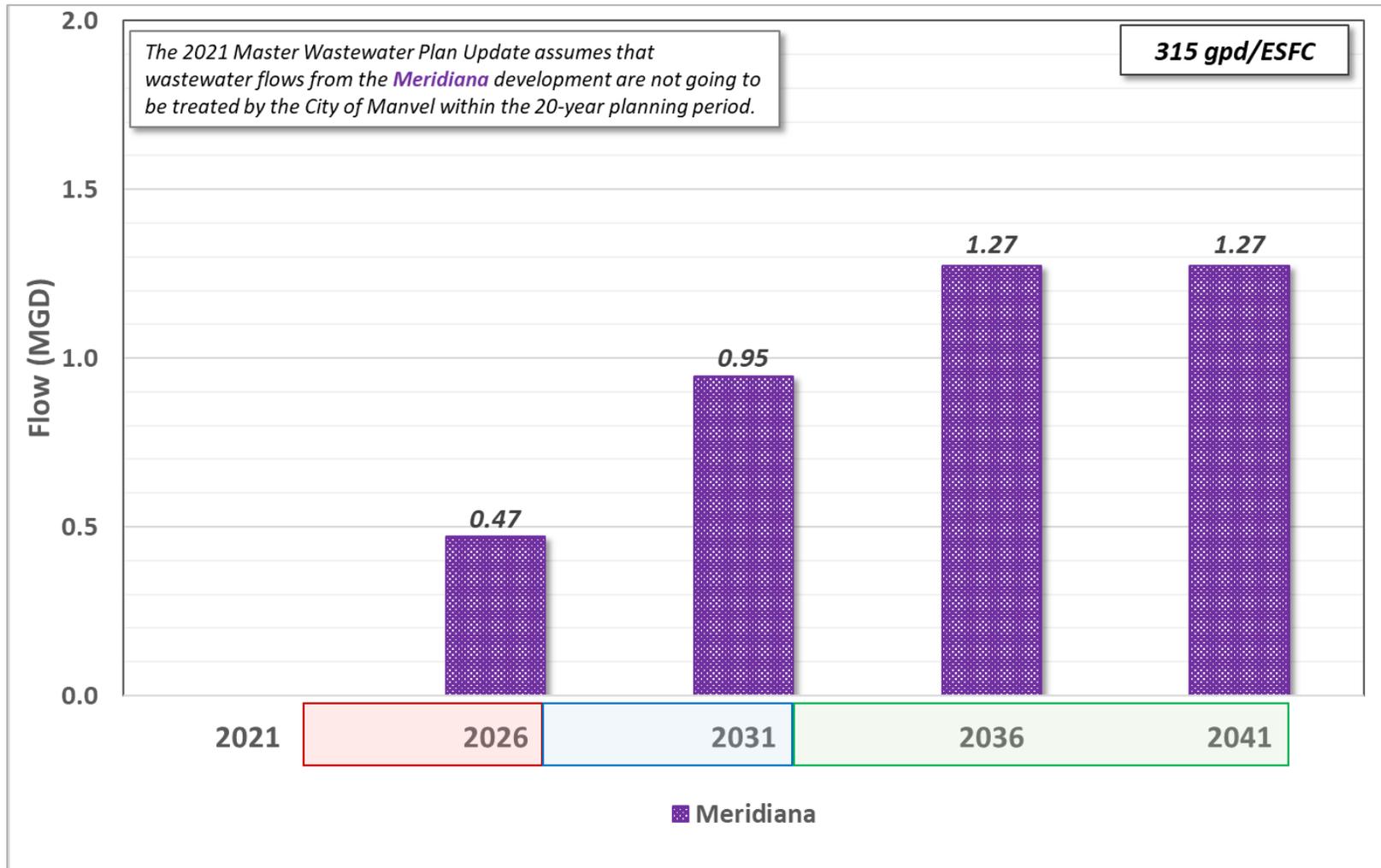


Figure 6-5: Meridiana Service Area – Projected Wastewater Flows (Manvel City Limits)



6.2.2 Future Wastewater Treatment Capacity

The following sections discuss the capacity evaluations for each wastewater service area. Recommended treatment capacities for the wastewater treatment plants were developed based on the projected average day wastewater flows and the capacity requirements in TCEQ §305.126. It should be noted that the recommended treatment plant capacities are based on best available data, incorporating the projected equivalent single family connections (ESFCs) discussed previously, and the City's design criteria of 315 gallons of wastewater flow per ESFC. If development flow rates differ from those assumed in this study or developers adjust their ultimate ESFC projections, the recommended facility capacities and/or timing of expansions should be re-evaluated.

Summary of Wastewater Treatment Capacity by Service Area and Planning Period

Table 6-4 presents a summary of the existing and proposed City of Manvel wastewater treatment facilities including the MUD WWTPs and permitted capacities by planning period. The Meridiana and Sedona Lakes service areas currently have existing MUD WWTPs, which are anticipated to eventually be part of the City's wastewater system.

Table 6-4: WWTP Capacities by Planning Period

Planning Period	Average Daily Flow Permitted Capacity (MGD)								
	Central Regional WWTP ⁽¹⁾	West Regional WWTP ⁽¹⁾	South Regional WWTP ⁽¹⁾	Town Center WWTP ⁽¹⁾	Sedona Lakes WWTP ⁽²⁾⁽⁴⁾	Meridiana WWTP ⁽²⁾⁽⁴⁾	Rodeo Palms WWTP ⁽²⁾⁽⁵⁾	Pomona WWTP ⁽²⁾⁽⁶⁾	Southfork WWTP ⁽²⁾⁽⁶⁾
2021	0.5	-	-	-	0.3	0.399	0.45	0.25	0.48
2026	1.5	-	-	0.15⁽⁷⁾	0.6	by MUD	by MUD	by MUD	by MUD
2031	2.0⁽³⁾	-	-	by MUD	0.6	by MUD	by MUD	by MUD	by MUD
2041	4.0	4.0	1.1	<i>Decommissioned and Flow Transferred to West WWTP</i>	0.6	by MUD	<i>Ownership Transfer to City as West Regional WWTP</i>	<i>Decommissioned and Flow Transferred to West WWTP</i>	<i>Decommissioned and Flow Transferred to West WWTP</i>

(1) City-owned WWTPs

(2) MUD WWTPs not currently owned and operated by the City.

(3) Decommission the existing 0.5 MGD package plant.

(4) Sedona Lakes WWTP and Meridiana WWTP are planned to be owned by the City in future (beyond 2041)

(5) Rodeo Palms Brazoria County MUD #29 WWTP ownership and operation to be transferred to the City as the West Regional WWTP.

(6) Pomona WWTP and Southfork WWTP are recommended to be decommissioned and served by the West Regional WWTP by 2041.

(7) Town Center WWTP is under construction as of December 2021.



1. Central Service Area

All existing wastewater flows in the Central Service Area are currently conveyed to the City of Manvel (Corporate Drive) WWTP site. This WWTP has 0.5 MGD of average daily flow permitted capacity. The wastewater flow projections show that the current 0.5 MGD capacity at this WWTP will not be sufficient to treat the projected flows from upcoming developments in near future, as shown on **Figure 6-1**.

The City has started design of a regional Central WWTP. This Central WWTP will be located on an approximately 6.5 acre tract of land adjacent to the existing City of Manvel (Corporate Drive) facility. It is planned for the City to operate both plants through the ten year planning period (2031) then decommission the existing 0.5 MGD package plant. The Central Regional WWTP will also eventually serve flows from the East service area via a planned regional lift station. Based on the flow projections in this master plan, phased expansions will be required at the Central WWTP. The recommendations based on the treatment capacity analysis in the Central service area are as follows:

- **5-Year Planning Period:** 1.0 MGD new Central Region WWTP to increase Central Region total average daily flow treatment capacity to 1.5 MGD.
- **10-Year Planning Period:** Additional 1.0 MGD expansion of the Central WWTP and decommissioning of the existing package plants, resulting in total ADF capacity of 2.0 MGD.
- **20-Year Planning Period:** Additional 2.0 MGD expansion of the Central WWTP to a total ADF capacity of 4.0 MGD.

The above mentioned expansions along with the projected wastewater flows from the proposed service area are shown on **Figure 6-1**. The City owns approximately 6.5-acre tract of land adjacent to the existing Corporate Drive WWTP site. The City has already begun preliminary design process for the first phase of the expansion. This site allows further expansion of the Central WWTP capacity beyond the 20-year planning period.

2. East Service Area

The City does not currently have wastewater infrastructure in the eastern portions of the Manvel city limits. To treat the projected future flows from this area it is recommended that the City construct a Regional Lift Station in the **20-Year planning period**. This lift station is proposed to be located in the vicinity of Hwy 6 and Mustang Bayou and will pump wastewater flows to the Central Regional WWTP. The



projected wastewater flows in the East service area (City East) are shown with the Central Regional WWTP projections on **Figure 6-1**.

3. West Service Area

There are currently three developments west of SH 288 that utilize MUD WWTPs to treat wastewater flows. Additionally, the **Town Center** development is planned at the intersection of SH 288 and Highway 6 that will have a separate WWTP (under construction). Brazoria County MUD #29 is planning construction of a new plant within the Rodeo Palms development that is scheduled to be under design in 2022. The ownership of this plant will be transferred to the City by 2041. Based on the analysis in this master plan, it is recommended to plan for a future expansion of the West WWTP to a total permitted average daily flow capacity of 4.0 MGD. This expansion is anticipated to be needed in the **20-year planning period** and will allow the WWTP to serve flows from additional City customer connections in the West service area as well as the **Town Center**, **Southfork** and **Pomona** developments. The decommissioning of these MUD WWTPs is planned to be accomplished via a network of lift stations, force mains, and gravity lines. These are discussed further in **Section 8.0**. The projected wastewater flows in the West service area along with the recommended expansion of the West WWTP are shown on **Figure 6-2**.

4. Sedona Lakes Service Area

Sedona Lakes is currently served by a MUD WWTP with an existing capacity of 0.3 MGD and permitted expansion to 0.6 MGD. Due to the location of this area, it is recommended that the City plan to serve this area in the future as a separate service area. Based on the wastewater flow projections in Sedona Lakes, the WWTP will require a 0.3 MGD expansion in the next 5 years. As this is a MUD WWTP, this expansion is not included in this master plan as a City project. It is shown as a developer project in **purple** on **Figure 8-1**.

5. South Service Area

The City does not currently have wastewater infrastructure in the southern portions of the Manvel city limits. It is recommended that the City construct a 1.1 MGD South Regional WWTP in the **20-Year planning period** to serve the wastewater flows in the area. The City has purchased land for this facility.



6. Meridiana Service Area (City Limits - Brazoria County MUDs 56 & 57)

The **Meridiana** development is located both in the City of Iowa Colony and the City of Manvel. A MUD WWTP is currently under construction to serve the **Meridiana** development. The portion of the future **Meridiana** development within the Manvel city limits is anticipated to be in Brazoria County MUDs 56 and 57. The projected buildout average day wastewater flows for the portion of the **Meridiana** Development within the city limits is 1.27 MGD. This *2022 Master Wastewater Plan Update* assumes that wastewater flows from the **Meridiana** development are not going to be treated by the City of Manvel within the 20-year planning period.



7.0 WASTEWATER TREATMENT PLANT EFFLUENT REUSE

The City of Manvel does not currently have a wastewater reuse system. As the City continues to grow, the water demand on the City's existing and future potable water sources will continue to increase. The City is considering wastewater reuse system to alleviate the need for additional water supply as the projected population and water demands increase. As part of the *2022 Master Wastewater Plan Update*, FNI summarized the steps involved in the implementation of a reuse program.

7.1 GOALS AND MOTIVATORS FOR WATER REUSE

The main goal of the reuse water system is to conserve water. Other goals include, realizing revenue from reuse water sales and reduction of potable water infrastructure needed to meet peak demands. Motivators for implementing a non-potable water reuse system include the following:

- Projected increase in residential and commercial/industrial customer base
- Desire to extend the life of existing, City-owned water supplies
- Minimizing the need to acquire additional potable water supply
- Availability of drought-resistant water supply for the City

7.2 REUSE REGULATIONS

Reclaimed water systems are regulated by the Texas Commission on Environmental Quality (TCEQ) which has documented reuse regulations in Chapters 210 and 344. Below is a summary of the requirements defined in each chapter:

- Chapter 210; Subchapter B and C: Defines the general requirements for the production, conveyance, and use of reclaimed water. Also defines the reclaimed water quality criteria for specific uses.
- Chapter 344; Subchapter F: Defines the standards for the design, installation, and maintenance of landscape irrigation systems utilizing reclaim water.

These chapters are included in **Appendix D**. The following sections summarize the TCEQ reuse regulations including the application process for obtaining a water reuse authorization.



7.2.1 TCEQ Chapter 210; Subchapters B and C

Subchapter B of Chapter 210 defines the general requirements for the production, conveyance, and use of reclaimed water. The requirements for storing reuse water are also defined in this chapter and consist of the following rules:

- Storage ponds must be designed to prevent unauthorized discharge of reclaimed water into the any waterbody defined as being “Waters of the US”
- Storage cannot be located within the floodway unless TCEQ authorization is granted
- Storage facilities must be designed to prevent groundwater contamination
- Storage ponds must be lined with an authorized earthen or synthetic material

Subchapter C of Chapter 210 defines the reclaimed water quality criteria and approved uses. There are two types of non-potable municipal reuse water in the State of Texas that can be authorized under Section 210:

- Type I Reclaimed Water: Includes irrigation or other uses where the public may be present during irrigation or may come into contact with reclaimed water (e.g. residential irrigation, fire protection, toilet flush water).
- Type II Reclaimed Water: Includes irrigation or other areas where the public is not present during irrigation or would not come into contact with reclaimed water (e.g. cooling tower water, irrigation at wastewater facilities).

TCEQ reclaimed water criteria are shown in **Table 7-1**.

Table 7-1: Reclaimed Water Quality Standards (TCEQ Ch. 210)

Attribute	Type I	Type II	Storage Pond
CBOD ₅ (mg/L)	5*	15*	30
Turbidity (NTU)	3*	-	-
Fecal coliform or <i>E.coli</i> (CFU/100mL)	20*/75**	200*/800**	200/800**
Enterococci*** (CFU/100mL)	4*/9**	35*/89**	35*/89**

*30-day average

** maximum single grab

***Enterococci typically apply to WWTPs that have saltwater discharges

Sampling: Type I reclaimed water uses are to be sampled twice per week, while Type II reclaimed water uses are to be sampled once per week.

Record Keeping and Reporting: Records are to be maintained for five years and the reclaimed water provider must report to TCEQ the volume of reclaimed water provided and the quality of the reclaimed water on a monthly basis.

7.2.2 TCEQ Chapter 344; Subchapter F

Subchapter F defines the standards for designing, installing, and maintaining landscape irrigation systems that utilize reclaimed water. Reclaimed water may be used for landscape irrigation if the following conditions are met:

- There is no direct contact with edible crops unless the crops will be pasteurized before consumption
- The irrigation system does not spray onto property not owned by the irrigation system owner
- The irrigation system is installed using purple components
- A sign (minimum size of eight inches by eight inch) is prominently located in the area being irrigated reading “RECLAIMED WATER – DO NOT DRINK”
- Backflow prevention of the reclaimed water supply is in accordance with the regulations of the water purveyor



7.2.3 Reclaimed Water Authorization

The TCEQ requires that municipalities submit for and obtain a Chapter 210 authorization before utilizing reclaimed water. The City of Manvel does not currently hold a Chapter 210 authorization for any of its wastewater treatment plants. The approval process requires the submission of application TCEQ-20427 with supporting documents that may include a service area map, any user water reuse contract(s), and an operation and maintenance plan.

7.3 SERVICE CONSIDERATIONS

Potential service issues must be addressed prior to the implementation or expansion of a reclaimed water system. In most cases, it is beneficial to plan to phase in the reuse system. The phasing schedule will consider the type of customer (public or private), proximity of the customer to an effluent source and the customers pressure requirements. In general, private customers will require more education on reuse regulations.

The reuse distribution system water quality also needs to be considered when developing the phasing schedule. If infrastructure is sized for ultimate non-potable water demands, and those demands are significantly higher than present water demands, the system may experience water quality problems as a result of high water age.

Another potential service issue to consider is the ability of the City to utilize existing ponds at parks where reuse water is being considered for irrigation. Using these ponds would allow the City to provide reuse water at lower pressures to the parks and will increase flexibility to match reuse demands. However, in most cases, the ponds would have to be lined to meet the TCEQ requirements for the storage of reuse water, which increases implementation costs.

7.4 REUSE WATER QUANTITY

This master plan update developed projections for wastewater flows for the purpose of sizing treatment facilities. The quantity of water available for reuse is called the maximum available safe supply and will need to be assessed during a future reuse study. **Table 7-2** summarizes flow projections from this master plan that can be utilized as part of a future analysis of the maximum available safe supply at each treatment facility.

Table 7-2: Summary of Flows for Future Reuse Analysis

Planning Period	Average Daily Flow ⁽¹⁾⁽²⁾ (MGD)			
	Central Regional WWTP	West Regional WWTP ⁽³⁾	South Regional WWTP	Total
2026	1.21	1.01	-	2.22
2031	1.70	1.38	-	3.08
2041	3.62	3.81	0.95	8.38

(1) Total average daily flows by wastewater treatment facility service area as developed in this master plan. The maximum available safe supply to be assessed during a future reuse study. Maximum available safe supply is the quantity of WWTP effluent that can be relied upon year round for reuse planning purposes.

(2) Sedona Lakes and Meridiana service area flows not included.

(3) Pomona and Southfork flows treated at existing MUD WWTPs within the 10-year planning period.

7.5 REUSE WATER QUALITY

TCEQ water quality requirements for Type I and Type II reuse types are provided in **Table 7-1**. A comparison of City’s wastewater treatment plant effluent quality with the TCEQ reuse requirements for Type I and Type II reuse are presented in **Figure 7-1**, **Figure 7-2** and **Figure 7-3**. The City WWTP effluent water quality information is obtained from the plant’s daily monitoring reports downloaded from the TCEQ Enforcement and Compliance History Online (ECHO) website. **Figure 7-1** illustrate historical 5-day Carbonaceous Biochemical Oxygen Demand (CBOD₅) data at the WWTP with the Type I and Type II requirements represented by the **red** solid and dashed lines, respectively.

Figure 7-2 and **Figure 7-3** illustrate the five-year E. coli water quality data for the City of Manvel (Corporate Drive) WWTP. In **Figure 7-2**, the **green** data points indicate the calculated 30-day average geometric mean E. coli levels at the WWTP discharge. In **Figure 7-3**, the **green** data points indicate the measures E.coli in the single grab samples a the WWTP discharge.

FNI recommends the City to perform an in-depth Reuse Study to evaluate the options for potential potable and non-potable reuse. If the City decides to have a reuse option, the wastewater treatment facilities need to be upgraded to produce effluent at required water quality standards.

Figure 7-1: Carbonaceous BOD (5-days) at Manvel WWTP

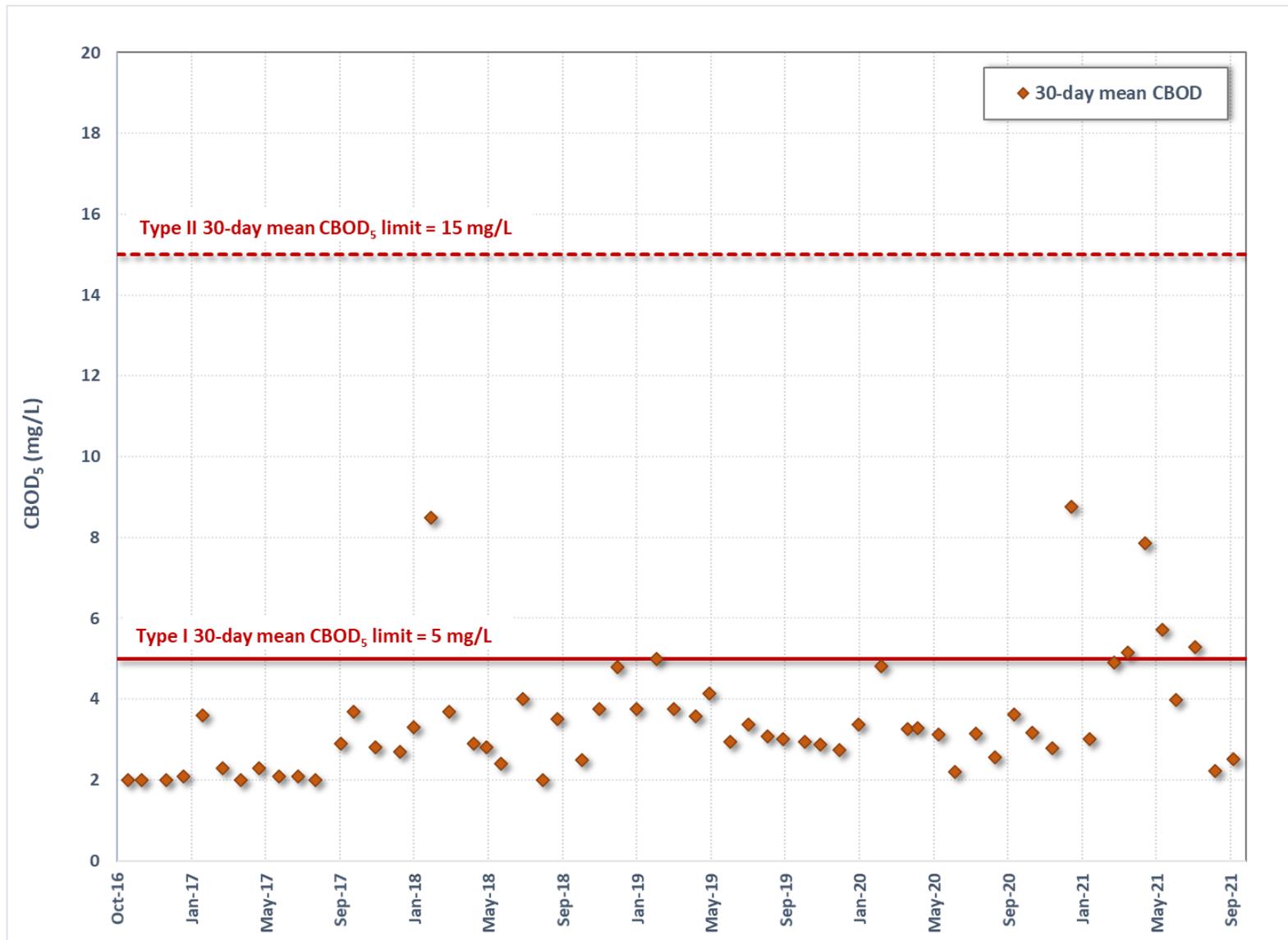


Figure 7-2: E.coli 30-day Average at Manvel WWTP

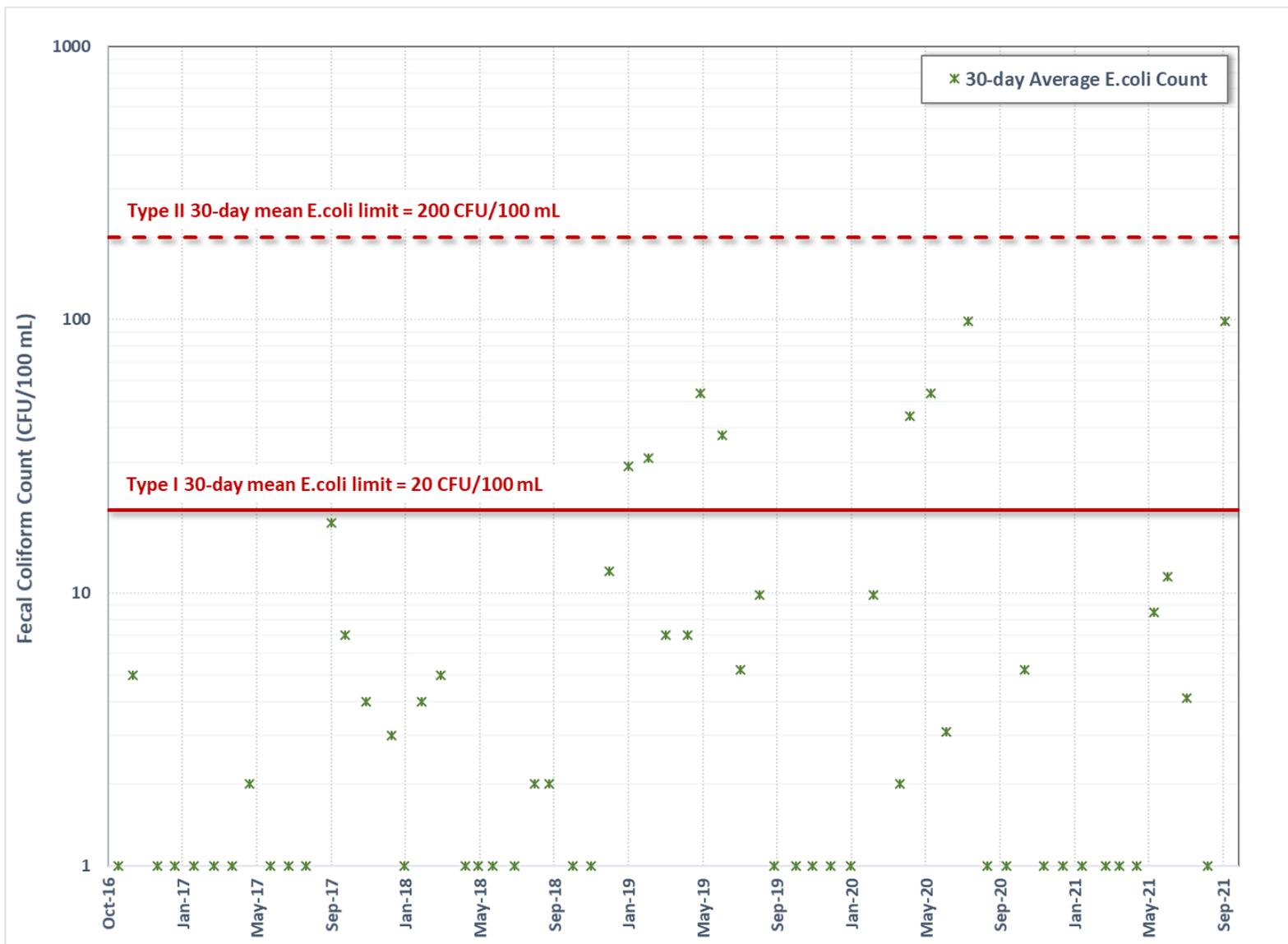
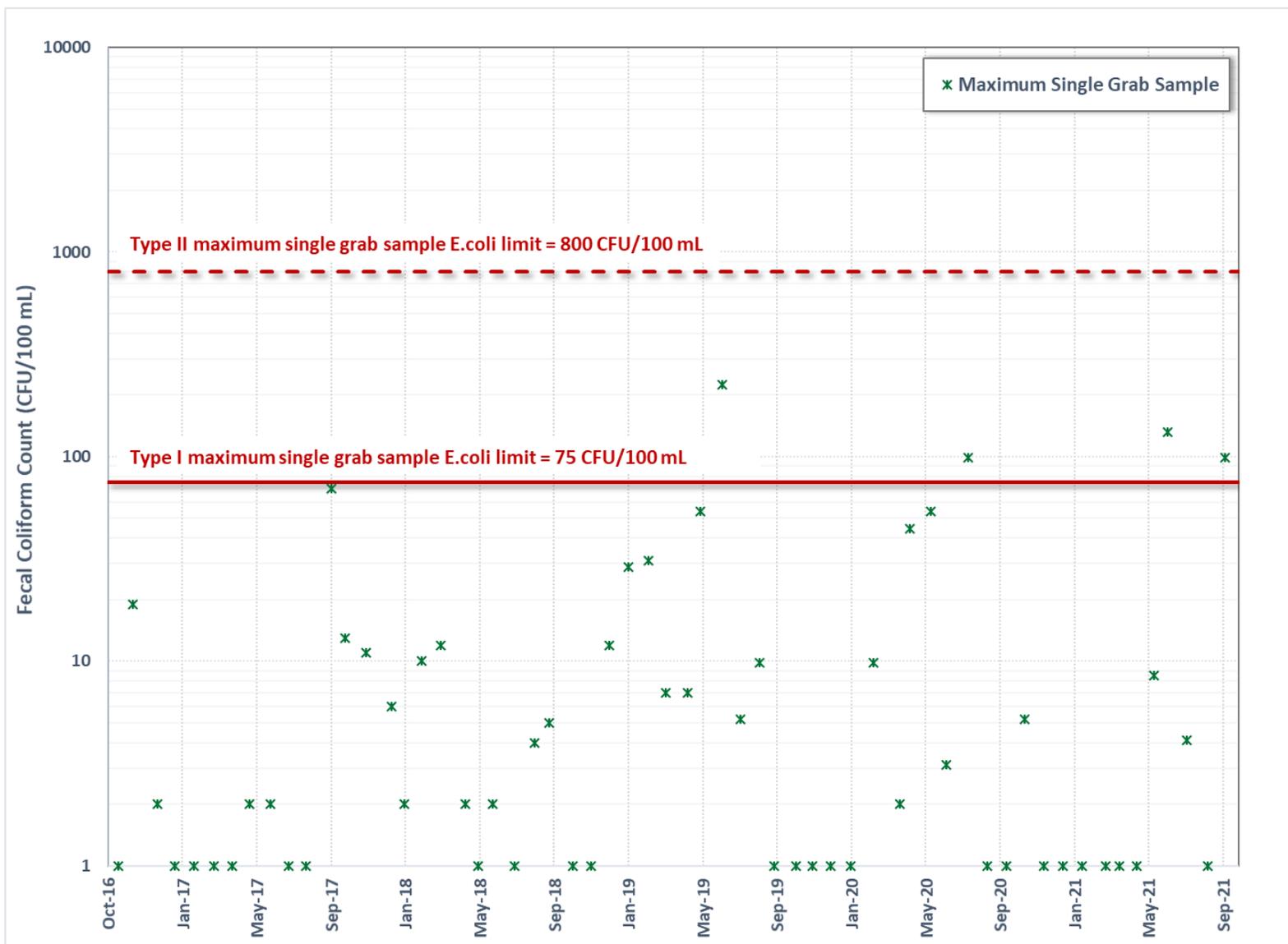


Figure 7-3: E.coli Maximum Single Grab at Manvel WWTP



8.0 WASTEWATER SYSTEM CAPITAL IMPROVEMENTS PLAN

An updated wastewater capital improvements plan (CIP) was developed for the City of Manvel. The CIP includes 21 conveyance and treatment project recommendations to facilitate the projected growth in the 20-year planning period and maintain regulatory compliance. These projects allow for regionalization of the City's wastewater collection and treatment infrastructure and provide the City with a phased CIP for collection system and treatment as the City grows.

The recommended wastewater collection and treatment projects are shown in **Table 8-3** and on **Figure 8-1**. The wastewater CIP projects are arranged by planning period (**5-year**, **10-year**, and **20-year**) as follows:

- **5-Year Projects:** These are shown **in red** and are recommended to be designed and constructed within the next 5 years (by 2026)
- **10-Year Projects:** These are shown **in blue** and are recommended to be designed and constructed within the next 10 years (by 2031)
- **20-Year Projects:** These are shown **in green** and are recommended to be designed and constructed within the next 20 years (by 2041)

All recommended infrastructure is sized to convey the projected 2041 peak wastewater flows, including an allowance for inflow and infiltration (I/I). It is recommended that these projects be constructed generally in the order presented; however, development patterns may make it necessary to construct some projects sooner than anticipated. Locations shown for new lines, lift stations, and wastewater treatment plants are generalized for hydraulic analyses. Specific alignments and sites will be determined as part of the design process. Wastewater projects currently under design or construction are shown in **orange** on **Figure 8-1**. Wastewater infrastructure to be constructed as part of future development by MUDs are shown in **purple** on **Figure 8-1**.

Planning level capital cost estimates were calculated for all recommended improvements and do not include individual service connections or subdivision lines. The costs are provided as estimates based on previous similar engineering experience in 2021 dollars and include allowances for contingency and engineering and surveying. Costs do not include easements or land acquisition, except where specifically noted.

The unit costs utilized for pipelines and manholes are shown in **Table 8-1**. Wastewater treatment costs were developed for each proposed wastewater treatment plant based on site specific information and previous similar engineering experience.

Table 8-1: Wastewater Capital Improvements Plan Unit Costs

Pipelines		Cost/Diam-in/LF
Force Mains		\$15
Gravity Lines < 8-feet deep		\$14
Gravity Lines 8 - 16-feet deep		\$15
Gravity Lines > 16-feet deep		\$16
Manholes		Cost/Manhole
4-ft Diameter	8-ft – 16-ft depth	\$14,000
	>16ft – 24-ft depth	\$18,000
	>24-ft – 30-ft depth	\$22,000
5-ft Diameter	8-ft – 16-ft depth	\$18,000
	>16ft – 24-ft depth	\$22,000
	>24-ft – 30-ft depth	\$26,000
6-ft Diameter	8-ft – 16-ft depth	\$20,000
	>16ft – 24-ft depth	\$25,000
	>24-ft – 30-ft depth	\$30,000
Contingency		Percentage
All Projects		25%
Engineering, Survey, & Inspection		Percentage
WWTPs and Lift Stations*		20%
Gravity and Force Mains		15%

(1) Used 15% engineering and survey for Central WWTP Phases 1 and 2 planning level cost calculations.

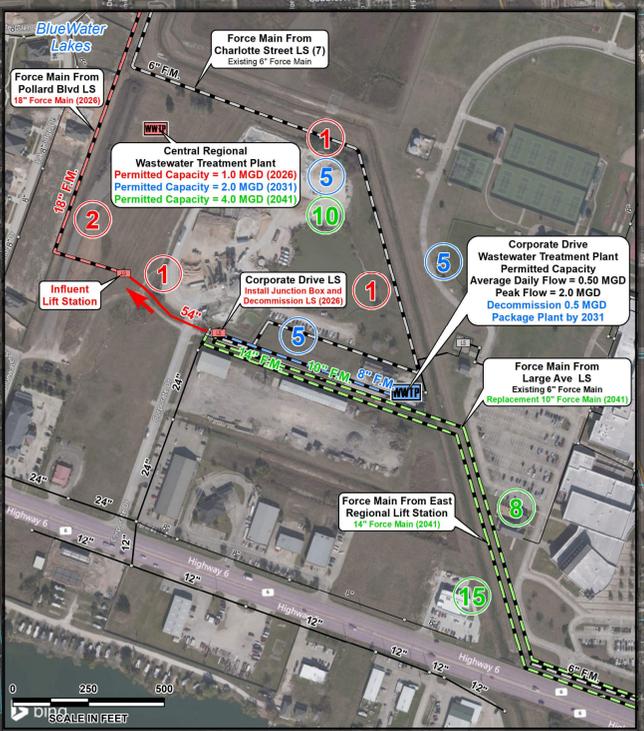
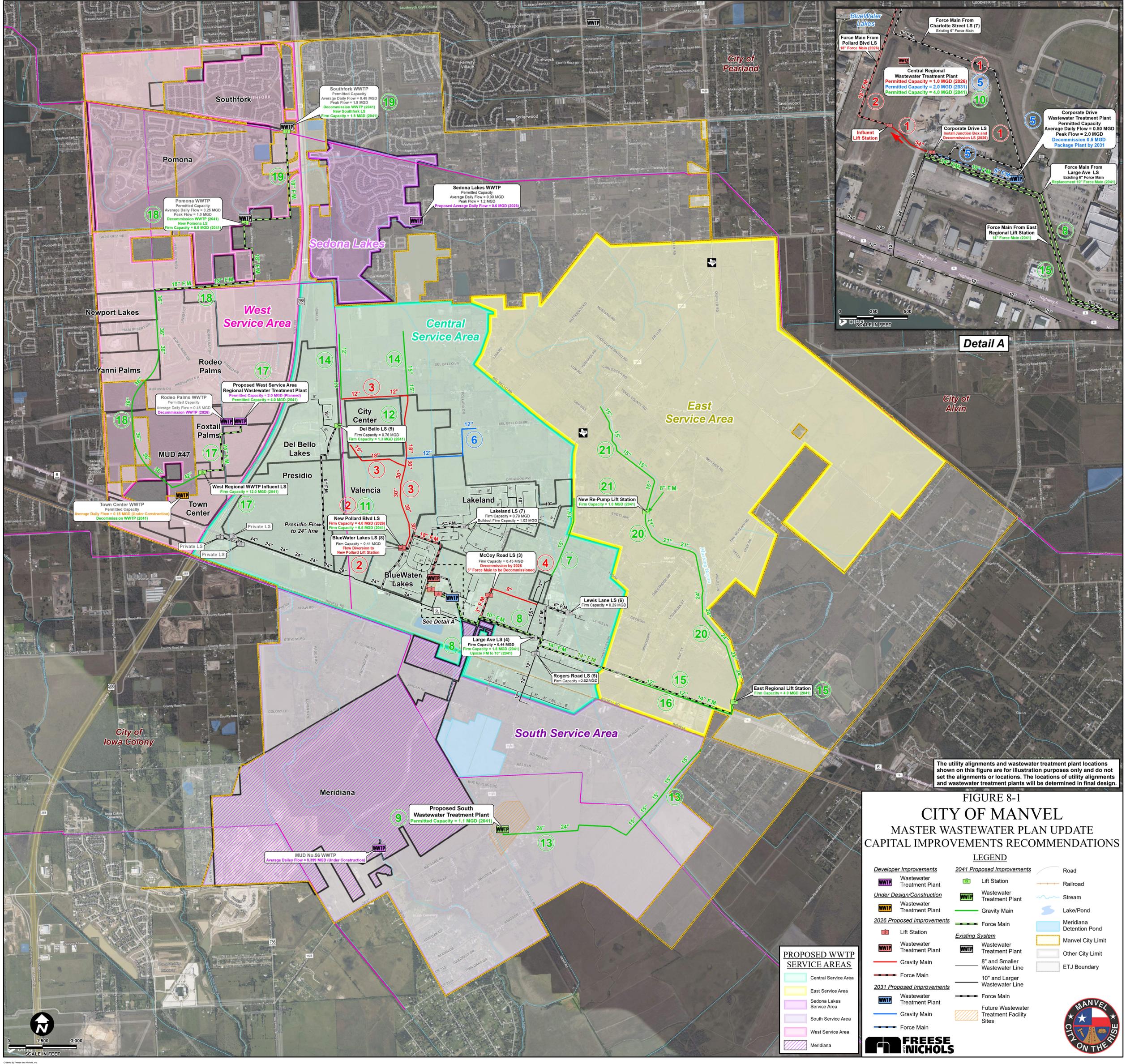
Table 8-2 summarizes the cost of the capital improvements plan by phase and project type (Treatment or Conveyance). **Table 8-3** summarizes the individual projects in the wastewater system CIP. The following sections provide a detailed project description and purpose for each CIP project. Individual planning level opinions of probable construction cost (OPCCs) for each project in the wastewater CIP are included in **Appendix A**.

Table 8-2: Wastewater Capital Improvements Plan Summary (by Phase and Project Type)

Phase	CIP	Cost
5 -Year (by 2026)	Treatment	\$26,948,900
	Conveyance	\$14,801,800
	Sub-total	\$41,750,700
10-Year (by 2031)	Treatment	\$15,904,500
	Conveyance	\$1,555,200
	Sub-total	\$17,459,700
20-Year (by 2041)	Treatment	\$98,182,000
	Conveyance	\$59,758,700
	Sub-total	\$157,940,700
Total 20-Year Wastewater CIP Cost		\$217,151,100

Table 8-3: Wastewater Capital Improvements Plan Summary (by Project)

Phase	Project Number	Project Name	Cost (In 2021 Dollars)
5-Year (by 2026)	1	1.0 MGD Central Regional Wastewater Treatment Plant (Phase 1)	\$26,948,900
	2	New 4.0 MGD Pollard Blvd Lift Station and 18-inch Force Main (Phase 1)	\$5,494,800
	3	12/15/18/30-inch Lines through Valencia Development (Central Service Area Interceptor and Gravity System)	\$8,553,200
	4	8-inch Gravity Main along McCoy Road and Lewis Lane	\$753,800
			Total 2021 - 2026
10-Year (by 2031)	5	Expansion of the Central Regional Wastewater Treatment Plant to 2.0 MGD Capacity (Phase 2)	\$15,904,500
	6	12-inch Del Bello SPUR Gravity Main	\$1,555,200
			Total 2027 - 2031
20-Year (by 2041)	7	15-inch Gravity Main Along Masters Road	\$1,796,700
	8	Large Avenue Lift Station Expansion to 1.8 MGD and 10-inch Force Main	\$3,211,800
	9	New 1.1 MGD South Regional Wastewater Treatment Plant (Phase 1)	\$26,688,000
	10	Expansion of the Central Region Wastewater Treatment Plant to 4.0 MGD Capacity (Phase 3)	\$30,840,000
	11	New Pollard Boulevard Lift Station Expansion to 6.5 MGD	\$2,150,100
	12	Del Bello Lift Station Expansion to 1.3 MGD	\$582,500
	13	15/24-inch South Region Gravity Main	\$6,069,700
	14	12/15-inch Central Region Gravity Main	\$2,442,600
	15	New 4.0 MGD East Regional Lift Station and 14-inch Force Main	\$8,877,000
	16	12-inch Gravity Main along Highway 6	\$2,071,000
	17	West Regional Wastewater Treatment Plant Expansion to 4.0 MGD	\$40,654,000
	18	West Service Area Wastewater Treatment Plant Consolidation and Gravity Main (Phase 1)	\$18,201,600
	19	West Service Area Wastewater Treatment Consolidation (Phase 2)	\$3,954,300
	20	21/24-inch Gravity Main along Mustang Bayou	\$6,224,300
	21	New 1.0 MGD Lift Station, 8-inch Force Main and 15-inch Gravity Line	\$4,177,100
		Total 2032 - 2041	\$157,940,700
Total Capacity Wastewater CIP Cost			\$217,151,100



Detail A

The utility alignments and wastewater treatment plant locations shown on this figure are for illustration purposes only and do not set the alignments or locations. The locations of utility alignments and wastewater treatment plants will be determined in final design.

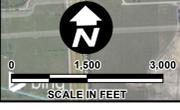
FIGURE 8-1
CITY OF MANVEL
MASTER WASTEWATER PLAN UPDATE
CAPITAL IMPROVEMENTS RECOMMENDATIONS

LEGEND

Developer Improvements	2041 Proposed Improvements	Road
WWTWP Wastewater Treatment Plant	Lift Station	Railroad
Under Design/Construction	WWTWP Wastewater Treatment Plant	Stream
WWTWP Wastewater Treatment Plant	Gravim Main	Lake/Pond
2026 Proposed Improvements	Force Main	Meridiana Detention Pond
Lift Station	Existing System	Manvel City Limit
WWTWP Wastewater Treatment Plant	Wastewater Treatment Plant	Other City Limit
Gravim Main	8" and Smaller Wastewater Line	ETJ Boundary
Force Main	10" and Larger Wastewater Line	
2031 Proposed Improvements	Force Main	
WWTWP Wastewater Treatment Plant	Future Wastewater Treatment Facility Sites	
Gravim Main		
Force Main		

PROPOSED WWTWP SERVICE AREAS

- Central Service Area
- East Service Area
- Sedona Lakes Service Area
- South Service Area
- West Service Area
- Meridiana



Created by: [unreadable] Date: [unreadable] Project: [unreadable] File: [unreadable]

8.1 FIVE-YEAR WASTEWATER CONVEYANCE AND TREATMENT PROJECTS (THROUGH 2026)

Project 1 - 1.0 MGD Central Regional Wastewater Treatment Plant (Phase 1)

Detailed description: This project includes the construction of a new 1.0 MGD Central Region Wastewater Treatment Plant (WWTP) at the Corporate Drive site. In conjunction with the existing 0.5 MGD package plant, this project will result in 1.5 MGD average daily flow treatment capacity in the Central Region. This WWTP will be expandable to 2.0 MGD by 2031 ([Project 5](#)). The existing Corporate Drive Lift Station will be decommissioned and converted into a junction box that will convey the projected wastewater flows to the new influent lift station through a 54-inch gravity line. The new influent lift station will pump flows to both the existing 0.5 MGD Package Plant and the proposed 1.0 MGD Central WWTP until the package plant is decommissioned ([Project 5](#)).

Purpose: The wastewater flow projections show that additional wastewater treatment is required beyond the 0.5 MGD capacity currently in the Central Service Area at the City of Manvel (Corporate Drive) WWTP. This 1.0 MGD expansion is required in the near-term to serve wastewater flows generated in the Central Service Area.

Project 2 - New 4.0 MGD Pollard Blvd Lift Station and 18-inch Force Main (Phase 1)

Detailed description: This project includes the construction of a wet well sized for a firm capacity of 6.5 MGD. Startup firm pumping capacity is projected to be 4.0 MGD. This project also includes the construction of a new 18-inch force main to the proposed Central Treatment Plant influent lift station ([Project 1](#)).

Purpose: This project is sized to convey the projected peak 2041 wastewater flows from the City Center and Valencia Developments, as well as additional City connections north and east of these developments. The lift station wet well and startup firm pumping capacity (4.0 MGD firm) includes the capacity to serve flows generated in the Bluewater Lakes development. As part of this project, it is anticipated that the Bluewater Lakes LS No. 1 will be decommissioned, and the corresponding wastewater flows conveyed to the New Pollard Blvd. Lift Station.

Project 3 - 12/15/18/30-inch Lines through Valencia Development (Central Service Area Interceptor and Gravity System)

Detailed description: This project includes the construction of a 12-inch/15-inch/18-inch/30-inch gravity main through the Manvel City Center and Valencia developments.

Purpose: This project will serve City customer connections in the Central Service Area including Manvel City Center and Valencia developments as well as adjacent areas to the north and west. This project is sized to convey the projected peak wastewater flows in this area through 2041.

Project 4 - 8-inch Gravity Main along McCoy Road and Lewis Lane

Detailed description: This project includes the construction of 8-inch consolidation gravity lines along McCoy Road and Lewis Lane to Palmetto Street. This project also includes decommissioning of the existing McCoy Lift Station and associated 3-inch force main.

Purpose: This project will allow the McCoy Road Lift Station to be decommissioned, and the wastewater flows to be conveyed to the recently constructed 15-inch gravity main along Palmetto Street.

8.2 TEN-YEAR WASTEWATER CONVEYANCE AND TREATMENT PROJECTS (THROUGH 2031)

Project 5 - Expansion of the Central Regional Wastewater Treatment Plant to 2.0 MGD Capacity (Phase 2)

Detailed description: This project includes the construction of 1.0 MGD of additional treatment capacity at the Central WWTP and decommissioning of the existing 0.5 MGD package plant. This expansion will result in a total of 2.0 MGD average day flow treatment capacity at the Central WWTP. This WWTP will be expandable to 4.0 MGD by 2041 (**Project 7**).

Purpose: The wastewater flow projections show that additional wastewater treatment is required beyond the capacity of the Proposed Central WWTP (**Project 1**) and the existing City of Manvel (Corporate Drive) WWTP. This expansion will be required in the 10-year planning period to serve the projected wastewater flows in the Central Service Area.

Project 6 - 12-inch Del Bello SPUR Gravity Main

Detailed description: This project includes the construction of 12-inch gravity main along Del Bello SPUR in the Central Service Area.

Purpose: This project is sized to convey projected future wastewater flows from the vicinity of Del Bello SPUR to the Central Regional WWTP.

8.3 TWENTY-YEAR WASTEWATER CONVEYANCE AND TREATMENT PROJECTS (THROUGH 2041)

Project 7 - 15-inch Gravity Main Along Masters Road

Detailed description: This project includes the construction of a 15-inch gravity main along Masters Road.

Purpose: This project will allow existing septic connections to connect to the City's wastewater system and also serve future projected wastewater flows in the Central Service Area to the north of Highway 6 near Masters Road.

Project 8 - Large Avenue Lift Station Expansion to 1.8 MGD and 10-inch Force Main

Detailed description: This project includes the expansion of the Large Avenue Lift Station to 1.8 MGD (firm pumping capacity), and a new 10-inch force main replacing the existing 6-inch force main. This project includes the construction of a new wet well and additional pumping to replace the existing lift station.

Purpose: The existing Large Avenue Lift Station (0.44 MGD firm capacity) is not sized to convey projected future peak wastewater flows in the Central Region along FM 1128 and in adjacent areas through 2041.

Project 9 - New 1.1 MGD South Regional Wastewater Treatment Plant (Phase 1)

Detailed description: This project includes the construction of a new South Service Area Regional Wastewater Treatment Plant (WWTP) with 1.1 MGD average daily flow treatment capacity. This planning level cost does not include land acquisition.

Purpose: This project is sized to treat the projected wastewater flows generated in the South Service Area through 2041.

Project 10 - Expansion of the Central Region Wastewater Treatment Plant to 4.0 MGD Capacity (Phase 3)

Detailed description: This project includes the construction of 2.0 MGD additional treatment capacity at the Central WWTP. This expansion will result in a 4.0 MGD average daily flow treatment capacity at the Central WWTP.

Purpose: This WWTP expansion is sized to serve wastewater flows generated in the Central Service Area and also diverted flows from the East Region through the East Regional Lift Station (**Project 14**) through 2041.

Project 11 - New Pollard Boulevard Lift Station Expansion to 6.5 MGD

Detailed description: This project includes the construction of an expansion at the Pollard Boulevard Lift Station to increase the firm pumping capacity from 4.0 MGD to 6.5 MGD. This project does not include construction of a new wet well and force main. The wet well and force main recommended in the Phase 1 expansion (**Project 2**) are sized for this 6.5 MGD expansion.

Purpose: This project will serve additional City customer connections in the Central Service Area north and east of the currently identified and anticipated developments. This project is sized to convey the projected peak wastewater flows in this area through 2041.

Project 12 - Del Bello Lift Station Expansion to 1.3 MGD

Detailed description: This project includes the expansion of the existing Del Bello Lift Station to firm pumping capacity of 1.3 MGD. The costs include pump, electrical, and piping expansion only.

Purpose: This expansion includes pump, electrical, and piping only. The existing wet well (diameter of 10-feet, depth of 29-feet) is sized to serve this growth.

Project 13 - 15/24-inch South Region Gravity Main

Detailed description: This project consists of 15-inch and 24-inch gravity mains South of Highway 6 to the Proposed South WWTP (**Project 9**).

Purpose: This project will serve future City connections in the South Service Area south of Highway 6. This project is sized to convey the projected peak wastewater flows through 2041.

Project 14 - 12/15-inch Central Region Gravity Main

Detailed description: This project includes the construction of 12-inch and 15-inch gravity lines north of City Center in the Central Service Area. The newly constructed lines will connect to the proposed 12-inch and 18-inch lines part of **Project 3**.

Purpose: This project is sized to convey projected future wastewater flows in the north and east portion of the Central Service Area by 2041.

Project 15 - New 4.0 MGD East Regional Lift Station and 14-inch Force Main

Detailed description: This project includes the construction of a 4.0 MGD regional lift station for the East Service Area and a 14-inch force main. This planning level cost does not include land acquisition.

Purpose: This project is sized to convey the projected future wastewater flows generated in the East Service Area to the Central WWTP through 2041.

Project 16 - 12-inch Gravity Main along Highway 6

Detailed description: This project includes the construction of a 12-inch gravity main along Highway 6.

Purpose: This project is sized to convey projected future wastewater flows in the East Service Area along Highway 6 to the new East Regional Lift Station.

Project 17 - West Regional Wastewater Treatment Plant Expansion to 4.0 MGD

Detailed description: This project includes the construction of 2.0 MGD additional treatment capacity at the West Regional WWTP. This project also includes the construction of a 12.0 MGD West Regional WWTP Influent Lift Station and a 24-inch force main.

Purpose: This construction of the West Regional WWTP and Influent Lift Station is sized to convey and treat the projected wastewater flows from the West Service Area through 2041. This expansion will convey and treat wastewater flows from the Pomona and Southfork Developments and additional City customer connections in the West Service Area via the West Service Area Treatment Consolidation Projects (**Project 18** and **Project 19**).

Project 18 - West Service Area Wastewater Treatment Plant Consolidation and Gravity Main (Phase 1)

Detailed description: This project includes the decommissioning of the Pomona WWTP, the construction of a new 6.0 MGD Pomona Lift Station (firm pumping capacity) and 18-inch force main, and the construction of a 36/42-inch trunk line to the West Regional WWTP Influent Lift Station.

Purpose: This project will convey the wastewater flows from the Pomona and Southfork Developments to the West Service Area Regional WWTP Influent Lift Station and WWTP. The existing Pomona WWTP does not have the long-term service life that the West Regional WWTP will have. Long-term, it will be more efficient for the City to operate fewer WWTPs. This project will decommission the Pomona WWTP in accordance with TCEQ regulations. Note that this project is also sized to re-pump the peak wastewater flows from the Southfork Development (**Project 19**).

Project 19 - West Service Area Wastewater Treatment Consolidation (Phase 2)

Detailed description: This project includes the decommissioning of the Southfork WWTP, and the construction of a new Southfork 1.8 MGD Lift Station (firm pumping capacity) and 10-inch force main.

Purpose: This project will pump the wastewater flows from the Southfork WWTP to the new Pomona Lift Station (**Project 18**), whereby the wastewater flow will be conveyed to the West Service Area Regional WWTP Influent Lift Station. The existing Southfork WWTP does not have the long-term service life that the West WWTP will have. Long-term, it will be more efficient for the City to operate fewer WWTPs. This project will decommission the Southfork WWTP in accordance with TCEQ regulations.

Project 20 - 21/24-inch Gravity Main along Mustang Bayou

Detailed description: This project includes the construction of new 21-inch and 24-inch trunk line along Mustang Bayou.

Purpose: This project is sized to convey the projected future (2041) peak wastewater flows from the East Service Area north of Highway 6 to the East Regional Lift Station.

Project 21 - New 1.0 MGD Lift Station, 8-inch Force Main and 15-inch Gravity Line

Detailed description: This project includes the construction of a 15-inch gravity main, a new 1.0 MGD lift station and an 8-inch force main along Mustang Bayou.

Purpose: This project is sized to convey the projected future (2041) peak wastewater projected peak wastewater flows from the East Service Area north of Highway 6 to the East Regional Lift Station.