

ORDINANCE NO. 2022-O-06

AN ORDINANCE OF THE CITY OF MANVEL, TEXAS, AMENDING CHAPTER 50. *PLANNING AND DEVELOPMENT*, ARTICLE III. *COMPREHENSIVE PLAN*, BY APPROVING THE 2022 MASTER WATER PLAN UPDATE DOCUMENT AS THE 2022 MASTER WATER PLAN; AMENDING SECTION 50-54. *MASTER WATER PLAN* INTEGRATING THE CITY'S 2022 MASTER WATER PLAN INTO THE CITY'S COMPREHENSIVE PLANS; PROVIDING FOR CONFORMITY OF ALL REGULATIONS TO THE MASTER WATER 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 commissioned HDR, Inc. with the task of developing a master water plan for the city; and

WHEREAS, the 2017 Master Water Plan prepared by HDR, Inc. was approved by the City and adopted and integrated into Chapter 50 of The City Code as a plan and policy for the city; and

WHEREAS, in 2020 the city commissioned an updated master water plan to be prepared by HDR, Inc.; and

WHEREAS, the new 2022 Master Water Plan update is now in final form and has been presented to the City for adoption; and

WHEREAS, the City Council hereby adopts the new 2022 Master Water 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 of the Code of Ordinances of the City of Manvel is hereby amended by adding a new section 50-54. *Master water plan* in Article III to read and provide as follows:

“CHAPTER 50. PLANNING AND DEVELOPMENT

...

ARTICLE III. COMPREHENSIVE PLAN

...

Sec. 50-54. Master water plan.

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

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

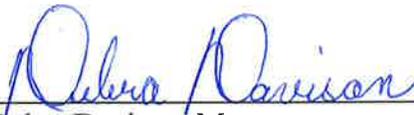
Section 2. **Penalty.** Any person who shall intentionally, knowingly, recklessly, or with criminal negligence violate any provision of this chapter shall be deemed guilty of a misdemeanor and, upon conviction, shall be fined in an amount not to exceed \$2,000.00. Each day of violation shall constitute 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 22 day of February, 2022.

PASSED, APPROVED, AND ADOPTED on second and final reading this March 7, 2022.



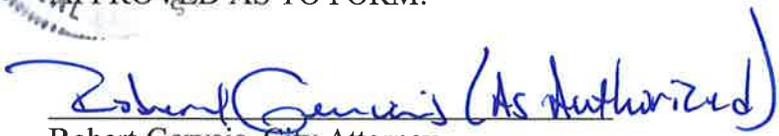
Debra Davison, Mayor

Attest:



Tammy Bell, City Secretary

APPROVED AS TO FORM:



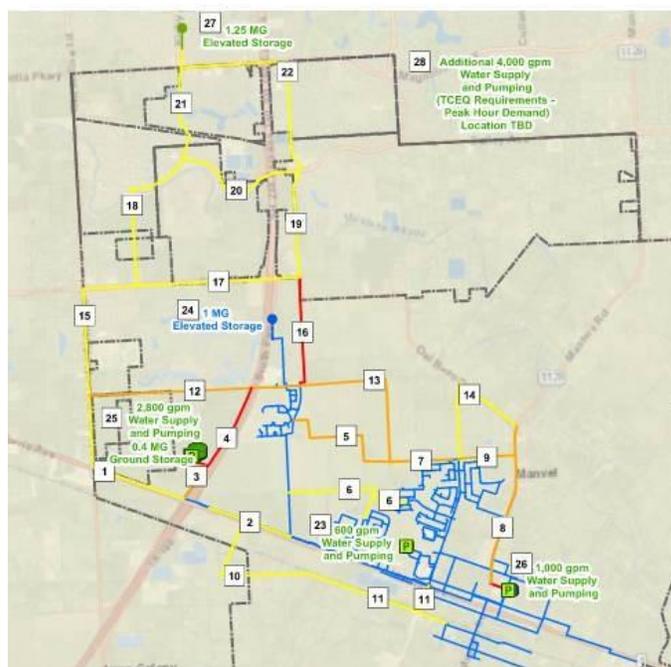
Robert Gervais, City Attorney



City of Manvel

2022 Master Water Plan

City of Manvel, Texas
December 10, 2021
Updated February 3, 2022



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2022 Master Water Plan

Prepared for:



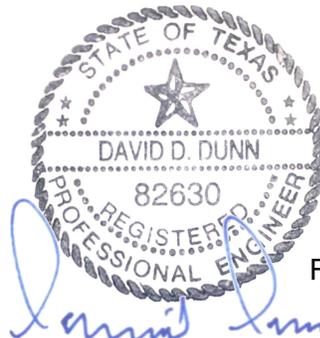
City of Manvel, Texas

Prepared by:



HDR Engineering, Inc.
TBPE Firm No. F-754

December 10, 2021
Updated February 3, 2022



February 3, 2022

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Contents

1	Introduction	1
	1.1 Background	1
	1.2 Purpose and Goals	1
2	Existing System Summary	1
3	Water Model Update and Analysis	2
	3.1 Water Distribution System Updates	2
	3.1.1 Network Update	2
	3.1.2 School Road Water Plant	2
	3.1.3 Maverick Water Plant	2
	3.1.4 Proposed Manvel Town Center Water Plant	2
	3.2 Model Demand Allocation	3
	3.2.1 Billing Information	3
	3.2.2 Peaking Factors	3
	3.3 Model Analysis	3
4	Equivalent Single-Family Unit (ESFU) Demand and Growth Projections	3
	4.1 ESFU Demand Analysis	3
	4.2 Municipal Utility District (MUD) ESFU Projections	4
	4.3 City Growth ESFU Projections	5
	4.4 Combined MUD and City ESFU Projections	5
5	TCEQ Requirements	5
	5.1 Elevated Storage	6
	5.2 Total/Ground Storage	7
	5.3 Booster Pumping	8
6	Water Supply Options	10
	6.1 Water Demands	10
	6.2 Current and Future (MUD) Supplies	10
	6.3 Projected Shortages	11
	6.4 Future Supply Options	13
	6.4.1 Groundwater	13
	6.4.2 Surface Water	14
	6.5 Alternative Plans for Future Supply	16
7	Capital Improvements Plan (CIP) and Opinion of Probable Construction Cost	20
	7.1 2030 Capital Improvements Plan	20
	7.1.1 Base 2030 CIP	20
	7.1.2 Additional 2030 CIP for Water Supply	21
	7.2 2040 Capital Improvements Plan	22
	7.2.1 Base 2040 CIP	22
	7.2.2 Additional 2040 CIP for Water Supply	22
	7.3 Recommendations	24
	7.3.1 Adaptive Infrastructure Planning	24

7.3.2 Future Water Supply 24

Exhibits

Exhibit 1. Base 2030 Capital Improvements Plan with Additional Pearland Water Supply CIP E-1
 Exhibit 2. Base 2030 Capital Improvements Plan with Additional GCWA Water Supply CIP E-3
 Exhibit 3. Base 2030 Capital Improvements Plan with Additional Hybrid Water Supply CIP E-5
 Exhibit 4. Base 2040 Capital Improvements Plan with Additional Pearland Water Supply CIP E-7
 Exhibit 5. Base 2040 Capital Improvements Plan with Additional GCWA Water Supply CIP E-9
 Exhibit 6. Base 2040 Capital Improvements Plan with Additional Hybrid Water Supply CIP E-11

Figures

Figure 6-1. Average-Day Demands and Total Supplies for the City of Manvel 12
 Figure 6-2. Supply Shortages Projected for the City of Manvel 13

Tables

Table 4-1. ESFU Demand Comparison 4
 Table 4-2. MUD ESFU Summary 4
 Table 4-3. Average-Day and Maximum-Day Demands Based on Combined MUD and City
 ESFUs 5
 Table 5-1. TCEQ Requirements for Public Water Systems 6
 Table 5-2. Total Projected ESFUs and Connections 6
 Table 5-3. TCEQ Public Water System Requirements Based on Projected Connections –
 Elevated Storage 7
 Table 5-4. TCEQ Public Water System Requirements Based on Projected Connections –
 Ground Storage 8
 Table 5-5. TCEQ Public Water System Requirements Based on Projected Connections –
 Booster Pumping 9
 Table 6-1. Current City Supplies 11
 Table 6-2. Supplies Projected from MUDs Expected to Connect the City System 11
 Table 6-3. Estimated Costs for a new Groundwater Plant 14
 Table 6-4. Estimated Costs for Treated Surface Water Supplies from City of Pearland 14
 Table 6-5. Estimated Costs for Treated Surface Water Supplies from GCWA (7 mgd total
 average-day capacity) 15
 Table 6-6. Estimated Costs for Treated Surface Water Supplies from GCWA (3 mgd
 average-day capacity) 15
 Table 6-7. Option 1 Supply Plan – Balance Groundwater and Surface Water 17
 Table 6-8. Option 2 Supply Plan – Subsidence Plan 18
 Table 6-9. Option 3 Supply Plan – Surface Water Only 19



Table 7-1. Annual 2030 CIP and Supply Costs for Pearland Supply (3.4 mgd average-day supply)	21
Table 7-2. Annual 2030 CIP and Supply Costs for GCWA Supply (4 mgd take or pay contract).....	22
Table 7-3. Annual 2040 CIP and Supply Costs for Pearland Supply (additional 3.6 mgd average-day supply)	23
Table 7-4. Annual 2040 CIP and Supply Costs for GCWA Supply (additional 3 mgd take or pay contract)	23
Table 7-5. Annual 2040 CIP and Supply Costs for Hybrid Supply (additional 3 mgd take or pay contract with GCWA).....	23

Acronyms/Abbreviations

acft/yr	acre-feet per year
BRA	Brazos River Authority
CIP	capital improvements plan
City	City of Manvel
ESFU	equivalent single-family unit
gal	gallons
gal/day or gpd	gallons per day
gpm	gallons per minute
HDR	HDR Engineering, Inc.
GCWA	Gulf Coast Water Authority
kgal	thousand gallons
mg	million gallons
mgd	million gallons per day
MUD	municipal utility district
O&M	operations and maintenance
TCEQ	Texas Commission on Environmental Quality
TWDB	Texas Water Development Board
UCM	Uniform Cost Model
yrs	years

1 Introduction

1.1 Background

HDR prepared a master water plan for the City of Manvel in 2017. Since that master plan, the City has experienced substantial growth and anticipates significant additional growth, through the connection of municipal utility districts (MUD) to the City's distribution system and organic growth through new developments.

1.2 Purpose and Goals

This master plan update includes:

- Evaluation of an appropriate equivalent single-family unit (ESFU) daily water demand factor,
- Update to the City's water distribution system hydraulic model,
- Forecast of demands expected through 2050,
- Review of current and future system capacities (supply, storage and booster pumping) with regard to TCEQ requirements,
- Review and update of capital projects recommended in the 2017 master water plan,
- Development of recommended future water supplies, and
- Recommendation of new CIP projects.

This master plan update is intended to serve as a roadmap for the City to use to anticipate improvements needed to the water distribution system, and the projected timing associated with the needs to serve future growth.

2 Existing System Summary

The City's current water distribution system primarily consists of the School Road Water Plant (which consists of two groundwater wells, ground storage tanks, hydropneumatic tanks, and booster pumps). The City has no elevated storage in the existing system but is pursuing design of a 1 million gallon (mg) elevated storage tank near the Del Bello development that is anticipated to be constructed in 2022.

The Manvel Town Center retail development is also under construction and will include new water production and distribution facilities, including new groundwater wells, ground storage tanks and booster pumps.

Manvel High School is currently served by an isolated distribution system, supplied by a dedicated groundwater supply (referred to as the Maverick water plant), which is owned and operated by the Alvin Independent School District. The City intends to acquire these water facilities and incorporate them into the City's overall water system.

3 Water Model Update and Analysis

3.1 Water Distribution System Updates

The City's existing water system hydraulic model was developed in the Innovyze InfoWater modeling platform¹, which was also utilized for this model update. This update included an update of the distribution pipeline network, water plants, and demand allocation based on updated customer billing data.

3.1.1 Network Update

The water distribution pipeline network was updated with current GIS information, which included the addition of the Del Bello and Bluewater developments. The model connectivity was evaluated and updated based on the location and intersection of water pipes included in the City's GIS database.

3.1.2 School Road Water Plant

The School Road Water Plant was updated in the model based on drawings and information provided by the City. The facilities at this plant include:

- Two groundwater wells with a combined capacity of 1,100 gallons per minute (gpm)²,
- Three ground storage tanks (211,000 gallons, 125,000 gallons and 125,000 gallons), and
- Three 1,000 gpm capacity booster pumps.

3.1.3 Maverick Water Plant

The Maverick Water Plant at Manvel High School was updated in the model based on GIS and information provided by the City. The water distribution facilities at this plant include:

- One 200 gpm groundwater well,
- Two 300 gpm booster pumps, and
- Two 66,000-gallon ground storage tanks.

3.1.4 Proposed Manvel Town Center Water Plant

The Manvel Town Center Water Plant was updated in the model based on drawings and information provided by the City. The facilities proposed for this plant include:

- One 1,200 gpm groundwater well,
- Two 1,000 gpm and one 500 gpm booster pumps, and
- One 244,000-gallon ground storage tank.

¹ <https://www.innovyze.com/en-us/products/infowater>

² Groundwater wells pump into ground storage tanks and are not included in the water system model.

3.2 Model Demand Allocation

3.2.1 Billing Information

The modeled demands were updated with City-provided monthly billing information from November 2016 to December 2019. The water billing data usage amounts were averaged to estimate the system average demand, and the addresses were used to spatially geolocate the accounts in the City’s system. Spatial allocation tools within the modeling software were used to apply the average demands to the nearest junction in the modeled network.

3.2.2 Peaking Factors

For the purposes of estimating maximum-day demands, a peaking factor of 2.4 times the average-day demand was used. For estimating peak-hour demands, a peaking factor of 1.85 times the maximum-day demand was used. Once the Del Bello Lakes elevated storage tank is constructed, the required peak-hour demand peaking factor is reduced to 1.25 times the maximum-day demand. Both the maximum-day and peak-hour factors were based on TCEQ guidance in the absence of daily production data.

3.3 Model Analysis

The updated hydraulic model was utilized to analyze the City’s water system under maximum-day demand conditions to identify potential deficiencies in the existing system.

Consistent with the hydraulic criteria developed in the 2017 master plan, these criteria were applied to establish the trigger point for when an asset is considered undersized. Distribution pipelines with model-predicted head losses greater than five feet per 1,000 feet of pipe were recommended for upsizing.

4 Equivalent Single-Family Unit (ESFU) Demand and Growth Projections

4.1 ESFU Demand Analysis

Manvel currently uses a value of 360 gallons/day per equivalent single family unit (ESFU) for water planning purposes, and currently serves approximately 2,000 ESFUs. To confirm the reasonableness of this demand factor, HDR identified planning numbers used by other cities and agencies in Texas, including Pearland, Missouri City, Angleton, and Houston, as shown in Table 4-1.

Manvel’s planning value of 360 gallons/day per ESFU is consistent with the values utilized by other cities in Texas. For the purposes of this master plan update, this value is primarily used to assign demands within the model.

Table 4-1. ESFU Demand Comparison

City	ESFU Demand (gal/day)
Angleton	330
Houston	340
Pearland	350
Round Rock	450
Austin	500
Missouri City	520
Manvel	360

4.2 Municipal Utility District (MUD) ESFU Projections

Much of the growth anticipated in the next 20 years is generated from MUDs that currently have their own groundwater supply and water distribution systems, but anticipate connecting to the City's distribution system once they reach build-out.

The projections of when these MUDs will connect to the City, along with their anticipated ESFU count at the time of connection, are listed in Table 4-2.

Table 4-2. MUD ESFU Summary

MUD	Projected Connection Year	ESFU Count at Connection	ESFU Count in 2030	ESFU Count in 2040
Manvel Town Center (MUD 42)	2023	150	900	1,950
Presidio (MUD 30)	2025	143	858	2,145
Rodeo Palms (MUD 29)	2040	3,000	0	3,000
MUD 47	2040	600	0	600
Southfork (MUD 25)	2040	1,355	0	1,370
2030 & 2040 Total ESFU Count			1,758	9,065

By 2050, the MUDs listed below are anticipated to connect to the City's system based on the ESFU projections listed below. Because these MUDs will not be connected in 2040, their projected demands were not included in the 2040 analysis.

- Sedona Lakes (MUD 1): 1,313 ESFUs
- Meridiana (MUDs 55, 56 and 57): 3,500 ESFUs
- Pomona (MUD 39): 3,020 ESFUs

4.3 City Growth ESFU Projections

In coordination with City staff and another consultant that is developing the City’s wastewater master plan update and impact fee study, 2030 and 2040 projections were developed for growth within the City that is not associated with a MUD-projected connection. This primarily includes growth in the City Center by 2030, plus additional growth in the City West, Central and East by 2040.

The City is projected to serve 12,729 ESFUs in 2030 and 22,785 ESFUs in 2040, in addition to the MUD ESFUs shown in Table 4-2.

4.4 Combined MUD and City ESFU Projections

The projected ESFUs from MUDs connecting to the City’s system were added to the projected ESFUs for City growth to obtain the total projected ESFU count to develop future demand scenarios for modeling, and are summarized in Table 4-3.

Table 4-3. Average-Day and Maximum-Day Demands Based on Combined MUD and City ESFUs

Year	MUD ESFUs	City ESFUs	Total ESFUs	Average Day Demand (mgd) ¹	Maximum-Day Demand (mgd) ²
2030	1,758	12,729	14,487	5.22	12.52
2040 ³	9,065	22,785	31,850	11.47	27.53

1. Calculated based on 360 gal/day per ESFU.
2. Calculated based on Average-Day Demand x 2.4.
3. ESFUs represent total ESFUs in 2040, not incremental ESFUs added between 2030 and 2040.

These average and maximum-day demand projections were loaded into future condition hydraulic model scenarios. The future MUD demands were spatially distributed according to the MUD location. The future City demands were spatially distributed according to the locations of projected developments, as predicted for the wastewater master plan.

5 TCEQ Requirements

Chapter 290 of the Texas Administrative Code includes requirements for the supply and distribution of public water systems as regulated by the Texas Commission on Environmental Quality (TCEQ). These requirements are summarized in Table 5-1.

HDR compared the City’s current storage and booster pumping capacity to the TCEQ requirements, as well as what will be required in 2030 and 2040 based on the connection and ESFU projections, as summarized in the following sections. ESFUs are calculated based on 1 ESFU per single family residential connection, and 5 ESFUs per commercial connection. A summary of ESFUs and connections is shown in Table 5-2.

Table 5-1. TCEQ Requirements for Public Water Systems

TCEQ Parameter	TCEQ Requirement
Total Storage (Combined Ground and Elevated Storage)	200 gallons per connection
Elevated Storage	For less than 2,500 connections: 100 gallons per connection, or hydropneumatics storage of 20 gallons per connection
	For more than 2,500 connections: 100 gallons per connection
Booster Pumping Capacity (if elevated storage is less than 200 gallons per connection)	The lesser of: <ul style="list-style-type: none"> • 2 gallons/minute per connection • Minimum of 1,000 gallons/minute and ability to meet peak-hour demands with the largest pump out of service¹

1. The peak-hour demand with the largest pump out of service criteria is less than 2 gallons/minute per connection, and is the controlling criteria used for projecting future booster pumping requirements.

Table 5-2. Total Projected ESFUs and Connections

Year	Connections	ESFUs
2020	1,104	1,584
2030	12,683	14,487
2040	28,240	31,850

5.1 Elevated Storage

The City currently has less than 2,500 connections and elevated storage is not required. The City does not currently have any elevated storage, but a 1 million gallon elevated storage tank near the Del Bello Lakes development is currently being designed. Table 5-3 summarizes the projected elevated storage needed to meet TCEQ requirements in 2030 and 2040.

By 2030, accounting for the 1 mg Del Bello tank, it is anticipated that an additional 268,342 gallons of elevated storage would be required to provide 100 gallons of elevated storage per connection. Because growth will continue after 2030, the analysis for subsequent years assumes that 1 mg of storage will be constructed to meet this requirement.

By 2040, in addition to the Del Bello tank and the 1 mg storage to be added by 2030, it is anticipated that an additional 532,200 gallons of elevated storage (total of 2,532,000 gallons) will be required to provide 100 gallons of elevated storage per connection. Similarly, it is assumed that a 1 mg elevated tank will be built to meet this requirement to accommodate additional growth in the years immediately following 2040.

Table 5-3. TCEQ Public Water System Requirements Based on Projected Connections – Elevated Storage

Year	Connections	Required Elevated Storage (gallons) ¹	Current Elevated Storage (gallons)	Elevated Storage Surplus/(Deficit) (gallons) ²	Recommended New Elevated Storage (gallons)
2020	1,104	0	0	0 ³	0
2030	12,683	1,268,400	1,000,000 ⁴	(268,400)	1,000,000
2040	28,240	2,824,000	2,000,000 ⁵	(824,000)	1,000,000

1. 100 gallons per connection.
2. Represents the minimum volume of total storage to add to the system to meet TCEQ requirements based on the total connections projected for that year.
3. Elevated storage is not required for systems with less than 2,500 connections.
4. Represents the elevated tank currently under design near Del Bello Lakes.
5. Represents the Del Bello Lakes tank and the tank projected to be added by 2030.

5.2 Total/Ground Storage

Once the City exceeds 2,500 connections and adds elevated storage to the system at a minimum of 100 gallons/connection, ground storage makes up the remainder of the total storage volume required by TCEQ, at 200 gallons/connection. It is anticipated that ground storage would be added in lieu of more expensive elevated storage to meet the total storage requirements.

The City’s ground storage currently consists of 425,000 gallons at the School Road plant and 132,000 gallons at the Maverick Water Plant.

By 2030, the following MUDs will connect to the system and are expected to provide the following ground storage volumes:

- MUD 42 (Manvel Town Center): 644,000 gallons (first phase of 244,000 gallons)³,
- MUD 30 (Presidio): 429,000 gallons.

With the addition of these MUDs, by 2030, the City’s ground storage tank volume is anticipated to be 1,630,000 gallons.

Three additional MUDs are forecasted to connect to the City’s system between 2030 and 2040:

- MUD 29 (Rodeo Palms): 600,000⁴ gallons (currently 300,000⁵ gallons)
- MUD 25 (Southfork): 562,000 gallons⁶
- MUD 47

³ Source: Construction Plans titled “Manvel Town Center Water Plant”, 4/2/2019. Volume of second ground storage tank not shown; assumed to be 400,000 gallons.

⁴ Source: TCEQ Drinking Water Watch Summary

⁵ Source: TCEQ Drinking Water Watch Summary

⁶ Source: TCEQ Drinking Water Watch Summary

In addition, approximately 10,600 new connections from new City developments are forecasted between 2030 and 2040. In addition to the 1,630,000 gallons of ground storage expected to be available in 2030, an additional 500,000 gallons of ground storage is anticipated to be needed by 2040 to serve these new connections. Table 5-4 summarizes the projected surplus in total storage to meet TCEQ requirements in 2030 and 2040.

Table 5-4. TCEQ Public Water System Requirements Based on Projected Connections – Ground Storage

Year	Connections	Required Total Storage (gallons)	Current Ground Storage (gallons)	Available Elevated Storage (gallons)	Total Available Storage (gallons)	Total Storage Surplus/ (Deficit), (gallons) ¹
2020	1,104	220,800 ²	557,000	0	557,000	336,200
2030	12,683	2,536,700	1,630,000 ³	2,000,000 ⁴	3,630,000	1,093,300
2040	28,240	5,648,000	2,792,000 ³	3,000,000 ⁴	5,792,000	144,000

1. Represents the volume of ground storage to add to the system to meet TCEQ requirements based on the total connections projected for that year.
2. 200 gallons per connection required with no elevated storage.
3. Includes 1,073,000 gallons of storage anticipated from connection of MUD systems by 2030.
4. Based on the recommended additional elevated storage described in Section 5.1.

5.3 Booster Pumping

Currently, the City has 3,000 gpm of total booster pumping capacity at the School Road water plant and 600 gpm of total booster pumping capacity at the Maverick water plant, which is sufficient to meet the estimated peak-hour demand of 1,759 gpm, based on the estimated average-day demand of 0.57 million gallons per day (mgd), maximum-day demand of 1.37 mgd and a peaking factor of 1.85 over maximum-day.

By 2030, the following MUDs will connect to the system and are expected to provide the following booster pumping capacity:

- MUD 42 (Manvel Town Center): 5,300 gpm (first phase of 2,500 gpm)⁷,
- MUD 30 (Presidio): 2,381 gpm⁸.

In addition, by 2030, the Maverick plant at Manvel High School is anticipated to be expanded from 600 gpm to 1,200 gpm.

By 2030, it is anticipated that an additional 4,000 gpm of booster pumping capacity, in addition to the booster pumping facilities added to the system through MUD connections, will be required to meet peak-hour demands of 10,866 gpm with the largest pump out of service. Table 5-5 summarizes the projected booster pumping needs to meet TCEQ requirements in 2030 and 2040.

⁷ Source: Construction Plans titled “Manvel Town Center Water Plant”, 4/2/2019. Volume of second ground storage tank not shown; assumed to be 400,000 gallons.

⁸ Source: TCEQ Drinking Water Watch Summary

Three additional MUDs are forecasted to connect to the City’s system between 2030 and 2040:

- MUD 29 (Rodeo Palms): 3,330 gpm (currently 2,400 gpm)
- MUD 25 (Southfork): 4,000 gpm
- MUD 47

In addition, approximately 10,600 new connections from new City developments are forecasted between 2030 and 2040. By 2040, it is anticipated that an additional 10,000 gpm of booster pumping capacity will be required to meet peak-hour demands of 23,888 gpm with the largest pump out of service.

Table 5-5. TCEQ Public Water System Requirements Based on Projected Connections – Booster Pumping

Year	Connections	Required Total Booster Pumping Capacity (gpm) ^{1,2}	Current Total Booster Pumping Capacity (gpm) ¹	Total Booster Pumping Capacity Surplus/ (Deficit) (gpm) ³
2020	1,104	1,759	3,600	1,841
2030	12,683	10,866	16,881 ⁴	(2,387)
2040	28,240	23,888	21,598 ⁴	(13,755)

1. Represents total booster pumping capacity. Firm capacity is calculated with the largest pump out of service.
2. Equivalent to peak-hour demand.
3. Represents the total booster pumping capacity to add to the system to meet TCEQ requirements based on the total connections projected for that year.
4. Includes 7,681 gpm of MUD booster pumping facilities (MUDs 30 and Manvel Town Center).
5. Includes 15,011 gpm of MUD booster pumping facilities (MUDs 25, 29, 30 and Manvel Town Center).

6 Water Supply Options

Growth within the City limits will occur within the service areas of the various MUDs, but also by development served by the City's water system. The City's current groundwater supplies combined with the supplies from the MUDs when the City takes over operations will be insufficient to meet future water demands and the City will need to develop additional sources of supply. The following section describes future annual water demands projected through 2070 for the City, describes current supplies, and presents projected supply shortages if current supplies are not supplemented with new supplies. Several alternatives were evaluated to address the City's future supply shortages.

Projected demands, supplies, and shortages were evaluated on the basis of both annual volumes and maximum-day requirements. In water supply planning annual demands and supplies are often expressed as volumes of acre-feet per year (acft/yr). An acre-foot is the volume of water required to cover an acre to one foot of depth. Annual volumes are equivalent to average-day demands and supplies when expressed in terms of mgd – one mgd equals 1,120 acft/y. For this report, annual water demands, supplies and shortages are expressed in average-day units of mgd.

Municipalities do not supply water only on an average-day basis and need to have supplies available at rates equivalent to their maximum-day demands, which are roughly twice average-day demands. This analysis includes both annual volumes (average-day demands) and maximum-day demands.

6.1 Water Demands

Future counts of ESFUs and associated average-day water demands are presented for years 2030 and 2040 in Section 4.4. These projections are expanded to include annual projections from 2022 through 2070, as shown in Figure 6-1. Consistent with the demands projected for the water system planning, an average-day water use value of 360 gallons per day (gpd), or 0.25 gpm, was assigned to each ESFU. This is based on TCEQ criteria of 0.6 gpd per connection for required pumping capacity for public water systems. This TCEQ criteria assumes that maximum-day demands are 2.4 times average-day demands ($0.6 \text{ gpm} \div 2.4 = 0.25 \text{ gpm}$). This value is conservative compared to the City's current value of roughly 187 gpd per ESFU, but as the City grows and its types of water users diversify, water use per ESFU is expected to increase. For purposes of projecting maximum-day water demands for water supply planning, a smaller factor of 2.0 is used to estimate maximum-day demands to closely approximate maximum-day demands for communities similar to Manvel.

6.2 Current and Future (MUD) Supplies

For water supply planning purposes, Table 6-1 presents the following supplies considered to be available currently to the City.



Table 6-1. Current City Supplies

Water Plant	Well Capacity (gpm)	Average-Day Supply (mgd)	Maximum-Day Supply (mgd)
School Road	1,100	0.79	1.58
Maverick	180	0.13	0.26
Town Center	1,200	0.86	1.73
Total	2,480	1.79	3.58

MUDs are anticipated to increase available supplies as the City acquires them upon each MUD reaching buildout conditions. Table 6-2 presents the MUD supplies and the year anticipated for build-out and City acquisition.

Table 6-2. Supplies Projected from MUDs Expected to Connect the City System

MUD	Projected Connection Year	Estimated Supply at Buildout – Average Day (mgd)	Estimated Supply at Buildout – Maximum-Day (mgd)
Presidio (MUD 30)	2025	0.77	1.54
Rodeo Palms (MUD 29) and MUD 47	2040	1.08	2.16
Southfork (MUD 25)	2040	1.45	2.89
Meridiana (MUD 55, 56, 57)	2050	1.26	2.52
Sedona Lakes (MUD 1)	2050	1.83	3.65
Pomona (MUD 39)	2050	1.09	2.18
Total Supplies from MUDs		7.47	14.94

The City has also contracted with the Brazos River Authority (BRA) for 3,100 acft/yr of supply from the BRA’s Brazos River system of reservoirs. The BRA supply is not currently a potable supply.

6.3 Projected Shortages

Projected City and MUD demands and supplies are shown in Figure 6-1. This demonstrates the increases in supplies available to the City as each MUD is connected to the City over time. The difference between the water demands and total supplies

represents supply shortages for which new supplies need to be developed, as shown in Figure 6-2. Generally, MUD supplies are equal to the projected demands at buildout, but in some cases MUD supplies are projected to exceed the MUDs demands resulting in a decrease in average-day supply shortages when a MUD connects. Shortages are anticipated to begin as early as 2027, increasing to 2.66 mgd (2,977 acft/yr) in 2030, 6.38 mgd (7,149 acft/yr) in 2040, and 8.10 mgd (9,072 acft/yr) in 2049. In 2050, several MUDs are projected to be connected and supplies from those MUDs are anticipated to reduce shortages to 6.94 mgd (7,773 acft/yr) in 2050 through 2070.

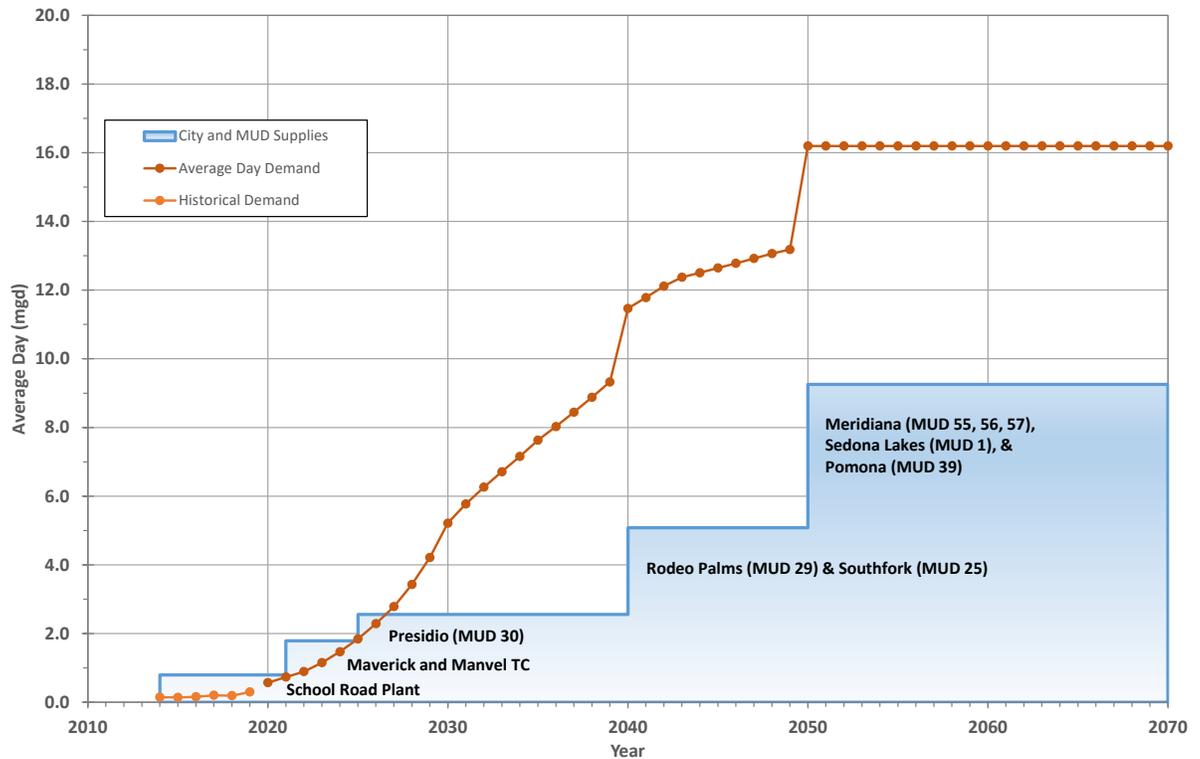


Figure 6-1. Average-Day Demands and Total Supplies for the City of Manvel

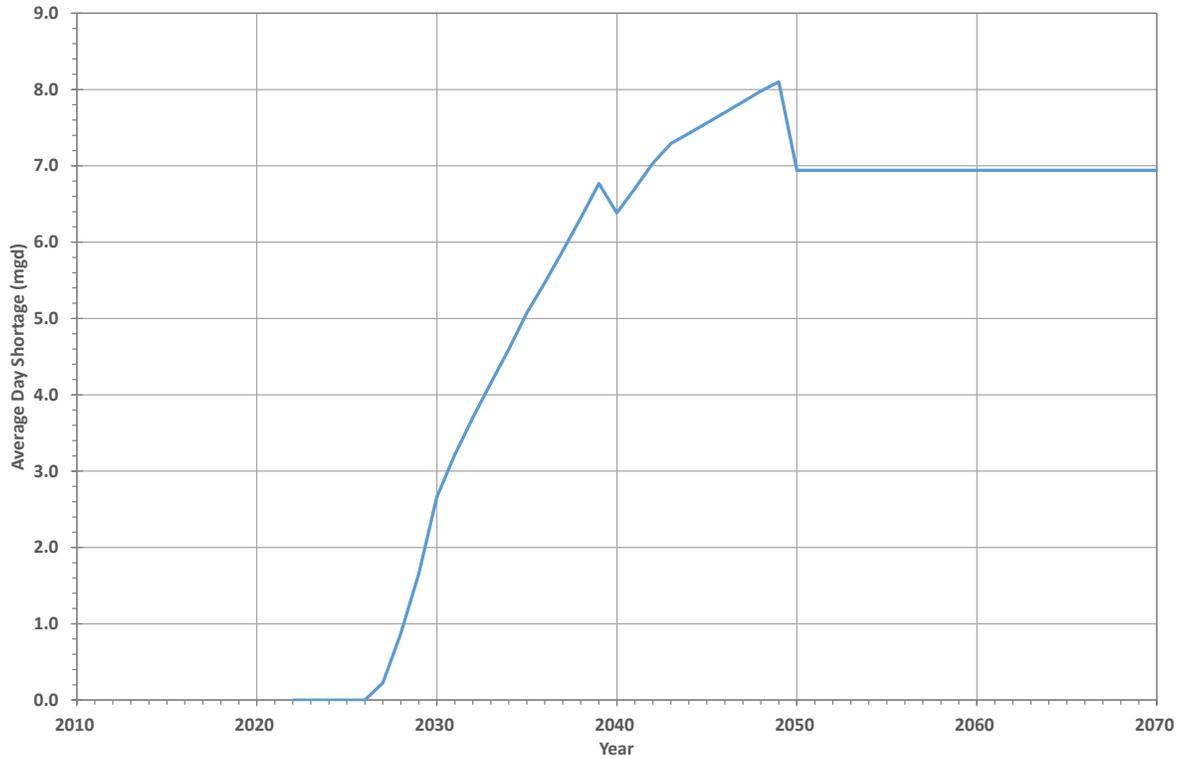


Figure 6-2. Supply Shortages Projected for the City of Manvel

6.4 Future Supply Options

During discussion with City staff, three primary water supply options were identified to consider for future water supplies: Groundwater and two surface water options. Reuse of the City’s wastewater was also considered but is not considered economically viable at this time given the relatively small amount of wastewater currently available from a centrally located wastewater plant. However, reuse should be considered in the future as potential wastewater supplies increase.

6.4.1 Groundwater

Groundwater from the Gulf Coast Aquifer System has long been relied upon by municipalities in the area and can be developed relatively inexpensively to provide a long-term reliable water supply. An individual well is anticipated to yield approximately 1,200 gpm, providing 1.73 mgd of maximum-day supply. Assuming a well would be available 95% of the time (5% downtime for maintenance), this would provide roughly 0.82 mgd of average-day supply (920 acft/yr). In order to meet the projected water demands in 2030 (2.66 mgd) and 2040 (6.38 mgd), four new wells would be required by 2030 and eight new wells in 2040. That level of groundwater use concentrated in the Manvel area likely would result in substantial declines in groundwater levels which would reduce well yields and potentially accelerate subsidence. Although no subsidence regulations exist in the area, groundwater use should be increased judiciously to preserve the resource as long as possible.

Based on bids tabulated recently for the Manvel Town Center water plant, a new 1,200 gpm well, 250,000 gal GST, and booster pump would cost approximately \$4.1 million. Annual Operation and Maintenance (O&M) costs were estimated using data from the Uniform Cost Model (UCM) developed by the Texas Water Development Board (TWDB) for use in regional and state water planning. Financing is assumed to be 3.5% for 20 years.

Table 6-3. Estimated Costs for a new Groundwater Plant

Average-Day Capacity (mgd)	Cost (\$ million)	Debt Service (20 yrs @ 3.5%)	O&M (TWDB UCM)	Total Unit Cost (\$/kgal)
0.82	\$4.1	\$288,500	\$133,800	\$1.41

6.4.2 Surface Water

Purchase Supply from City of Pearland

The City of Pearland is nearing completion of a new water treatment plant that will be capable of treating 10 mgd of surface water obtained from the canal system operated by the Gulf Coast Water Authority (GCWA). Pearland has indicated a willingness to provide treated surface water supplies to neighboring utilities.

Pearland has indicated that the overall cost of the first phase of the surface water treatment plant project is \$137.4 million⁹, and is being financed at a discount rate of approximately 2 percent. Expansion of the project could occur in increments of 2 mgd up to an additional 10 mgd of capacity. No costs have been provided for this expansion, so total project costs are estimated to be 60 percent of the initial project costs. Table 6-4 summarizes costs expected for the project. Water would be purchased from Pearland on a “pay as you go” basis, and not a “take or pay.” Therefore, Manvel would only pay for water actually used at the estimated unit costs show in Table 6-4. Transmission and pumping costs from Pearland to Manvel would not be part of the Pearland contract, but would be identified as a separate item in Manvel’s water CIP.

Table 6-4. Estimated Costs for Treated Surface Water Supplies from City of Pearland

Phase	Capacity (mgd)	Cost (\$ million)	Debt Service (\$ million/yr) (20 yrs @ 2%)	O&M (5% of cap cost) (\$ million/yr)	GCWA Raw Water Cost (\$/kgal)	Total Unit Cost (\$/kgal)
1	10	\$137.4	\$8.40	\$6.87	\$0.25	\$4.43
2	10	\$82.4	\$5.80	\$4.12	\$0.25	\$2.97

⁹ Pearland has budgeted \$175 million for the entire water supply project, which includes the new water treatment plant, transmission lines to deliver the water within the City’s system, and a water meter change-out program. Based on conversations with Pearland during December 2021, the costs associated with the water treatment plant are expected to be \$137.4 million. (personal communication, Skipper Jones, City of Pearland, December 2, 2021)

Purchase Supply from Gulf Coast Water Authority (GCWA)

GCWA has indicated a willingness to construct and operate a water treatment plant utilizing surface water supplies delivered through GCWA’s canal system. GCWA’s supplies are a combination of GCWA-owned water rights in the Brazos and San Jacinto-Brazos Basins and contractual supplies from the BRA. GCWA has indicated that if Manvel were to contract with GCWA for supply that GCWA would incorporate into GCWA supplies Manvel’s 3,731 acft/yr (2.77 mgd) of BRA supplies as a “30% backup” and leverage those supplies into a total supply of as much as 12,400 acft/yr (11.1 mgd). GCWA would take over payments to the BRA for the 3,731 acft/yr and Manvel would begin paying GCWA for supplies from the GCWA canal system. Costs from the GCWA canal system are shared among GCWA participants and the method to allocate costs to individual users is complex. For simplicity in evaluating this supply option, it is assumed that raw water costs from GCWA are \$0.25 per thousand gallons, or \$81.43/acft, consistent with values provided by Pearland for their purchase of raw water from GCWA.

Costs for a potential surface water supply from GCWA would include an intake from the GCWA “B Canal”, a water treatment plant, and purchase of raw water. Transmission and pumping costs for the treated water would not be included in the GCWA contract but would be shown as a separate item in Manvel’s water CIP. Costs estimated to be paid to GCWA for the treated water supply are summarized in Table 6-5. These costs were developed using the TWDB’s UCM. Consistent with known GCWA policies, costs would be paid to GCWA on a “take or pay” basis for the full contractual supply. The supplies shown for Phase 1 and Phase 2 of the GCWA supply are based on the options presented in Section 6.5. Financing is assumed to be 3.5% for 20 years.

Table 6-5. Estimated Costs for Treated Surface Water Supplies from GCWA (7 mgd total average-day capacity)

Phase	Capacity (mgd)	Cost (\$ million)	Debt Service (\$ million/yr) (20 yrs @ 3.5%)	O&M (\$ million/yr)	GCWA Raw Water Cost (\$/kgal)	Total Unit Cost (\$/kgal)
1	8	\$64.2	\$4.52	\$3.31	Included ¹	\$5.36
2	6	\$105	\$7.39	\$5.25	included	\$3.09

1. The UCM includes raw water purchase costs in the annual O&M costs.

An alternative “Hybrid Supply” option was evaluated whereby 4 mgd of City of Pearland supplies are utilized first, followed by a supply of 3 mgd from GCWA starting around 2040. Table 6-6 presents costs for 3 mgd of treated water supplies from GCWA under the hybrid option.

Table 6-6. Estimated Costs for Treated Surface Water Supplies from GCWA (3 mgd average-day capacity)

Phase	Capacity (mgd)	Cost (\$ million)	Debt Service (\$ million/yr) (20 yrs @ 3.5%)	O&M (\$ million/yr)	GCWA Raw Water Cost (\$/kgal)	Total Unit Cost (\$/kgal)
1	6	\$48.3	\$3.40	\$2.57	Included ¹	\$5.45

1. The UCM includes raw water purchase costs in the annual O&M costs.

Note that GCWA could develop the water treatment plant as a regional facility to serve other utilities such as Iowa Colony, which would reduce overall costs to project participants. Those options have not been vetted for this study.

6.5 Alternative Plans for Future Supply

There exist many different combinations of future groundwater and surface water options that could be used to meet the future water demands for the City of Manvel. For this water supply plan, three primary optional supply plans were investigated.

Option 1. Balance groundwater and surface water. This option would initially expand groundwater supplies, then incorporate surface water. This option balances groundwater supplies with new surface water supplies, but does not specifically address any future subsidence regulations.

Option 2. Subsidence plan. This option addresses potential subsidence regulations by gradually limiting groundwater use to 40% of total supply.

Option 3. Surface water only. Develop surface water to meet future demands while maximizing use of current groundwater supplies. This option does not address any future subsidence regulations.

Common goals for each option included the following:

- Provide at least 10% annual supply surplus in every year.
- Surface water capacity would be increased at minimum increments of 2 mgd.
- Capacity increases should be sized to last at least 7 years before another capacity increase is required.
- Provide sufficient capacity to meet maximum-day demands. Projects are sized to meet maximum-day demands, but are considered to supply only average-day demands on an annual basis.
- For meeting potential subsidence regulations considered by Option 2, assume that the target groundwater use is phased in by decreasing groundwater use from 100 percent (current) by 6 percent per year starting in 2026, then by 10 percent per year starting in 2030 until a target goal of 40% is reached in 2033. After 2033, a constant target of 40% groundwater use is maintained. Options 1 and 3 do not consider potential limitations on groundwater use from future subsidence regulations.

Option 1 is presented in Table 6-7. This option calls for a new groundwater well to be constructed by each of years 2027, 2028, and 2029 to meet initial supply shortages. This will allow time develop contracts and infrastructure for a new 4 mgd surface water supply, that would be incorporated by 2030. The surface water supply would be expanded to 7 mgd by 2037 to maintain at least a 10 percent supply surplus.



Table 6-7. Option 1 Supply Plan – Balance Groundwater and Surface Water

Year	Average-Day Shortage (mgd)	New Groundwater Supplies (mgd)			Surface Water Supplies (mgd)	Surplus (mgd)	Surplus as % of Demand	% GW Used ¹
		1 st Well	2 nd Well	3 rd Well				
2021	0.00					1.05	143.29%	100%
2022	0.00					0.89	100.12%	100%
2023	0.00					0.63	55.16%	100%
2024	0.00					0.32	21.50%	100%
2025	0.00					0.71	38.74%	100%
2026	0.00					0.27	11.79%	100%
2027	0.23	0.82				0.59	21.34%	100%
2028	0.87	0.82	0.82			0.77	22.54%	100%
2029	1.66	0.82	0.82	0.82		0.81	19.13%	100%
2030	2.66	0.82	0.82	0.82	4.0	3.81	72.99%	23%
2031	3.22	0.82	0.82	0.82	4.0	3.25	56.27%	31%
2032	3.70	0.82	0.82	0.82	4.0	2.76	44.08%	36%
2033	4.15	0.82	0.82	0.82	4.0	2.31	34.44%	40%
2034	4.60	0.82	0.82	0.82	4.0	1.86	26.04%	44%
2035	5.07	0.82	0.82	0.82	4.0	1.39	18.27%	48%
2036	5.47	0.82	0.82	0.82	4.0	0.99	12.37%	50%
2037	5.89	0.82	0.82	0.82	7.0	3.58	42.37%	17%
2038	6.32	0.82	0.82	0.82	7.0	3.15	35.43%	21%
2039	6.77	0.82	0.82	0.82	7.0	2.70	28.91%	25%
2040	6.38	0.82	0.82	0.82	7.0	3.08	26.87%	39%
2041	6.70	0.82	0.82	0.82	7.0	2.76	23.45%	41%
2042	7.03	0.82	0.82	0.82	7.0	2.43	20.07%	42%
2043	7.29	0.82	0.82	0.82	7.0	2.17	17.57%	43%
2044	7.42	0.82	0.82	0.82	7.0	2.04	16.31%	44%
2045	7.56	0.82	0.82	0.82	7.0	1.90	15.06%	45%
2046	7.70	0.82	0.82	0.82	7.0	1.77	13.82%	45%
2047	7.84	0.82	0.82	0.82	7.0	1.63	12.59%	46%
2048	7.98	0.82	0.82	0.82	7.0	1.48	11.37%	46%
2049	8.10	0.82	0.82	0.82	7.0	1.36	10.35%	47%
2050	6.94	0.82	0.82	0.82	7.0	2.52	15.58%	57%

1. % groundwater used assumes surface water supplies are fully utilized.

Option 2 is presented in Table 6-8. This option assumes no new groundwater supplies will be developed and surface water will be incorporated to meet the percent groundwater supply targets in the assumed subsidence regulations. Under this option, maintaining a surplus supply of 10 percent typically controls the timing of the new supplies, except for the first new surface water supply which would be implemented to begin meeting subsidence targets. The ultimate surface water capacity of 10 mgd would only be needed in 2050 and later to meet the subsidence targets.

Table 6-8. Option 2 Supply Plan – Subsidence Plan

Year	Average-Day Shortage (mgd)	Groundwater Target (% of total supply)	Surface Water Needed to Meet Goal (mgd)	Surface Water Supplies (mgd)	Surplus (mgd)	Surplus as % of Demand	% GW Used ¹
2021	0.00	100%	0.00		1.05	143.29%	100.0%
2022	0.00	100%	0.00		0.89	100.12%	100.0%
2023	0.00	100%	0.00		0.63	55.16%	100.0%
2024	0.00	100%	0.00		0.32	21.50%	100.0%
2025	0.00	100%	0.00		0.71	38.74%	100.0%
2026	0.00	94%	0.14	5.0	5.27	230.30%	0.0%
2027	0.23	88%	0.33	5.0	4.77	171.39%	0.0%
2028	0.87	82%	0.62	5.0	4.13	120.48%	0.0%
2029	1.66	76%	1.01	5.0	3.34	79.27%	0.0%
2030	2.66	70%	1.56	5.0	2.34	44.91%	4.1%
2031	3.22	60%	2.31	5.0	1.78	30.90%	13.4%
2032	3.70	50%	3.13	5.0	1.30	20.70%	20.2%
2033	4.15	40%	4.03	8.0	3.85	57.32%	0.0%
2034	4.60	40%	4.29	8.0	3.40	47.49%	0.0%
2035	5.07	40%	4.58	8.0	2.93	38.40%	0.0%
2036	5.47	40%	4.82	8.0	2.53	31.50%	0.4%
2037	5.89	40%	5.07	8.0	2.11	25.03%	5.3%
2038	6.32	40%	5.33	8.0	1.68	18.94%	9.9%
2039	6.77	40%	5.60	8.0	1.23	13.21%	14.2%
2040	6.38	40%	6.88	8.0	1.62	14.10%	30.2%
2041	6.70	40%	7.07	8.0	1.30	11.02%	32.1%
2042	7.03	40%	7.27	10.0	2.97	24.50%	17.5%
2043	7.29	40%	7.42	10.0	2.71	21.90%	19.2%
2044	7.42	40%	7.50	10.0	2.58	20.59%	20.0%
2045	7.56	40%	7.59	10.0	2.44	19.30%	20.9%
2046	7.70	40%	7.67	10.0	2.30	18.01%	21.8%
2047	7.84	40%	7.75	10.0	2.16	16.73%	22.6%
2048	7.98	40%	7.84	10.0	2.02	15.47%	23.4%
2049	8.10	40%	7.91	10.0	1.90	14.41%	24.1%
2050	6.94	40%	9.72	10.0	3.06	18.89%	38.3%

1. % groundwater used assumes surface water supplies are fully utilized.

Option 3 is presented in Table 6-9. This option is similar to Option 2 except that the surface water supply can be delayed by a year because subsidence regulations are not a consideration, and the ultimate capacity of the surface water supply is 0.5 mgd less than Option 2.



Table 6-9. Option 3 Supply Plan – Surface Water Only

Year	Average-Day Shortage (mgd)	Surface Water Supplies (mgd)	Surplus (mgd)	Surplus as % of Demand	% GW Used ¹
2021	0.00		1.05	143.29%	100.0%
2022	0.00		0.89	100.12%	100.0%
2023	0.00		0.63	55.16%	100.0%
2024	0.00		0.32	21.50%	100.0%
2025	0.00		0.71	38.74%	100.0%
2026	0.00	5.0	0.27	11.79%	100.0%
2027	0.23	5.0	4.77	171.39%	0.0%
2028	0.87	5.0	4.13	120.48%	0.0%
2029	1.66	5.0	3.34	79.27%	0.0%
2030	2.66	5.0	2.34	44.91%	4.1%
2031	3.22	5.0	1.78	30.90%	13.4%
2032	3.70	5.0	1.30	20.70%	20.2%
2033	4.15	5.0	0.85	12.62%	25.5%
2034	4.60	8.0	3.40	47.49%	30.1%
2035	5.07	8.0	2.93	38.40%	0.0%
2036	5.47	8.0	2.53	31.50%	0.4%
2037	5.89	8.0	2.11	25.03%	5.3%
2038	6.32	8.0	1.68	18.94%	9.9%
2039	6.77	8.0	1.23	13.21%	14.2%
2040	6.38	8.0	1.62	14.10%	30.2%
2041	6.70	8.0	1.30	11.02%	32.1%
2042	7.03	9.5	2.43	20.07%	21.9%
2043	7.29	9.5	2.17	17.57%	23.5%
2044	7.42	9.5	2.04	16.31%	24.3%
2045	7.56	9.5	1.90	15.06%	25.1%
2046	7.70	9.5	1.77	13.82%	25.9%
2047	7.84	9.5	1.63	12.59%	26.8%
2048	7.98	9.5	1.48	11.37%	27.5%
2049	8.10	9.5	1.36	10.35%	28.2%
2050	6.94	9.5	2.52	15.58%	41.6%

1. % groundwater used assumes surface water supplies are fully utilized.

Water Supply Option 1 is recommended for the City to pursue. It is the most economical by providing cheaper groundwater supplies and reducing the quantity of more expensive surface water. It also provides for additional time to negotiate agreements and to plan and develop new surface water supplies. Finally, it provides the most flexibility because the timing can be adjusted easily if future demands do not develop as projected. Additionally, if subsidence considerations require the City to reduce the portion of their supply met by groundwater, the surface water supplies can be increased, and the additional groundwater supplies already developed can be kept in reserve to help meet

maximum-day water demands or provide a redundant supply if surface water supplies are temporarily interrupted.

Three alternative capital improvement plans were developed based on Water Supply Option 1 and whether new surface water supplies would be purchased from Pearland, from GCWA, or from both Pearland and GCWA (Hybrid Supply). Those are presented in the next section.

7 Capital Improvements Plan (CIP) and Opinion of Probable Construction Cost

HDR prepared 10- and 20-year water capital improvements plans (CIP) to serve as a roadmap of what storage and water supply/booster pumping expansion projects will be required to meet TCEQ requirements, as well as what piping improvements will be necessary to serve areas of growth and development.

It is recommended the City further prioritize these projects in accordance with other implementation needs so that a holistic infrastructure management plan is established to promote overall infrastructure efficiencies and minimize community disruption whenever possible. This process should be considered as an element of annual CIP planning to promote an adaptive infrastructure plan for the City.

Because the projects necessary to provide water service throughout the City's service territory will change depending on what surface water source is pursued (Pearland, GCWA, or both), base CIPs were developed for 2030 and 2040 consisting of projects that are necessary regardless of future water supply sources. Alternative CIPs were then developed considering the water supply sources that could be pursued by the City. A total of three plans were developed for 2030 and three plans for 2040 based on these alternatives.

Complete alternative CIPs are presented in Exhibits 1 through 6. The CIP maps in the exhibits reflect firm capacity of proposed new pumping capacity, but CIP costs include standby capacity that will be required per TCEQ regulations.

7.1 2030 Capital Improvements Plan

7.1.1 Base 2030 CIP

Base 2030 CIP water projects and their associated opinions of probable construction cost¹⁰ are presented in Exhibits 1 through 3. Because of high demand for materials and the high cost of oil, prices of plastic pipe have dramatically increased since 2020. The costs have been escalated to account for recent market trends and volatility, but have

¹⁰ *Any opinions of probable construction cost provided by HDR are made based on information available to HDR and based on the cost estimator's experience and qualifications and represents its judgment as an experienced and qualified professional engineer. HDR has no control over the cost of labor, materials, equipment, or services furnished by others, or over methods of determining prices, or over competitive bidding or market conditions. HDR does not guarantee that proposals, bids, or actual project or construction cost will not vary from opinions of probable cost prepared by HDR.

not been escalated beyond 2021 dollars. The total costs include a 25% contingency for unknowns and 15% for professional services (engineering and survey). The Base 2030 CIP includes expansion of supplies including the new wells and associated water plant improvements.

7.1.2 Additional 2030 CIP for Water Supply

Pearland Supply

If a surface water supply from the City of Pearland is pursued by Manvel, additional CIP projects necessary to utilize the Pearland supply include a 30-inch water line to transfer the supply from Pearland, a 500,000 gallon GST, and a booster pumping station having a combined capital cost of \$17,880,000, shown as project P-1 in Exhibit 1. Annual costs for the additional CIP items and costs to obtain supply from Pearland are summarized in Table 7-1. Costs shown are for Manvel to contract for an average-day supply of 4 mgd and a maximum-day supply of 8 mgd. Supply costs assume Manvel pays for 3.4 mgd (3,800 acft/yr) of supply, which is equivalent to the amount Manvel would need in 2035 assuming that Manvel maximizes its use of groundwater and only utilizes the amount needed to meet the projected shortages with a 10 percent overall supply surplus. Unit costs are based on the unit costs of Pearland supplies of \$4.43/1,000 gals (see Table 6-4) plus the annual costs to amortize the capital costs of the CIP over 20 years at 3.5% interest and estimated O&M costs equal to 5% of the capital cost.

Table 7-1. Annual 2030 CIP and Supply Costs for Pearland Supply (3.4 mgd average-day supply)

Cost Item	Unit Cost (\$/kgal)	Annual Cost
Treated Water Supply	\$4.43	\$5,498,000
CIP Project P-1	\$1.74	\$2,152,000
Total		\$7,650,000

GCWA Supply

If a surface water supply from GCWA is pursued, additional CIP projects necessary to utilize treated water from the proposed GCWA water treatment plant include one 30-inch transmission line that splits into two 24-inch lines, which reduce to 20-inch lines north of SH 6, a 500,000 gallon GST, and a booster pumping station with a combined capital cost of \$14,880,000, as shown in Exhibit 2. Annual costs to obtain the GCWA supply are summarized in Table 7-2. These costs assume a take or pay contract for 4 mgd of supply (8 mgd maximum-day). Unit costs are based on the unit costs for GCWA supplies \$5.36/1,000 gals (see Table 6-5), plus the annual costs to amortize the capital cost of the CIP over 20 years at 3.5% interest and O&M costs estimated by the TWDB's UCM.

Table 7-2. Annual 2030 CIP and Supply Costs for GCWA Supply (4 mgd take or pay contract)

Cost Item	Unit Cost (\$/kgal)	Annual Cost
Treated Water Supply	\$5.36	\$7,827,000
CIP Project G-1	\$1.19	\$1,743,000
Total		\$9,570,000

Hybrid Supply

If the City pursues surface water supplies from both Pearland and GCWA, it is assumed that the Pearland supply would be developed first, to take advantage of the Pearland water treatment plant nearing completion. The Additional 2030 CIP for the Hybrid Supply is identical to the 2030 Pearland supply, costs for which are shown in Table 7-1. The 2030 CIP for the Hybrid Supply is shown in Exhibit 3.

7.2 2040 Capital Improvements Plan

7.2.1 Base 2040 CIP

Base 2040 CIP water projects and their associated opinion of probable construction cost are presented in Exhibits 4 through 6. Because of high demand for materials and the high cost of oil, prices of plastic pipe have dramatically increased since 2020. The costs have been escalated to account for recent market trends and volatility, but have not been escalated beyond 2021 dollars. The total costs include a 25% contingency for unknowns and 15% for professional services (engineering and survey).

7.2.2 Additional 2040 CIP for Water Supply

Note that the projects and costs are shown as “2040” projects, but would appear to be needed by 2037 under the recommended Water Supply Option 1.

Pearland Water Supply

Additional 2040 CIP projects for the Pearland supply include additional 24-inch, 20-inch and 16-inch transmission lines, an additional 500,000 gallon GST, and a booster pumping station, located along the northwest side of the future Manvel system. These projects have a total capital cost of \$22,680,000 as shown for projects P-27, P-28, P-30, and P-31 in Exhibit 4. Annual costs are developed similarly as for the additional 2030 CIP and summarized in Table 7-3, assuming that the full 7 mgd average day supply is taken by 2045 (an additional 3.6 mgd).

Table 7-3. Annual 2040 CIP and Supply Costs for Pearland Supply (additional 3.6 mgd average-day supply)

Cost Item	Unit Cost (\$/kgal)	Annual Cost
Treated Water Supply	\$2.97	\$3,903,000
CIP Projects P-27, P-28, P-30, & P-31	\$2.08	\$2,730,000
Total		\$6,633,000

GCWA Water Supply

Additional 2040 CIP projects for the GCWA supply include multiple additional transmission lines to move water from the south to the north portion of the future Manvel system, an additional 500,000 gallon GST, and an expansion of the finished water booster station. These projects (G-2, G-3, G-4, G-23, G-24, G-25, G-27, G-40, and G-43) have a total combined capital cost of \$29,180,000 as shown in Exhibit 5. Annual costs are summarized in Table 7-4 assuming that an additional 3 mgd average-day supply is contracted for on a take or pay basis.

Table 7-4. Annual 2040 CIP and Supply Costs for GCWA Supply (additional 3 mgd take or pay contract)

Cost Item	Unit Cost (\$/kgal)	Annual Cost
Treated Water Supply	\$3.09	\$3,387,000
CIP Projects P-27, P-28, P-30, & P-31	\$3.21	\$3,512,000
Total		\$6,899,000

Hybrid Water Supply

Additional 2040 CIP projects for the Hybrid Supply option include additional pipeline projects to convey the additional supply throughout the Manvel system, a 500,000 gallon GST, and a booster pump station, as shown in Exhibit 6. These projects (H-2, H-23, H-27, H-40, H-42, and H-43) have a total capital cost of \$32,310,000. Costs for GCWA supplies under the Hybrid Supply option are as shown in Table 6-6. Total annual costs are shown in Table 7-5.

Table 7-5. Annual 2040 CIP and Supply Costs for Hybrid Supply (additional 3 mgd take or pay contract with GCWA)

Cost Item	Unit Cost (\$/kgal)	Annual Cost
Treated Water Supply	\$5.45	\$5,969,000
CIP Projects H-2, H-23, H-27, H-40, H-42 & H-43	\$3.55	\$3,889,000
Total		\$9,858,000

7.3 Recommendations

7.3.1 Adaptive Infrastructure Planning

The City's rapid growth is causing a highly dynamic development environment in which it is difficult to prioritize the large number of capital projects and efficiently utilize the City's capital resources. It is recommended the City further prioritize these projects in accordance with other implementation needs so that a holistic infrastructure management plan is established to promote efficient utilization of capital and minimize community disruption. Based on the rapidly changing development environment, the City should revisit this Master Water Plan at least annually so that the City can adaptively manage its capital investments.

7.3.2 Future Water Supply

It is recommended that the City pursue Water Supply Option 1, in which three additional groundwater wells would be constructed prior to 2030, followed by the incorporation of surface water supplies into the City's water supply portfolio about 2030. This approach will provide the City with flexibility in meeting future demands by allowing these first additional supplies to be delayed or expedited if water demands develop differently than projected.

Based on conversations with City staff the City should obtain surface water utilizing the Hybrid approach, whereby the City would obtain an initial surface water supply from the City of Pearland by 2030. The next increment of supply would be contracted from the GCWA sometime around 2040, depending on future growth. This Hybrid approach initially would take advantage of the relatively less expensive water from Pearland and take advantage of the shorter timeframe needed to obtain the supply. Then, as demands grow and the City has a better understanding of expected water demands, a new water treatment plant on the south side of the system would be developed with GCWA, which would also allow the City to utilize its water contracted from the BRA. This new plant would have the option of serving as a regional supply which would decrease the City's unit costs from those shown here, which assume only the City would be supplied from the new plant. This Hybrid approach also provides the City flexibility if additional supplies from Pearland or another water supplier are more advantageous in the future.



Exhibit 1. Base 2030 Capital Improvements Plan with Additional Pearland Water Supply CIP

LEGEND

- Pearland Supply
- Pearland Supply
- 2030 Pearland CIP Pipelines

- 2030 CIP Plants
- Existing Plants

2030 CIP Tanks

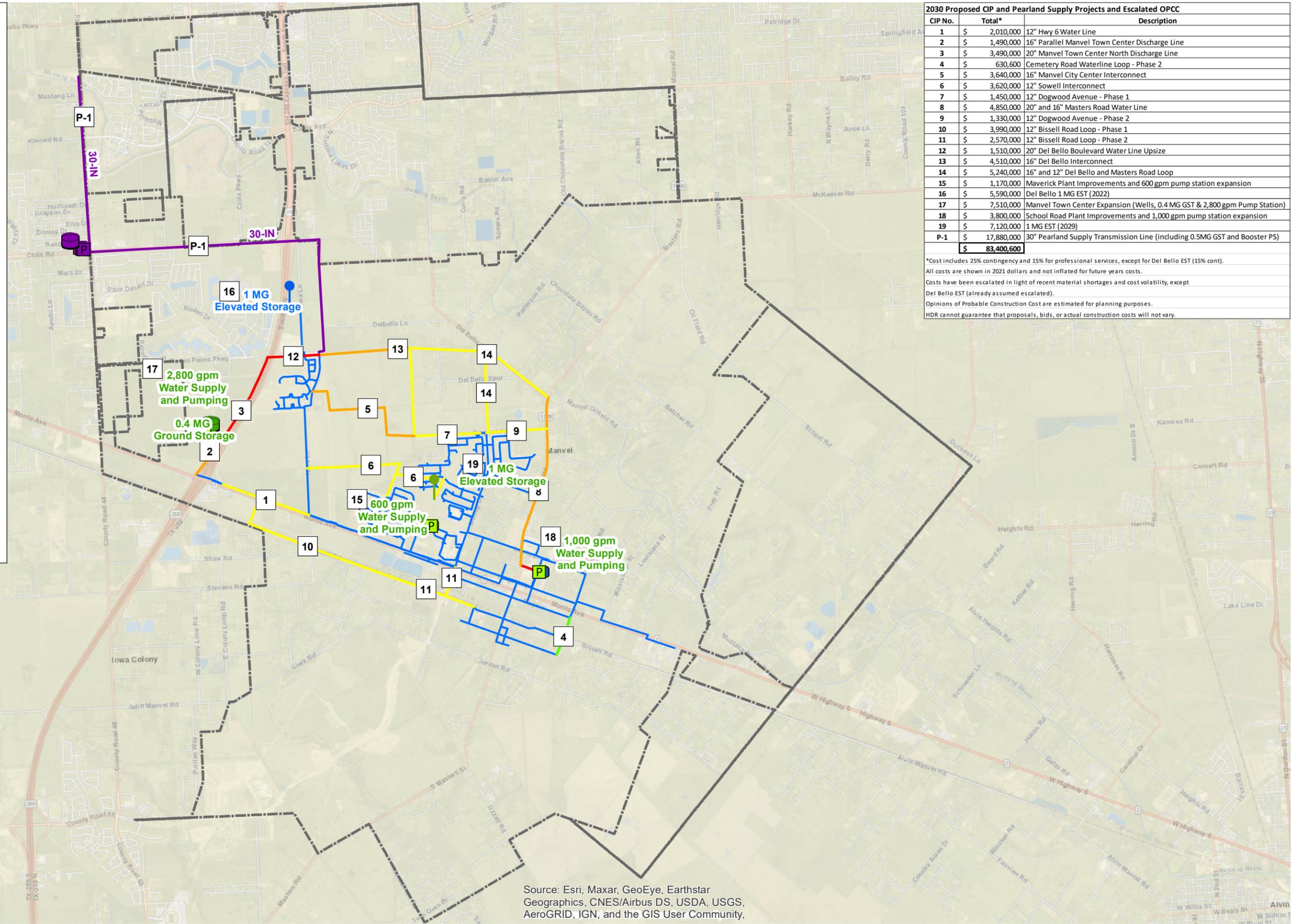
- EST
- GST

Existing Tanks

- EST
- GST

2030 CIP Water Lines

- 8"
- 12"
- 16"
- 20"
- Existing Water Lines
- City Limits



2030 Proposed CIP and Pearland Supply Projects and Escalated OPCC		
CIP No.	Total*	Description
1	\$ 2,010,000	12" Hwy 6 Water Line
2	\$ 1,490,000	16" Parallel Manvel Town Center Discharge Line
3	\$ 3,490,000	20" Manvel Town Center North Discharge Line
4	\$ 630,600	Cemetery Road Waterline Loop - Phase 2
5	\$ 3,640,000	16" Manvel City Center Interconnect
6	\$ 3,620,000	12" Sowell Interconnect
7	\$ 1,450,000	12" Dogwood Avenue - Phase 1
8	\$ 4,850,000	20" and 16" Masters Road Water Line
9	\$ 1,330,000	12" Dogwood Avenue - Phase 2
10	\$ 3,990,000	12" Bissell Road Loop - Phase 1
11	\$ 2,570,000	12" Bissell Road Loop - Phase 2
12	\$ 1,510,000	20" Del Bello Boulevard Water Line Upsize
13	\$ 4,510,000	16" Del Bello Interconnect
14	\$ 5,240,000	16" and 12" Del Bello and Masters Road Loop
15	\$ 1,170,000	Maverick Plant Improvements and 600 gpm pump station expansion
16	\$ 5,590,000	Del Bello 1 MG EST (2022)
17	\$ 7,510,000	Manvel Town Center Expansion (Wells, 0.4 MG GST & 2,800 gpm Pump Station)
18	\$ 3,800,000	School Road Plant Improvements and 1,000 gpm pump station expansion
19	\$ 7,120,000	1 MG EST (2029)
P-1	\$ 17,880,000	30" Pearland Supply Transmission Line (including 0.5MG GST and Booster PS)
	\$ 83,400,600	

*Cost includes 25% contingency and 15% for professional services, except for Del Bello EST (15% cont).
 All costs are shown in 2021 dollars and not inflated for future years costs.
 Costs have been escalated in light of recent material shortages and cost volatility, except Del Bello EST (already assumed escalated).
 Opinions of Probable Construction Cost are estimated for planning purposes.
 HDR cannot guarantee that proposals, bids, or actual construction costs will not vary.

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community,





Exhibit 2. Base 2030 Capital Improvements Plan with Additional GCWA Water Supply CIP

LEGEND

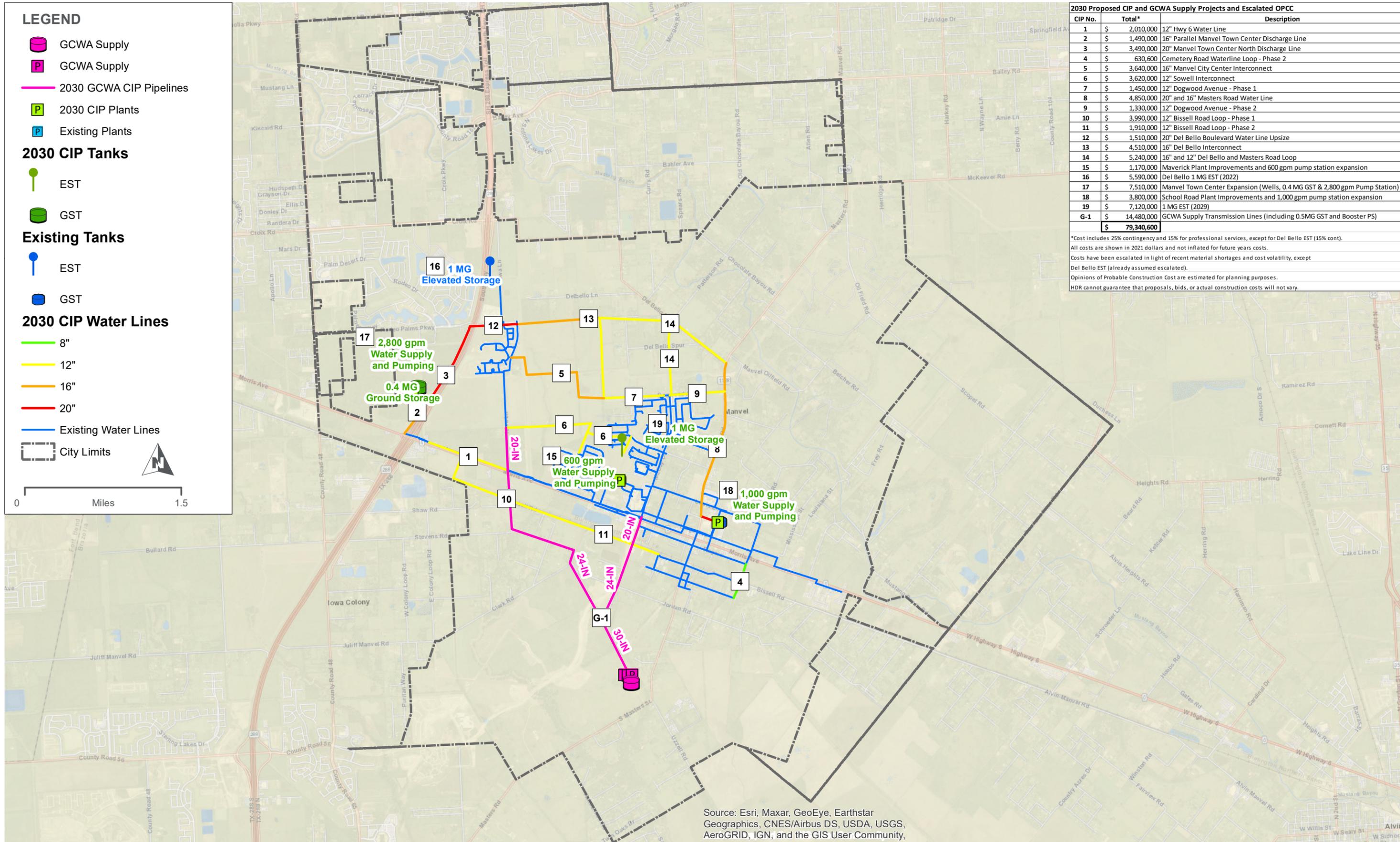
-  GCWA Supply
-  GCWA Supply
-  2030 GCWA CIP Pipelines
-  2030 CIP Plants
-  Existing Plants
- 2030 CIP Tanks**
-  EST
-  GST
- Existing Tanks**
-  EST
-  GST
- 2030 CIP Water Lines**
-  8"
-  12"
-  16"
-  20"
-  Existing Water Lines
-  City Limits

0 Miles 1.5



2030 Proposed CIP and GCWA Supply Projects and Escalated OPCC			
CIP No.	Total*		Description
1	\$ 2,010,000	12"	Hwy 6 Water Line
2	\$ 1,490,000	16"	Parallel Manvel Town Center Discharge Line
3	\$ 3,490,000	20"	Manvel Town Center North Discharge Line
4	\$ 630,600		Cemetery Road Waterline Loop - Phase 2
5	\$ 3,640,000	16"	Manvel City Center Interconnect
6	\$ 3,620,000	12"	Sowell Interconnect
7	\$ 1,450,000	12"	Dogwood Avenue - Phase 1
8	\$ 4,850,000	20" and 16"	Masters Road Water Line
9	\$ 1,330,000	12"	Dogwood Avenue - Phase 2
10	\$ 3,990,000	12"	Bissell Road Loop - Phase 1
11	\$ 1,910,000	12"	Bissell Road Loop - Phase 2
12	\$ 1,510,000	20"	Del Bello Boulevard Water Line Upsize
13	\$ 4,510,000	16"	Del Bello Interconnect
14	\$ 5,240,000	16" and 12"	Del Bello and Masters Road Loop
15	\$ 1,170,000		Maverick Plant Improvements and 600 gpm pump station expansion
16	\$ 5,590,000		Del Bello 1 MG EST (2022)
17	\$ 7,510,000		Manvel Town Center Expansion (Wells, 0.4 MG GST & 2,800 gpm Pump Station)
18	\$ 3,800,000		School Road Plant Improvements and 1,000 gpm pump station expansion
19	\$ 7,120,000		1 MG EST (2029)
G-1	\$ 14,480,000		GCWA Supply Transmission Lines (including 0.5MG GST and Booster PS)
	\$ 79,340,600		

*Cost includes 25% contingency and 15% for professional services, except for Del Bello EST (15% cont).
 All costs are shown in 2021 dollars and not inflated for future years costs.
 Costs have been escalated in light of recent material shortages and cost volatility, except Del Bello EST (already assumed escalated).
 Opinions of Probable Construction Cost are estimated for planning purposes.
 HDR cannot guarantee that proposals, bids, or actual construction costs will not vary.



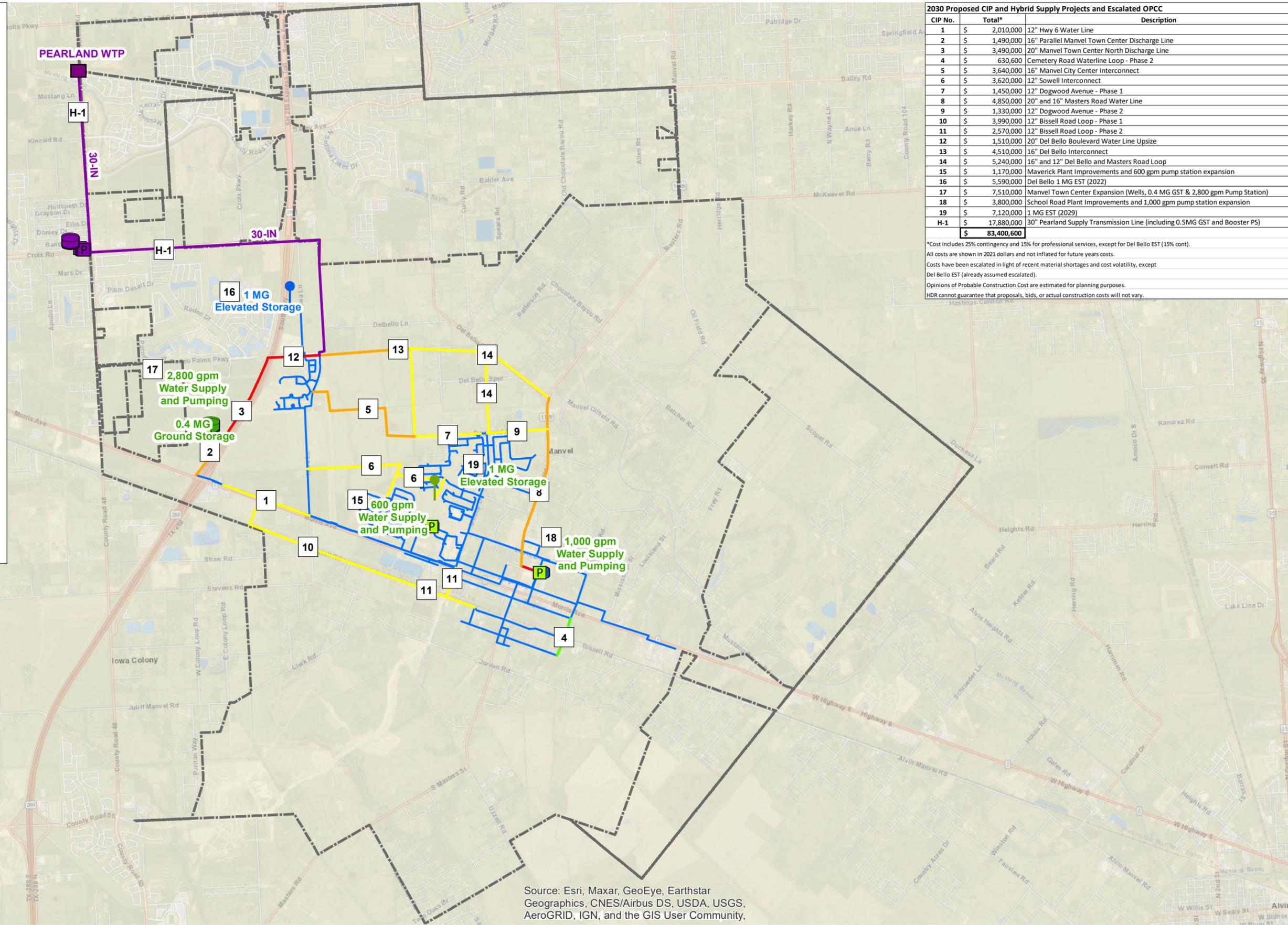
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Exhibit 3. Base 2030 Capital Improvements Plan with Additional Hybrid Water Supply CIP

LEGEND

- Pearland Supply
- Pearland Supply
- 2030 Hybrid CIP Pipelines
- 2030 CIP Plants
- Existing Plants
- 2030 CIP Tanks**
- EST
- GST
- Existing Tanks**
- EST
- GST
- 2030 CIP Water Lines**
- 8"
- 12"
- 16"
- 20"
- Existing Water Lines
- City Limits



2030 Proposed CIP and Hybrid Supply Projects and Escalated OPCC		
CIP No.	Total*	Description
1	\$ 2,010,000	12" Hwy 6 Water Line
2	\$ 1,490,000	16" Parallel Manvel Town Center Discharge Line
3	\$ 3,490,000	20" Manvel Town Center North Discharge Line
4	\$ 630,600	Cemetery Road Waterline Loop - Phase 2
5	\$ 3,640,000	16" Manvel City Center Interconnect
6	\$ 3,620,000	12" Sowell Interconnect
7	\$ 1,450,000	12" Dogwood Avenue - Phase 1
8	\$ 4,850,000	20" and 16" Masters Road Water Line
9	\$ 1,330,000	12" Dogwood Avenue - Phase 2
10	\$ 3,990,000	12" Bissell Road Loop - Phase 1
11	\$ 2,570,000	12" Bissell Road Loop - Phase 2
12	\$ 1,510,000	20" Del Bello Boulevard Water Line Upsize
13	\$ 4,510,000	16" Del Bello Interconnect
14	\$ 5,240,000	16" and 12" Del Bello and Masters Road Loop
15	\$ 1,170,000	Maverick Plant Improvements and 600 gpm pump station expansion
16	\$ 5,590,000	Del Bello 1 MG EST (2022)
17	\$ 7,510,000	Manvel Town Center Expansion (Wells, 0.4 MG GST & 2,800 gpm Pump Station)
18	\$ 3,800,000	School Road Plant Improvements and 1,000 gpm pump station expansion
19	\$ 7,120,000	1 MG EST (2029)
H-1	\$ 17,880,000	30" Pearland Supply Transmission Line (including 0.5MG GST and Booster PS)
	\$ 83,400,600	

*Cost includes 25% contingency and 15% for professional services, except for Del Bello EST (15% cont).
 All costs are shown in 2021 dollars and not inflated for future years costs.
 Costs have been escalated in light of recent material shortages and cost volatility, except Del Bello EST (already assumed escalated).
 Opinions of Probable Construction Cost are estimated for planning purposes.
 HDR cannot guarantee that proposals, bids, or actual construction costs will not vary.

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





Exhibit 4. Base 2040 Capital Improvements Plan with Additional Pearland Water Supply CIP

LEGEND

- Pearlland Supply
- Pearlland Supply
- 2030 and 2040 Pearlland CIP Pipelines
- Existing and 2030 CIP Plants

2040 CIP Tanks

- EST
- GST

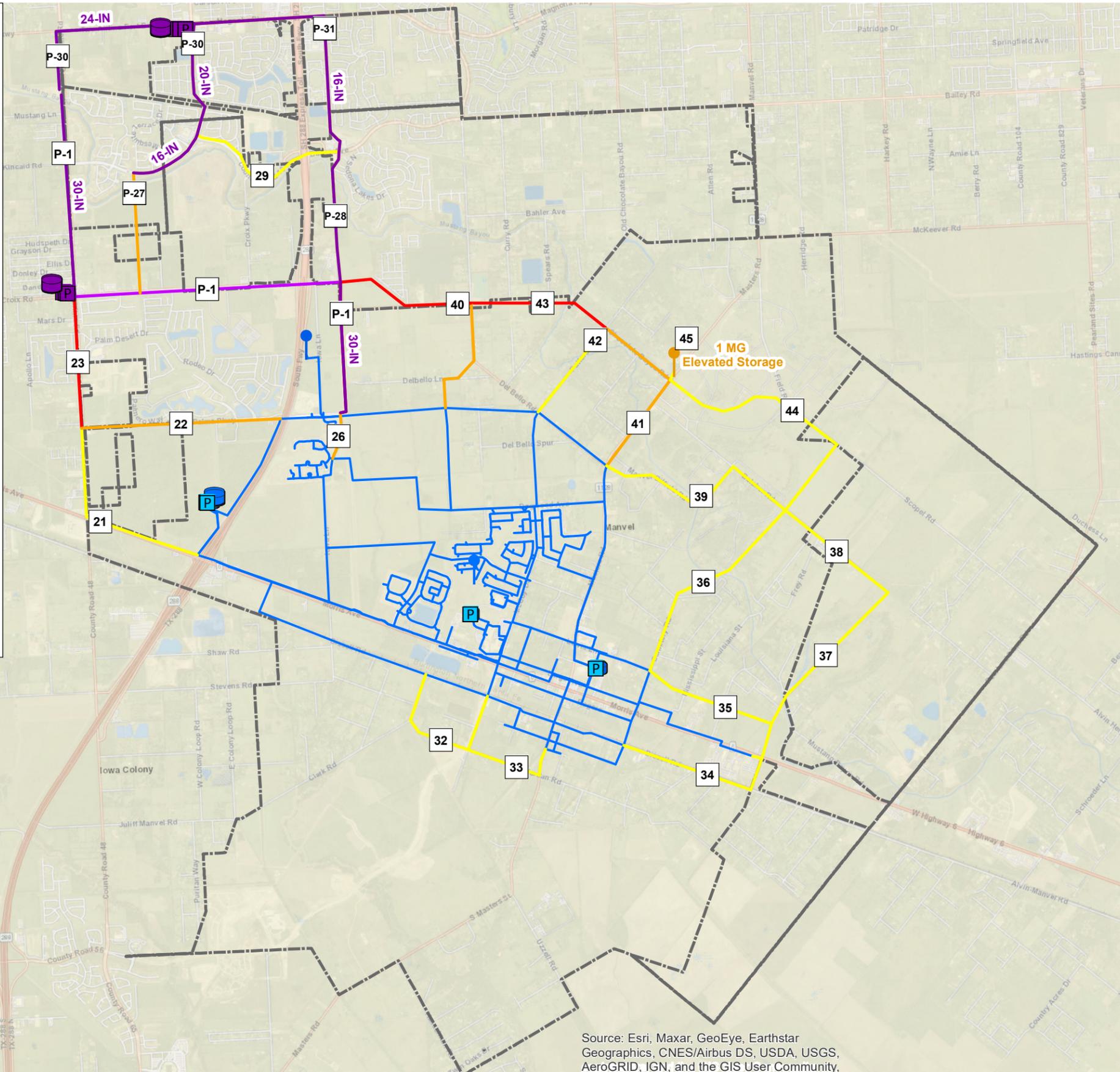
Existing and 2030 CIP Tanks

- EST
- GST

2040 CIP Water Lines

- 12"
- 16"
- 20"
- 30"
- Existing and 2030 CIP Water Lines
- City Limits

0 Miles 1.5



2040 Proposed CIP and Pearland Supply Projects and Escalated OPCC		
CIP No.	Total*	Description
21	\$ 3,910,000	12" Hwy 6 and CR48 Water Line
22	\$ 4,330,000	16" Rodeo Palms Parkway
23	\$ 3,300,000	20" Old Airline Road Water Line
26	\$ 1,030,000	16" Manvel Parkway Water Line Upsize
P-27	\$ 4,330,000	16" Pomona Parkway Water Line
P-28	\$ 2,890,000	16" SH 288 Water Line
29	\$ 3,230,000	12" County Road 101 Water Line
P-30	\$ 9,590,000	24" Pearland Supply and 20" Kirby Drive Water Line
P-31	\$ 5,870,000	16" Northwest Interconnect
32	\$ 3,260,000	12" Jordan Road Loop - Phase 1
33	\$ 1,950,000	12" Jordan Road Loop - Phase 2
34	\$ 3,350,000	12" Bissell Road Loop
35	\$ 3,230,000	12" Southeast Loop
36	\$ 4,180,000	12" Cemetery Road Water Line
37	\$ 3,340,000	12" Markham Road Water Line
38	\$ 2,490,000	12" Belcher Road Water Line - Phase 1
39	\$ 4,200,000	12" Belcher Road Water Line - Phase 2
40	\$ 6,210,000	20" Croix Road Line and 16" CR90 Line
41	\$ 2,320,000	16" Masters Road Water Line
42	\$ 3,860,000	12" Patterson Rd Line and 16" Chocolate Bayou Rd Line
43	\$ 3,590,000	20" Northern System Interconnect
44	\$ 5,280,000	12" Oil Field Road Water Line
45	\$ 7,120,000	EST (1 MG)
\$	\$ 92,860,000	

*Cost includes 25% contingency and 15% for professional services.
 All costs are shown in 2021 dollars and not inflated for future years costs.
 Costs have been escalated in light of recent material shortages and cost volatility.
 Opinions of Probable Construction Cost are estimated for planning purposes.
 HDR cannot guarantee that proposals, bids, or actual construction costs will not vary.

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community,





Exhibit 5. Base 2040 Capital Improvements Plan with Additional GCWA Water Supply CIP

LEGEND

-  GCWA Supply
-  GCWA Supply
-  2030 and 2040 GCWA CIP Pipelines
-  Existing and 2030 CIP Plants

2040 CIP Tanks

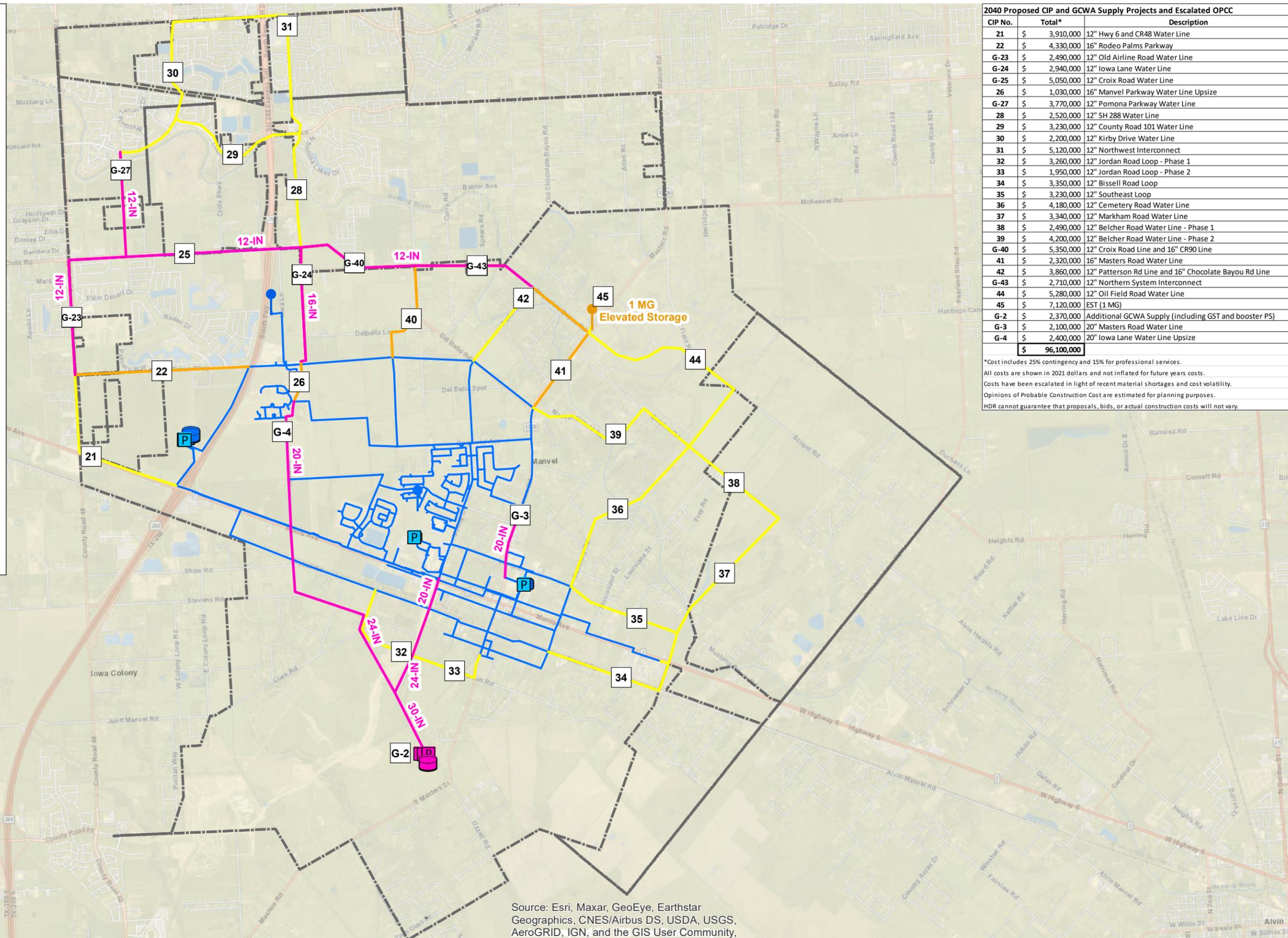
-  EST
-  GST

Existing and 2030 CIP Tanks

-  EST
-  GST

2040 CIP Water Lines

-  12"
-  16"
-  20"
-  30"
-  Existing and 2030 CIP Water Lines
-  City Limits



2040 Proposed CIP and GCWA Supply Projects and Escalated OPCC		
CIP No.	Total*	Description
21	\$ 3,910,000	12" Hwy 6 and CR48 Water Line
22	\$ 4,330,000	16" Rodeo Palms Parkway
G-23	\$ 2,490,000	12" Old Airline Road Water Line
G-24	\$ 2,940,000	12" Iowa Lane Water Line
G-25	\$ 5,050,000	12" Croix Road Water Line
26	\$ 1,030,000	16" Manvel Parkway Water Line Upsize
G-27	\$ 3,770,000	12" Pomona Parkway Water Line
28	\$ 2,520,000	12" SH 288 Water Line
29	\$ 3,230,000	12" County Road 101 Water Line
30	\$ 2,200,000	12" Kirby Drive Water Line
31	\$ 5,120,000	12" Northwest Interconnect
32	\$ 3,260,000	12" Jordan Road Loop - Phase 1
33	\$ 1,950,000	12" Jordan Road Loop - Phase 2
34	\$ 3,350,000	12" Bissell Road Loop
35	\$ 3,230,000	12" Southeast Loop
36	\$ 4,180,000	12" Cemetery Road Water Line
37	\$ 3,340,000	12" Markham Road Water Line
38	\$ 2,490,000	12" Belcher Road Water Line - Phase 1
39	\$ 4,200,000	12" Belcher Road Water Line - Phase 2
G-40	\$ 5,350,000	12" Croix Road Line and 16" CR90 Line
41	\$ 2,320,000	16" Masters Road Water Line
42	\$ 3,860,000	12" Patterson Rd Line and 16" Chocolate Bayou Rd Line
G-43	\$ 2,710,000	12" Northern System Interconnect
44	\$ 5,280,000	12" Oil Field Road Water Line
45	\$ 7,120,000	EST (1 MG)
G-2	\$ 2,370,000	Additional GCWA Supply (including GST and booster PS)
G-3	\$ 2,100,000	20" Masters Road Water Line
G-4	\$ 2,400,000	20" Iowa Lane Water Line Upsize
	\$ 96,100,000	

*Cost includes 25% contingency and 15% for professional services.
 All costs are shown in 2021 dollars and not inflated for future years costs.
 Costs have been escalated in light of recent material shortages and cost volatility.
 Opinions of Probable Construction Cost are estimated for planning purposes.
 HDR cannot guarantee that proposals, bids, or actual construction costs will not vary.

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community,

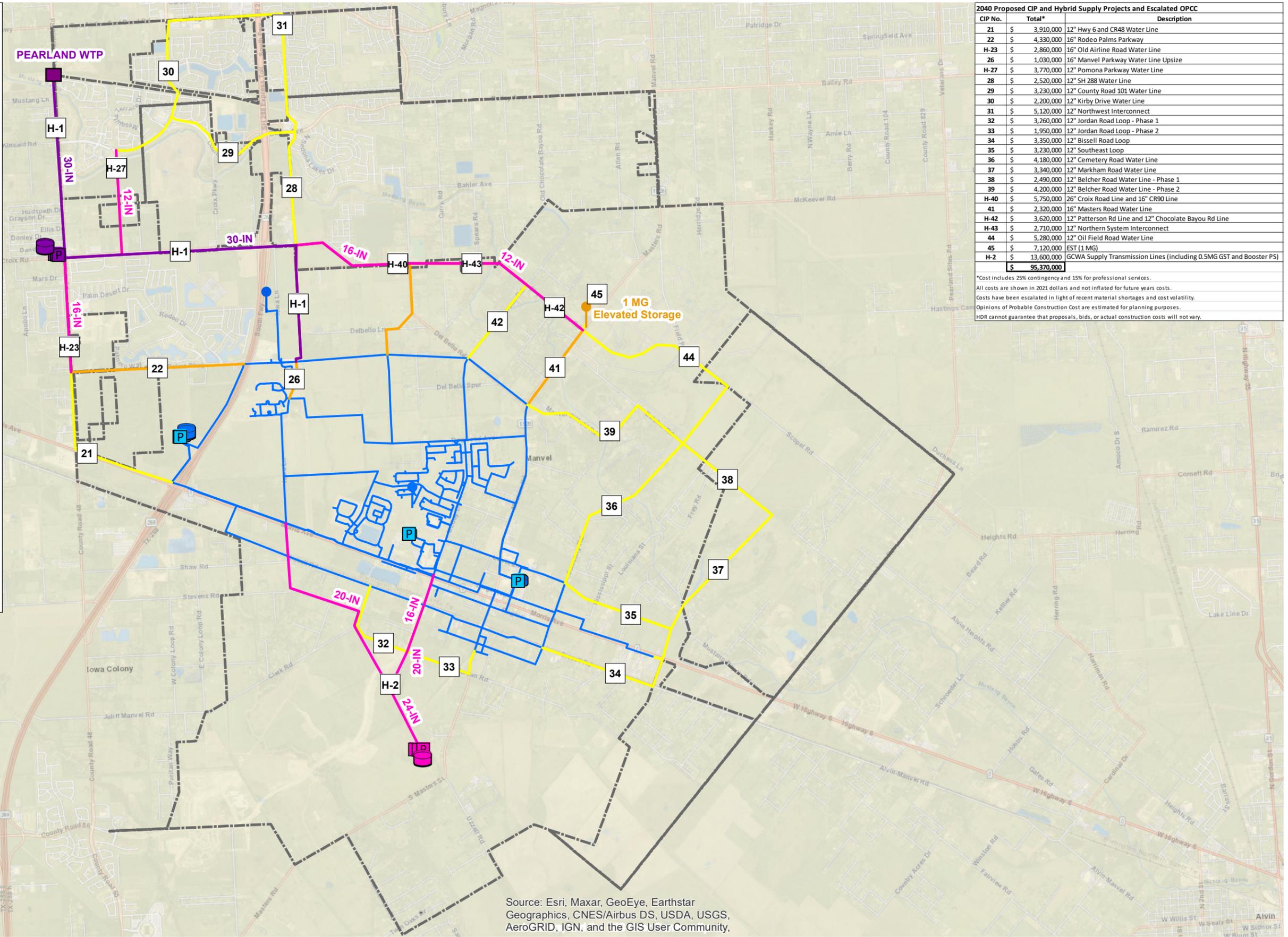




Exhibit 6. Base 2040 Capital Improvements Plan with Additional Hybrid Water Supply CIP

LEGEND

- GCWA Supply
- GCWA Supply
- Pearland Supply
- Pearland Supply
- 2030 Hybrid CIP Pipelines
- 2040 Hybrid CIP Pipelines
- Existing and 2030 CIP Plants
- EST
- GST
- Existing and 2030 CIP Tanks**
- EST
- GST
- 2040 CIP Water Lines**
- 12"
- 16"
- 20"
- 30"
- Existing and 2030 CIP Water Lines
- City Limits



2040 Proposed CIP and Hybrid Supply Projects and Escalated OPCC			
CIP No.	Total*		Description
21	\$ 3,910,000	12"	Hwy 6 and CR48 Water Line
22	\$ 4,330,000	16"	Rodeo Palms Parkway
H-23	\$ 2,860,000	16"	Old Airline Road Water Line
26	\$ 1,030,000	16"	Manvel Parkway Water Line Upsize
H-27	\$ 3,770,000	12"	Pomona Parkway Water Line
28	\$ 2,520,000	12"	SH 288 Water Line
29	\$ 3,230,000	12"	County Road 101 Water Line
30	\$ 2,200,000	12"	Kirby Drive Water Line
31	\$ 5,120,000	12"	Northwest Interconnect
32	\$ 3,260,000	12"	Jordan Road Loop - Phase 1
33	\$ 1,950,000	12"	Jordan Road Loop - Phase 2
34	\$ 3,350,000	12"	Bissell Road Loop
35	\$ 3,230,000	12"	SE Southeast Loop
36	\$ 4,180,000	12"	Cemetery Road Water Line
37	\$ 3,340,000	12"	Markham Road Water Line
38	\$ 2,490,000	12"	Belcher Road Water Line - Phase 1
39	\$ 4,200,000	12"	Belcher Road Water Line - Phase 2
H-40	\$ 5,750,000	26"	Croix Road Line and 16" CR90 Line
41	\$ 2,320,000	16"	Masters Road Water Line
H-42	\$ 3,620,000	12"	Patterson Rd Line and 12" Chocolate Bayou Rd Line
H-43	\$ 2,710,000	12"	Northern System Interconnect
44	\$ 5,280,000	12"	Oil Field Road Water Line
45	\$ 7,120,000	EST (1 MG)	
H-2	\$ 13,600,000		GCWA Supply Transmission Lines (including 0.5MG GST and Booster PS)
	\$ 95,370,000		

*Cost includes 25% contingency and 15% for professional services.
 All costs are shown in 2021 dollars and not inflated for future years costs.
 Costs have been escalated in light of recent material shortages and cost volatility.
 Opinions of Probable Construction Cost are estimated for planning purposes.
 HDR cannot guarantee that proposals, bids, or actual construction costs will not vary.

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

