RESOLUTION NO. 25-363

A RESOLUTION OF THE CITY OF DENTON, TEXAS, A TEXAS HOME-RULE MUNICIPAL CORPORATION, ADOPTING THE CITY OF DENTON WATER MASTER PLAN; SUPERSEDING PREVIOUSLY ADOPTED WATER MASTER PLANS; AND DECLARING AN EFFECTIVE DATE

WHEREAS, on September 30, 2025, City of Denton Water Utilities presented the City of Denton Water Master Plan ("Water Master Plan") to City Council and recommended approval; and

WHEREAS, the Water Master Plan serves as a guide that supports the City's efforts to maintain, operate, and expand water infrastructure to meet community needs; and

WHEREAS, the Water Master Plan benefits the City of Denton and its residents by ensuring efficient and sustainable management of water resources, protecting public health and safety, and providing a robust plan for constructing water treatment and conveyance infrastructure for the population growth projected over the next 25 years; and

WHEREAS, the Water Master Plan is intended to supersede any water master plan previously adopted by City Council; and

WHEREAS, City Council wishes to adopt the Water Master Plan.

NOW THEREFORE, THE COUNCIL OF THE CITY OF DENTON HEREBY RESOLVES:

<u>SECTION 1</u>. The recitals in the preamble of this Resolution are true and correct and incorporated into the body of this Resolution as if copied in their entirety.

<u>SECTION 2</u>. The Water Master Plan, attached hereto as Exhibit "A" and incorporated herein, is hereby adopted by the City of Denton, Texas.

<u>SECTION 3</u>. The Water Master Plan attached in Exhibit "A" supersedes any water master plan previously adopted by City Council.

<u>SECTION 4</u>. The Water Master Plan attached in Exhibit "A" shall be filed with the City Secretary.

<u>SECTION 5</u>. This Resolution shall become effective immediately upon its passage and approval.

The motion to approve this Resolution was made by __________________________ and seconded by __________________________, the Resolution was passed and approved by the following vote [___ - ___]:

	Aye	Nay	Abstain	Absent
Mayor Gerard Hudspeth:	______	______	______	______
Vicki Byrd, District 1:	______	______	______	______
Brian Beck, District 2:	______	______	______	______
Suzi Rumohr, District 3:	______	______	______	______
Joe Holland, District 4:	______	______	______	______
Brandon Chase McGee, At Large Place 5:	______	______	______	______
Jill Jester, At Large Place 6:	______	______	______	______

PASSED AND APPROVED this the _________ day of ____________________, 2025.

____
GERARD HUDSPETH, MAYOR

ATTEST:
INGRID REX, INTERIM CITY SECRETARY

BY: ___________________________________

APPROVED AS TO LEGAL FORM:
MACK REINWAND, CITY ATTORNEY

BY: Christopher Mullins

EXHIBIT “A”

CITY OF DENTON WATER MASTER PLAN

PREPARED FOR

CITY OF DENTON

PREPARED BY

Kimley»Horn

Expect More. Experience Better.

2024 WATER MASTER PLAN

CITY OF DENTON

Prepared By:

Kimley»Horn

Sensitive content has been removed from this version of the report for public release.

Texas Board of Professional Engineers Firm Registration Number: F-928

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Jeff James, P.E.
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John R. Atkins, P.E.
02/15/2025

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CHAPTER 1

EXECUTIVE SUMMARY

1.1. INTRODUCTION

The Water Master Plan (WMP) and the underlying hydraulic model serve as the basis for the planning, design, construction, and financing of the water infrastructure for the City of Denton. The primary goal of the WMP was to develop a plan for City of Denton (City) to provide systematic upgrades and expansions of the water system to serve all future developments within the Study Area. A secondary goal of the WMP was to identify existing capacity deficiencies within the system and provide recommended upgrades. The significant scope elements of this project are as follows:

1. Utilization of existing land use and future land use as determined in the 2023 Wastewater Master Plan (WWMP) with minor updates
2. Utilization of population and growth projections as determined in the 2023 WWMP with minor updates
3. Fire hydrant flow testing and pressure monitoring
4. Pump station performance testing
5. Historical customer water usage and water demand analysis per pressure plane
6. Existing hydraulic model creation and calibration
7. Existing water system analysis and deficiency identification
8. Existing water treatment unit process capacities and deficiency identification
9. Future water demand projections through the 5-Year, 10-Year, and 25-Year planning periods
10. Identify additional Water Treatment Plant (WTP) capacity needed to serve future water demand projections
11. Review current and anticipated regulation requirements for the WTPs
12. Alternative treatment technology evaluation and recommendations
13. Capital Improvement Plan development for the 5-Year, 10-Year, and 25-Year planning periods

Kimley-Horn and the City selected the 5, 10, and 25-year planning periods for analysis and the Capital Improvement Plan (CIP). See **Table 1.1** for a description of each planning period.

Table 1.1 – Planning Periods

Planning Period	Description
5-Year	Represents present day to the next 5 years. Projects in this category are recommended to serve known incoming single and multi-phase developments or to remedy existing deficiencies. City staff are aware of these projects and are actively planning, designing, and determining financing.
10-Year	Represents 5 years through 10 years. Projects in this category are recommended to serve continuing multi-phase developments or projected growth within the City.
25-Year	Represents 10 years through 25 years. Projects in this category are recommended to serve continuing multi-phase developments or projected growth within the City.

1.2. GROWTH AND FUTURE LAND USE

Based on known incoming developments, including Municipal Utility Districts (MUDs) identified in Extra Territorial Jurisdiction (ETJ) 2, a compound annual growth rate of 8.6% is projected over the next 5 years. Kimley-Horn worked with the City to establish a 2.9% growth rate for the 10-year planning period and 2.0% growth rate for the 25-year period that account for the known multi-phase developments, MUDs, and additional growth throughout the City (**Figure 1.1**).

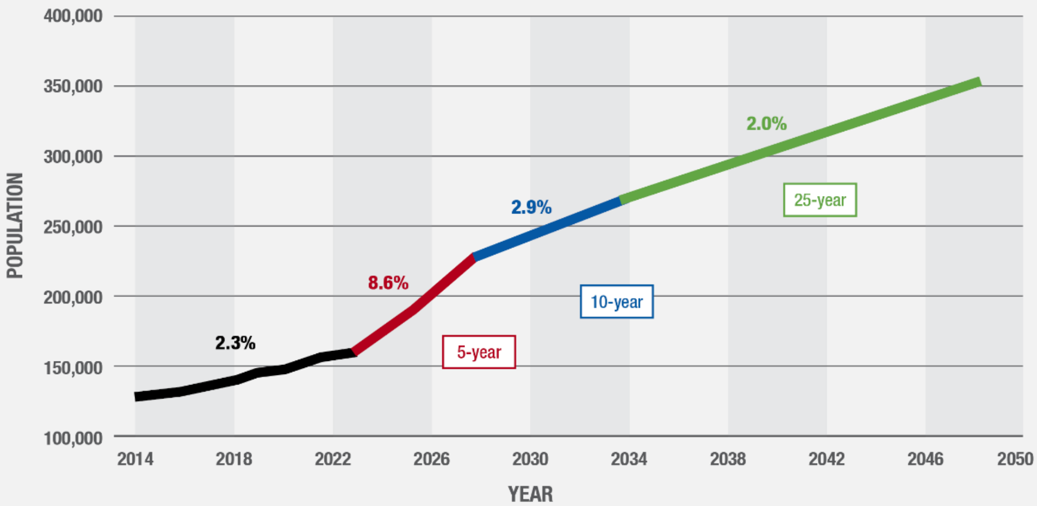


Figure 1.1 – Population Growth Rates for the 5, 10, and 25-Year Planning Periods

All single-phase known developments were assumed to fully develop within the 5-year planning period, while the known multi-phase developments and MUDs developed according to the 5-year phasing plans provided by developers. For the 10-year planning period, known multi-phase developments and MUDs were developed according to the 10-year phasing plans provided by developers, with additional growth allocated to areas identified by the City until the 2.9% growth rate was achieved. For the 25-year planning period, known multi-phase developments and MUDs were developed according to the 25-year phasing plans provided by developers, with additional growth allocated to areas identified by the City until the 2.0% growth rate was achieved. The locations of the identified growth areas for the planning periods are shown in **Exhibit E – Growth and Phasing**.

The future land use, identified in the 2040 Comprehensive Plan, was then applied to the identified growth areas for the 5, 10 and 25-year planning periods. Future Land Use is shown in **Exhibit D – Future Land Use.**

1.3. WATER DEMAND

1.3.1. RETAIL WATER DEMAND PROJECTIONS

Retail demand includes demand from any existing or future customer within the Study Area. Retail water demand projections for the 5, 10, and 25-year planning periods were determined utilizing the growth projections outlined in **Section 1.2** and loading factors based on future land use**.** The projected retail average day and maximum day demand per planning period is outlined in **Table 1.2**.

Table 1.2 – Projected Retail Demand Per Planning Period

Planning Period	ADD (MGD)	MDD (MGD)[1]
Existing	24.2	46.5
5-Year	33.8	65.1
10-Year	39.5	76.1
25-Year	50.4	97.0

[1]*Average to maximum day peaking factor of 1.9 (see* ***Section 4.1.1****)*

1.3.2. WHOLESALE WATER DEMAND PROJECTIONS

The City provides wholesale treated water to three entities through a contract with Upper Trinity Regional Water District (UTRWD):

- City of Krum
- City of Sanger
- Lake Cities Municipal Water Authority (LCMUA) – emergency only

Within the next 5 years, the City plans to provide wholesale treated water to the City of Ponder as well. **Table 1.3** outlines the total projected wholesale demand per planning period.

Table 1.3 – Projected Wholesale Demand Per Planning Period

Planning Period	ADD (MGD)	MDD (MGD)
Existing	0.7	1.4
5-Year	1.1	2.3
10-Year	1.8	4.3
25-Year	3.0	7.1

1.3.3. TOTAL WATER DEMAND PROJECTIONS

The total average and maximum day demand for both retail and wholesale connections are summarized in **Table 1.4**.

Table 1.4 – Projected Demand per Planning Period

Planning Period	ADD (MGD)	MDD (MGD)
Existing	24.9	47.9
5-Year	34.9	67.4
10-Year	41.3	80.3
25-Year	53.4	104.1

1.4. SYSTEM ANALYSIS

1.4.1. EXISTING SYSTEM

The City owns and operates two water treatment plants (WTPs), the Lake Lewisville WTP and Lake Ray Roberts WTP. The City also maintains approximately 700 miles of water lines and operates four elevated storage tanks (ESTs), one vertical standpipe, and four pump stations. The City water system currently consists of five (5) pressure planes – Central, East, Northwest, Southeast, and Southwest.

The Lake Lewisville and Lake Ray Roberts WTPs supply the Central Pressure Plane through high service pump stations. A portion of the McKenna Park Standpipe serves as elevated storage for the Central PP, along with the Riney Road and Roselawn ESTs. The Central PP supplies water to the East and Southeast PPs through multiple pressure-reducing valves (PRVs). Central also supplies water to multiple storage tanks that serve the Northwest and Southwest PPs.

The Northwest PP is currently served by the McKenna Park Pump Station and Northwest EST. The Mckenna Park Standpipe supplies the Mckenna Park Pump Station. The Northwest Booster Pump Station, currently under construction, will also serve Northwest. The Riney Road EST will supply the Northwest Booster Pump Station. Once the Northwest Booster Pump Station is in service and the Jim Christal EST is constructed, the Mckenna Park Pump Station and Standpipe can be demolished.

The Southwest PP is served by the Southwest Pump Station and the Southwest EST. Central PP supplies water to the GST at the Southwest Pump Station through a pressure sustaining valve (PSV) and flow control valve (FCV).

Refer to **Exhibit F – Existing System** for an overview of the City's existing system and **Figure 1.2** for a schematic of major infrastructure in the City's existing system.

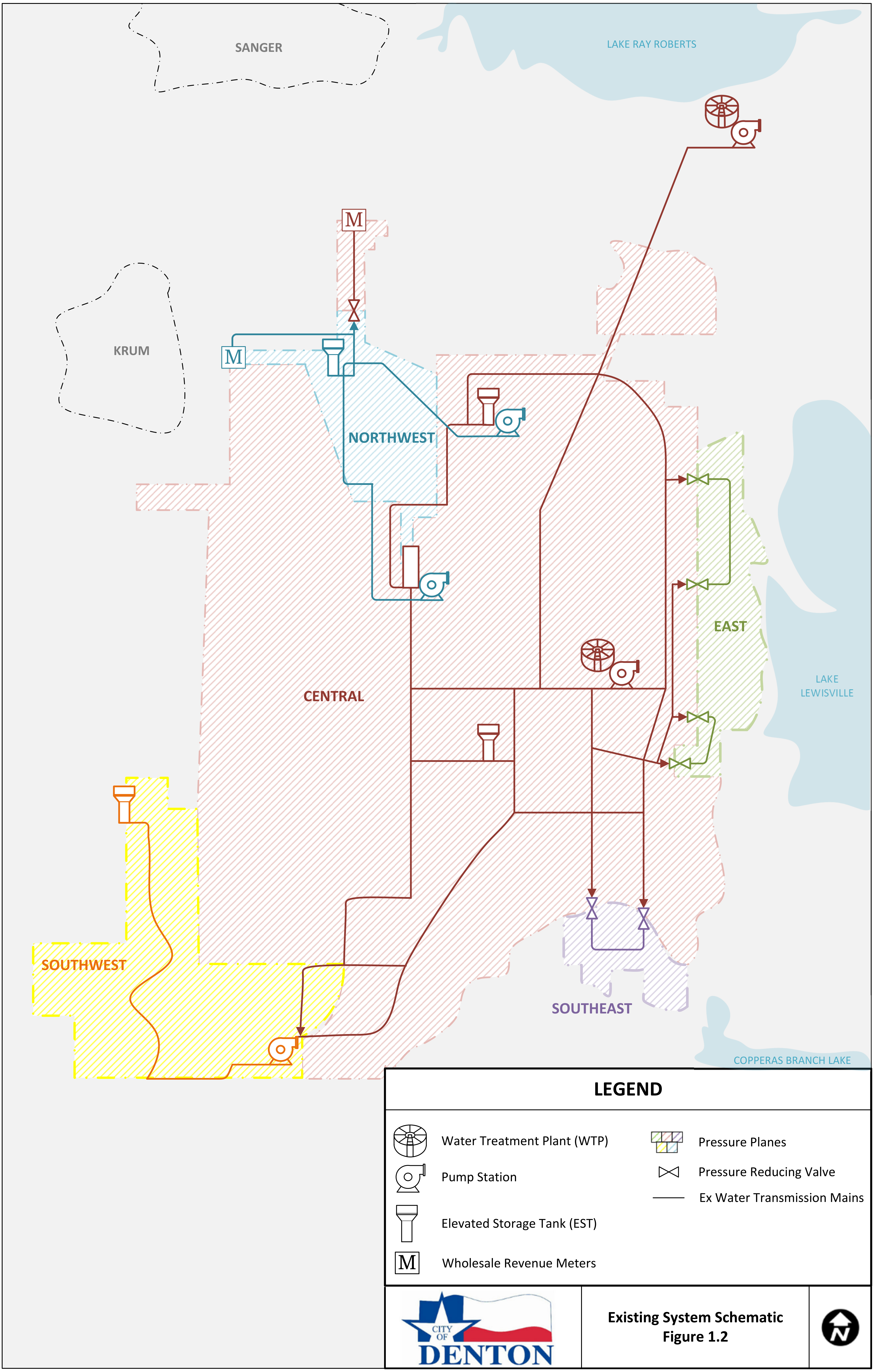
1.4.2. FUTURE SYSTEM

Kimley-Horn analyzed the existing infrastructure against the City and TCEQ design criteria outlined in **Section 4.3.2**.

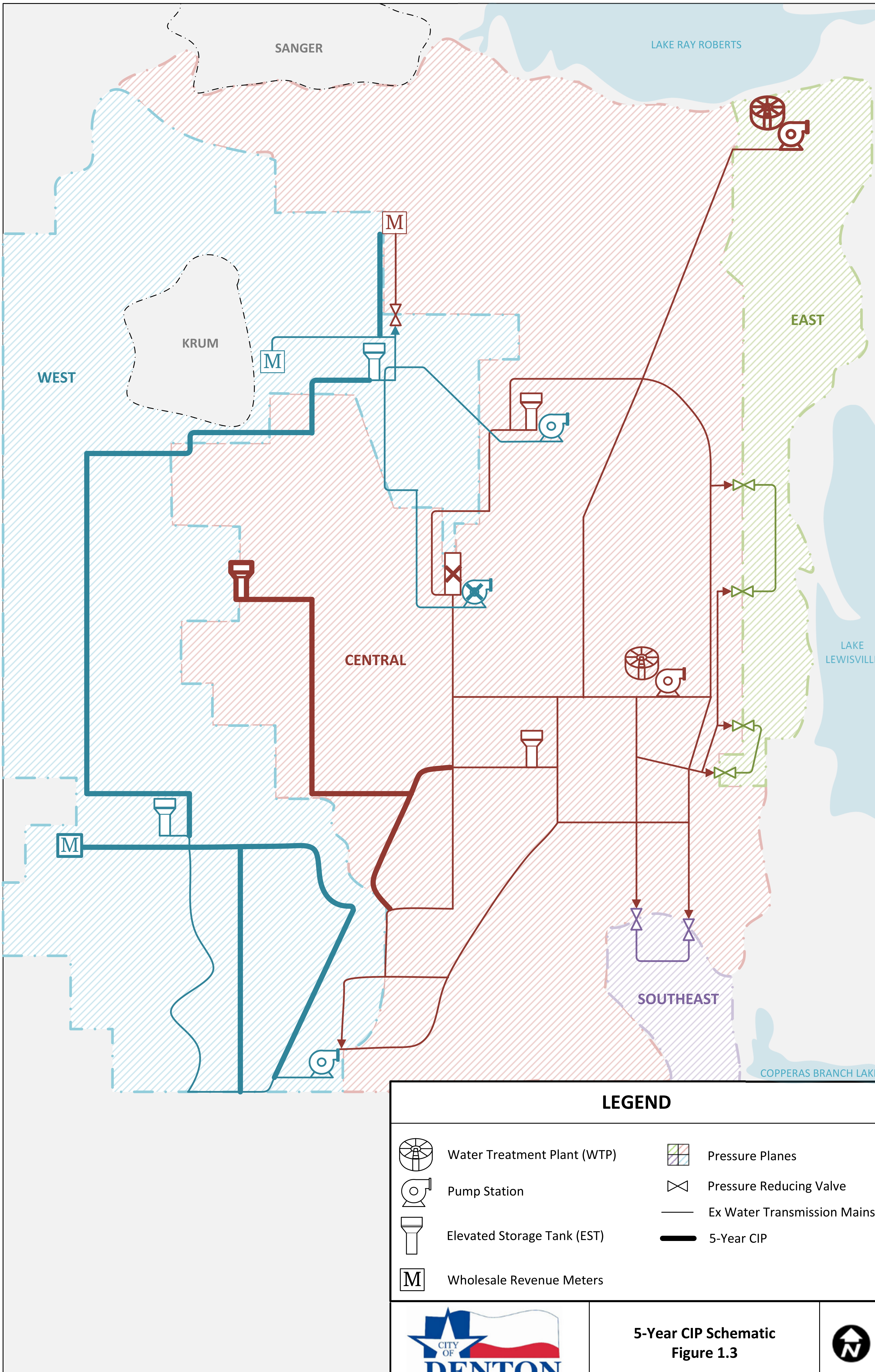
The proposed infrastructure in the 5-Year CIP that will produce systematic changes to the Denton Water System includes an expansion of the Lake Ray Roberts WTP and High Service Pump Station, construction of the Jim Christal EST, and the connection of the Northwest and Southwest pressure planes to form the West Pressure Plane. **Figure 1.3** provides a schematic of major systematic changes in the 5-Year CIP.

The proposed infrastructure in the 10-Year CIP that will produce systematic changes to the Denton Water System in the Central Pressure Plane includes an additional expansion to the Lake Ray Roberts WTP and High Service Pump Station, and construction of a second transmission main from Lake Ray Roberts WTP. In the West Pressure Plane, the Southwest Booster Pump Station will be expanded with additional ground storage and pump replacements. **Figure 1.4** provides a schematic of major systematic changes in the 10-Year CIP.

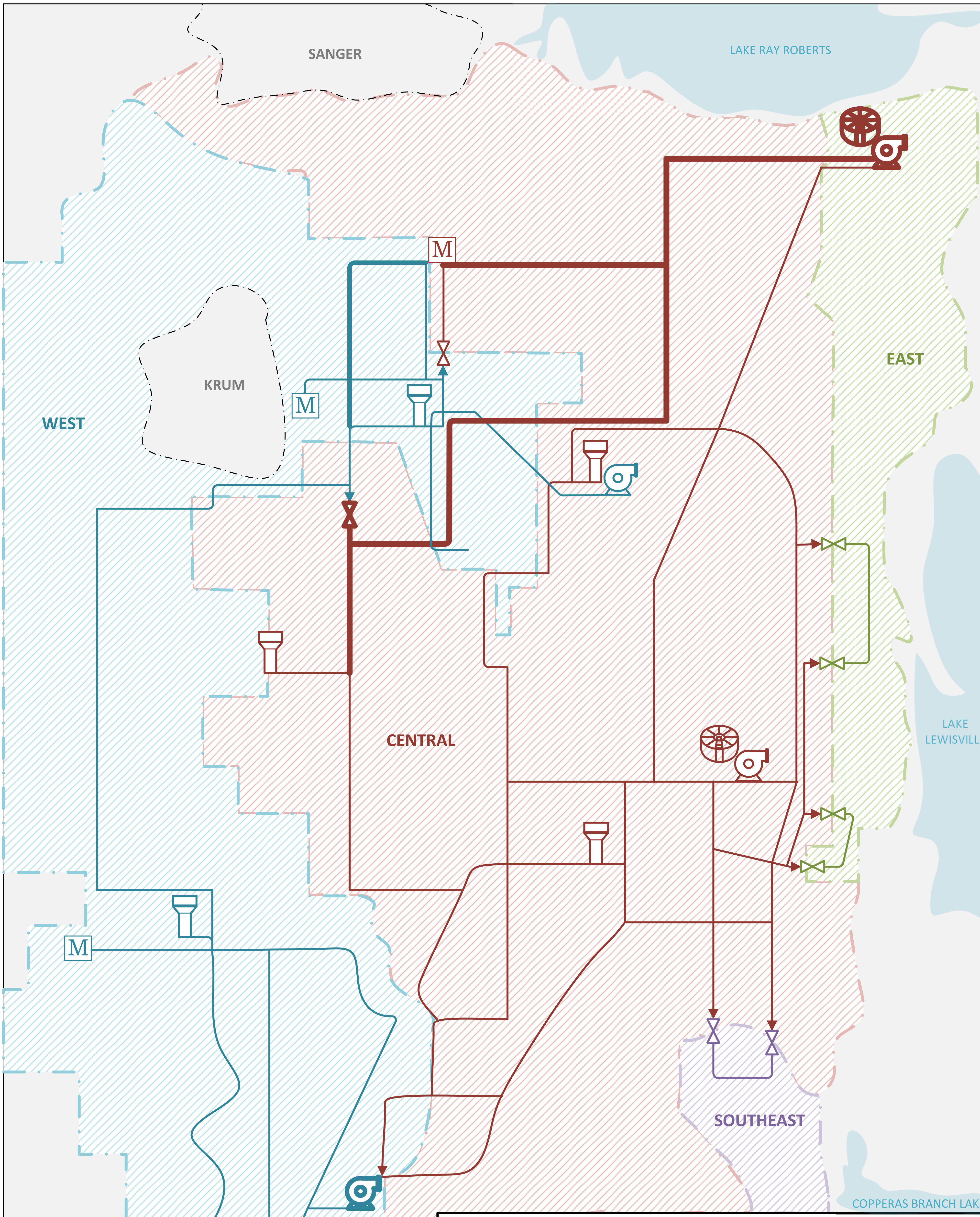
The proposed infrastructure in the 25-Year CIP that will produce systematic changes to the Denton Water System in the Central Pressure Plane includes an expansion of the Lake Ray Roberts WTP and High Service Pump Station. In the West Pressure Plane, pumping capacity will increase by filling the final pump slot at the Northwest Booster Pump Station and constructing the Jim Christal Pump Station. **Figure 1.5** provides a schematic of major systematic changes in the 25-Year CIP.



Existing System Schematic
Figure 1.2



5-Year CIP Schematic
Figure 1.3

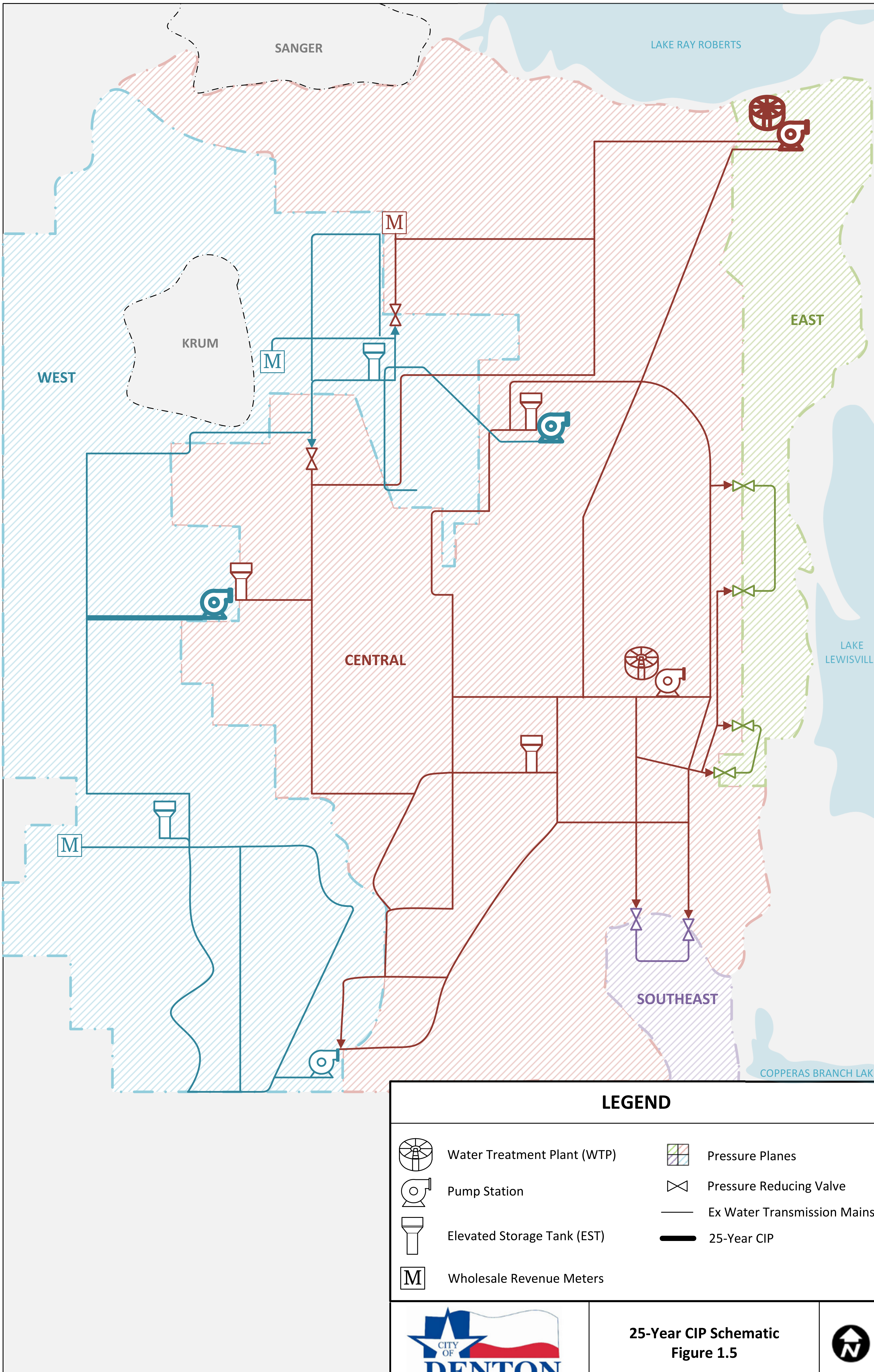


LEGEND

- Water Treatment Plant (WTP)
- Pump Station
- Elevated Storage Tank (EST)
- Wholesale Revenue Meters
- Pressure Planes
- Pressure Reducing Valve
- Ex Water Transmission Mains
- 10-Year CIP

CITY OF DENTON

10-Year CIP Schematic
Figure 1.4



25-Year CIP Schematic
Figure 1.5

1.5. WATER CAPITAL IMPROVEMENT PLAN

The Capital Improvement Plan (CIP) is divided into three sections: 5-Year, 10-Year, and 25-Year. All proposed projects are shown in **Exhibit P – Capital Improvement Plan**. The project priority, name, and total cost is listed in **Tables 1.5, 1.6,** and **1.7** for the 5, 10, and 25-year planning periods, respectively.

Individual project descriptions and detailed costs have been included in **Appendix C – Opinion of Probable Construction Costs**. The opinion of probable costs for each capital project assumes no design completed, are based on 2024 dollars, and do not include annual construction cost increases.

Table 1.5 – 5-Year CIP Projects

Project No.	Project Name	Project Cost
1	Lake Ray Roberts WTP Rerate to 30 MGD	Funded
2	Lake Lewisville WTP Rehabilitation	TBD[1]
3	Lake Ray Roberts WTP 20 MGD Expansion to 50 MGD	$195,845,000
4	24" Robson Ranch Transmission Main	$16,055,000
5	16" Northwest I-35 Frontage Rd Water Line	$4,524,000
6	Roselawn EST Rehabilitation	$3,780,000
7	Northwest Pressure Plane Swap	N/A
8	24" Tom Cole Rd Transmission Main	$30,206,000
9	42" Jim Christal EST Transmission Main	$12,345,000
10	Jim Christal 3.0 MG EST	$20,527,000
11	McKenna Park Standpipe and Pump Station Demolition	$500,000
12	12" Underwood Rd Water Line	$3,393,000
13	12" Cole Ranch Water Line	$9,469,000
14	16" C Wolfe Rd Water Line	$6,488,000
15	36" I-35W Transmission Main	$31,336,000
16	24/30" West Allred Rd Transmission Main	$29,952,000
17	16" Ponder Water Line	$4,303,000
18	16/30" Rosebrook/Sanctuary Transmission Main	$53,142,000
19	24" Rosebrook Transmission Main	$9,419,000
20	24" North/South Transmission Main	$26,281,000
21	12" Old Stoney Rd Water Line	$2,582,000
22	12" Rosebrook Water Line	$5,981,000
23	12" Cooper Creek Rd Water Line	$14,862,000
24	12" N Mayhill Rd Water Line	$3,044,000
25	12" Duchess Dr Water Line	$2,205,000
26	12" Shady Oaks Dr Water Line	$3,067,000
27	12/16" US 380 Water Line	$9,594,000

28	12" Stuart Ridge Water Line	$4,846,000
29	Lake Ray Roberts HSPS Improvements Phase 1	$5,530,000
	5-Year Projects Subtotal:	**$509,276,000**

[1]Cost to be determined once condition assessment is complete, see **Section 5.5.1**

Table 1.6 – 10-Year CIP Projects

Project No.	Project Name	Project Cost
30	Lake Ray Roberts WTP 54/60" Transmission Main	$118,639,000
31	Lake Ray Roberts WTP 10 MGD Expansion to 60 MGD	$97,922,500
32	48" Loop 288 Transmission Main	$64,555,000
33	Lake Ray Roberts HSPS Improvements Phase 2	$5,530,000
34	Southwest PS Improvements	$10,087,000
35	12/16" Hunter Ranch Water Line	$9,374,000
36	12" Hunter Ranch Water Line	$2,864,000
37	12" Central Allred Rd Water Line	$6,063,000
38	12" Northwest Water Line	$13,304,000
39	16" Milam Rd Water Line	$9,968,000
40	16" North Central Water Line	$11,902,000
41	12" N Locust Rd to E Sherman Dr Water Line	$3,959,000
42	12" North Cooper Creek Rd Water Line	$8,295,000
43	12" Swisher Rd Water Line	$3,360,000
44	12" John Paine Rd Water Line	$3,221,000
45	Direct Potable Reuse Pilot Program	$5,000,000
46	Aquifer Storage Recovery Pilot Program	$5,000,000
	10-Year Projects Subtotal:	**$379,043,500**

Table 1.7 – 25-Year CIP Projects

Project No.	Project Name	Project Cost
47	Lake Ray Roberts WTP 10 MGD Expansion to 70 MGD	$97,922,500
48	Northwest Booster PS Improvements	$945,000
49	Jim Christal PS and 36" Transmission Main	$31,026,000
50	Lake Ray Roberts HSPS Improvements Phase 3	$7,910,000
51	Lake Ray Roberts WTP 10 MGD Expansion to 80 MGD	$97,922,500
	25-Year Projects Subtotal:	**$235,726,000**

CHAPTER 2

INTRODUCTION

2.1. OBJECTIVE

The Water Master Plan (WMP) and the underlying hydraulic model serve as the basis for the planning, design, construction, and financing of the water infrastructure for the City of Denton. The primary goal of the WMP was to develop a plan for City of Denton (City) to provide systematic upgrades and expansions of the water system to serve all future developments within the Study Area. A secondary goal of the WMP was to identify existing capacity deficiencies within the system and provide recommended upgrades.

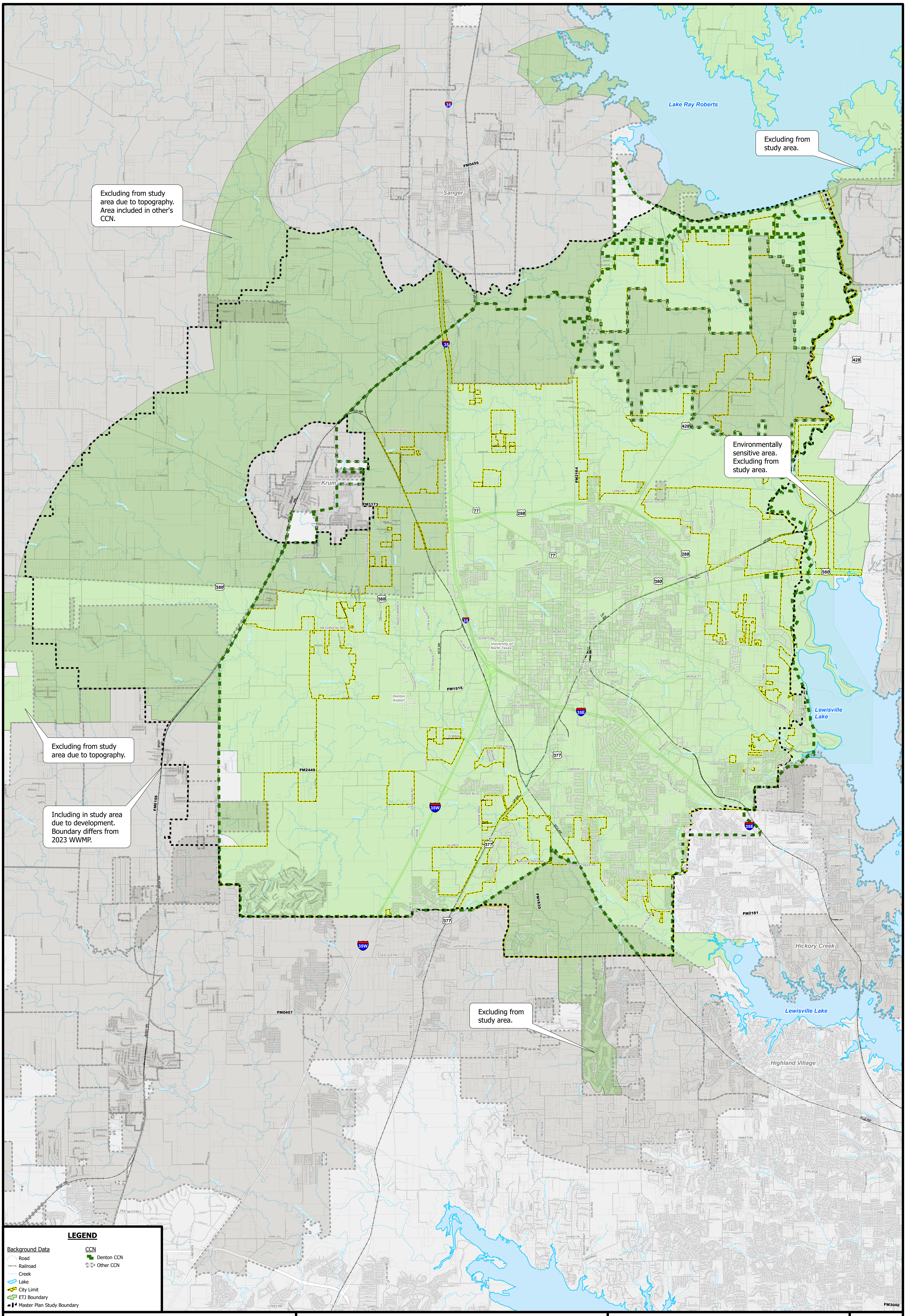
2.2. SCOPE OF WATER MASTER PLAN

The scope of the study was to create and calibrate a hydraulic model of the existing water system, analyze the existing system for deficiencies, and to make recommendations to serve projected development through the 25-year planning period. The significant scope elements of this project are as follows:

1. Utilization of existing land use and future land use as determined in the 2023 Wastewater Master Plan (WWMP) with minor updates
2. Utilization of population and growth projections as determined in the 2023 WWMP with minor updates
3. Fire hydrant flow testing and pressure monitoring
4. Pump station performance testing
5. Historical customer water usage and water demand analysis per pressure plane
6. Existing hydraulic model creation and calibration
7. Existing water system analysis and deficiency identification
8. Existing water treatment unit process capacities and deficiency identification
9. Future water demand projections through the 5-Year, 10-Year, and 25-Year planning periods
10. Identify additional Water Treatment Plant (WTP) capacity needed to serve future water demand projections
11. Review current and anticipated regulation requirements for the WTPs
12. Alternative treatment technology evaluation and recommendations
13. Capital Improvement Plan development for the 5-Year, 10-Year, and 25-Year planning periods

2.3. STUDY AREA BOUNDARY

Kimley-Horn worked with City staff to determine the study area for the WMP. The Study Area largely extends to the City's existing 5-mile ETJ boundary, with a few exceptions (see **Exhibit A – Study Area**). The Study Area is approximately 121,000 acres (189 square miles) and includes approximately 56,300 acres (88 square miles) within the City's current City limits. The Study Area closely aligns with the Study Area used in the 2023 WWMP with a few adjustments in the West due to the Municipal Utility Districts (MUDs). The Study Area limits were extended beyond the existing Water Certificate of Convenience and Necessity (CCN), particularly in primarily undeveloped areas in the west, to better prepare for and incorporate planned MUDs into the City's overall water plan. See **Section 3.2.1** for further discussion on the planned MUDs.



CITY OF DENTON

CITY OF DENTON WATER MASTER PLAN STUDY AREA

December 2024

Kimley»Horn

This map product is for information purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and represents only the approximate relative location of property boundaries.

A

2.4. PLANNING PERIODS

Kimley-Horn and the City selected the 5, 10, and 25-year planning periods for analysis and the Capital Improvement Plan (CIP). See **Table 2.1** for a description of each planning period.

Table 2.1 – Planning Periods

CIP Year	CIP Year Description
5-Year	Represents present day to the next 5 years. Projects in this category are recommended to serve known incoming single and multi-phase developments or to remedy existing deficiencies. City staff are aware of these projects and are actively planning, designing, and determining financing.
10-Year	Represents 5 years through 10 years. Projects in this category are recommended to serve continuing multi-phase developments or projected growth within the City.
25-Year	Represents 10 years through 25 years. Projects in this category are recommended to serve continuing multi-phase developments or projected growth within the City.

Due to the expansive undeveloped acreage within the Study Area, significant growth is expected beyond the 25-year planning period before build-out of the Study Area occurs. CIP projects are sized for the 25-year planning period.

2.5. DEFINITIONS AND ABBREVIATIONS

The following terms are used throughout the WMP report. The definitions may provide the reader with a better understanding of the subtle differences between several of these terms.

Average Day Demand (ADD) – Annual water consumption divided by the number of days in a year. The average daily water demand is the average water demand a system experiences within a one-day period. Typically measured in units of Million Gallons Per Day (MGD).

Capital Improvement Plan (CIP) – Recommended improvements to the water system based on population and water demand projections through a planning period.

Demand (Consumption) – Volume of water used for a given time period, typically measured in units of Million Gallons Per Day (MGD) or Gallons Per Minute (gpm).

Direct Potable Reuse (DPR) - The process of using treated wastewater for drinking water without an environmental buffer.

Disinfection By-Products (DBP) - Unwanted chemicals that form when disinfectants react with organic matter during the disinfection process.

Distribution System (Piping) – Distribution piping typically consists of 10-inch diameter and smaller piping. Distribution piping functions primarily to serve local customer water connections.

Diurnal Curve – A graph depicting typical water demand over a 24-hour period with water demand plotted on the y-axis and time plotted on the x-axis.

Firm Pumping Capacity – The total pumping capacity that a pump station or pressure plane can deliver with the largest pump out of service.

Log Removal Value (LRV) - a logarithmic term that measures the percentage of microorganisms that are removed or inactivated by the treatment process.

Maximum Contaminant Level (MCL) - highest level of a contaminant that the US Environmental Protection Agency (EPA) allows in public drinking water systems.

Maximum Contaminant Level Goal (MCLG) - the level of a contaminant in drinking water below which there is no known or expected risk to health. This is not enforceable by regulating agencies.

Maximum Day Demand (MDD) – Water consumption, in volume of water, used on the highest consumption day in a year. Typically measured in units of Million Gallons Per Day (MGD) or Gallons Per Minute (gpm).

Peak Hour Demand (PHD) – The maximum one-hour water demand that a system experienced or is anticipated to experience during a particular year or other time period. Typically measured in units of Million Gallons Per Day (MGD) or Gallons Per Minute (gpm).

Peaking Factor – A factor applied to the average day demand to determine maximum day demand. An additional peaking factor is then applied to the maximum day demand to determine peak hour demand.

Per- and Polyfluoroalkyl Substances (PFAS) – a large group of man-made chemicals with unique properties that have been widely used in industry and consumer products. PFAS are known for their resistance to heat, grease, oil, and water.

Pressure Plane – A network of water pipes having a common pressure range; each plane may be separated from the other planes by closed valves, pressure-regulating valves, pump stations, and storage facilities.

SCADA Data – Supervisory control and data acquisition (SCADA) data is system data (flow, pressure, tank level, etc.) that is digitally collected and stored in real time.

Total Pumping Capacity – The total pumping capacity that a pump station or pressure plane can deliver with all pumps in service.

Transmission System (Piping) – Transmission piping typically consists of 12-inch diameter and larger piping. Transmission piping has minimal service connections and functions primarily as the vehicle to move larger quantities of water throughout the system.

Refer to **Table 2.2** for abbreviations frequently used in this report.

Table 2.2 – WMP Abbreviations

Abbreviation	Meaning
ADD	Average Day Demand
CCN	Certificate of Convenience and Necessity
CIP	Capital Improvement Plan
DBP	Disinfection By-Products
DPR	Direct Potable Reuse
EST	Elevated Storage Tank
ETJ	Extra Territorial Jurisdiction
GAC	Granular Activated Carbon
GIS	Geographic Information System
GPD	Gallons Per Day
GPM	Gallons Per Minute
HGL	Hydraulic Grade Line (Feet)
LF	Linear Feet
LRV	Log Removal Value
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDD	Maximum Day Demand
MG	Million Gallons
MGD	Million Gallons Per Day
OPCC	Opinion of Probable Construction Costs
PFAS	Per- and Polyfluoroalkyl Substances
PHD	Peak Hour Demand
PP	Pressure Plane
PRV	Pressure Reducing Valve
PS	Pump Station
PSI	Pounds Per Square Inch
SCADA	Supervisory Control and Data Acquisition
TAC	Texas Administrative Codes
TCEQ	Texas Commission on Environmental Quality
TOC	Total Organic Content
US EPA	United States Environmental Protection Agency
WMP	Water Master Plan
WTP	Water Treatment Plant

CHAPTER 3

LAND USE AND GROWTH

3.1. HISTORICAL GROWTH AND EXISTING LAND USE

3.1.1. HISTORICAL POPULATION GROWTH

The City has experienced modest yet steady growth, sustaining a 2.3% compound annual growth rate over the last ten years (**Table 3.1**).

Table 3.1 – Historical Population Growth Rate

Year	Population[1]	Compound Annual Growth Rate
2014	123,200	2.0%
2015	125,980	2.3%
2016	128,160	1.7%
2017	130,990	2.2%
2018	134,460	2.6%
2019	139,869	4.0%
2020	141,882	1.4%
2021	146,751	3.4%
2022	149,509	1.9%
2023	152,350	1.9%
	10-Year Growth Rate	**2.3%**

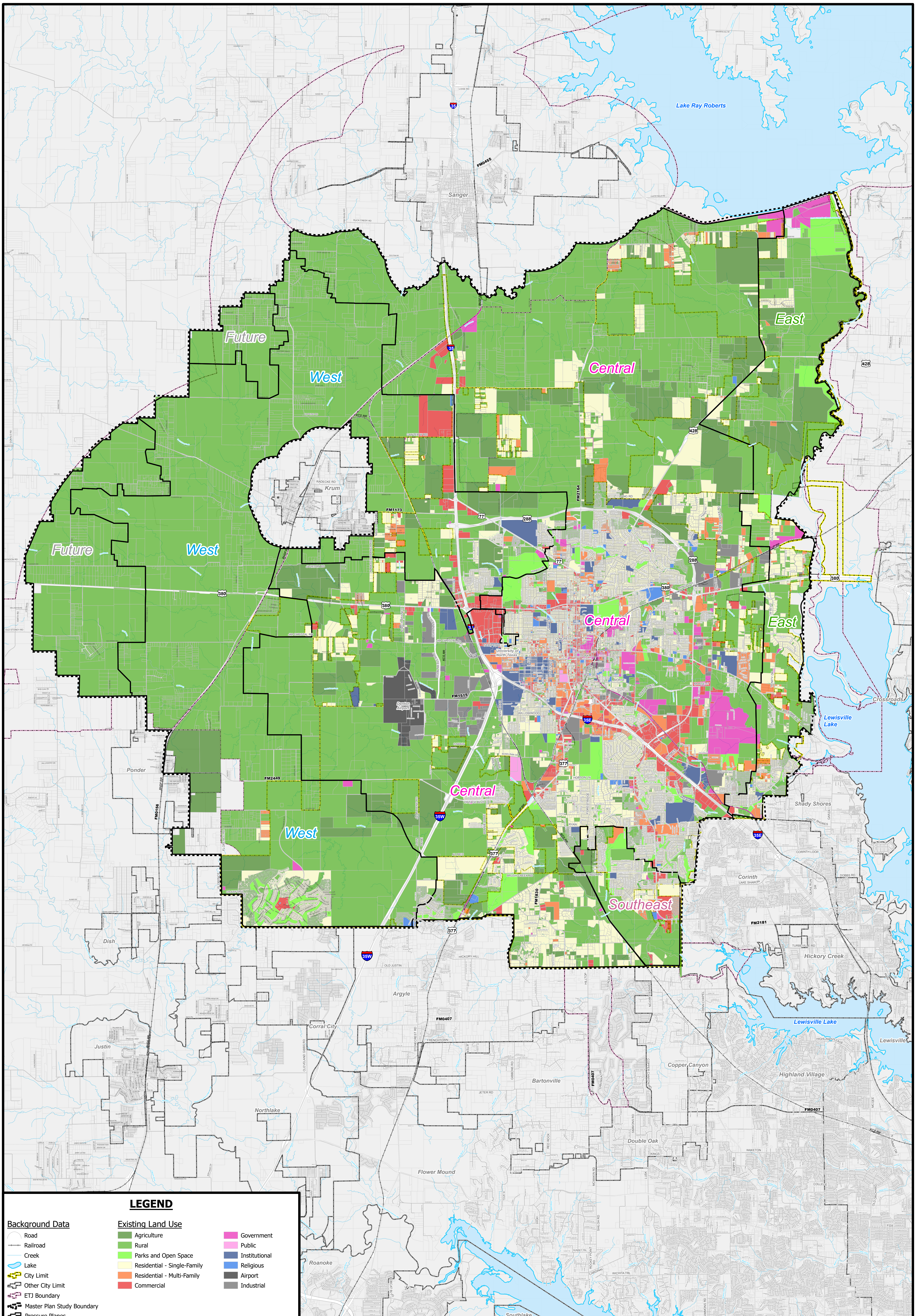
[1]*North Central Texas Council of Governments (NCTCOG)*

3.1.2. EXISTING LAND USE

Existing land use was provided by the City. Of the total 121,000 acres in the Study Area, 31,100 acres, or approximately 26% of the available area, are currently developed. Existing land use is shown in **Exhibit B – Existing Land Use** and summarized in **Table 3.2**.

Table 3.2 – Existing Land Use Categories

Existing Land Use Category	Acreage
Residential – Single-Family	16,100
Residential – Multi-Family	2,720
Commercial	3,290
Government	1,820
Public	130
Institutional	1,600
Religious	370
Airport	690
Industrial	1,520
Parks and Open Space	2,870
Total:	**31,100**



CITY OF DENTON

CITY OF DENTON WATER MASTER PLAN EXISTING LAND USE

December 2024

Kimley»Horn

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B

3.2. PROJECTED GROWTH AND FUTURE LAND USE

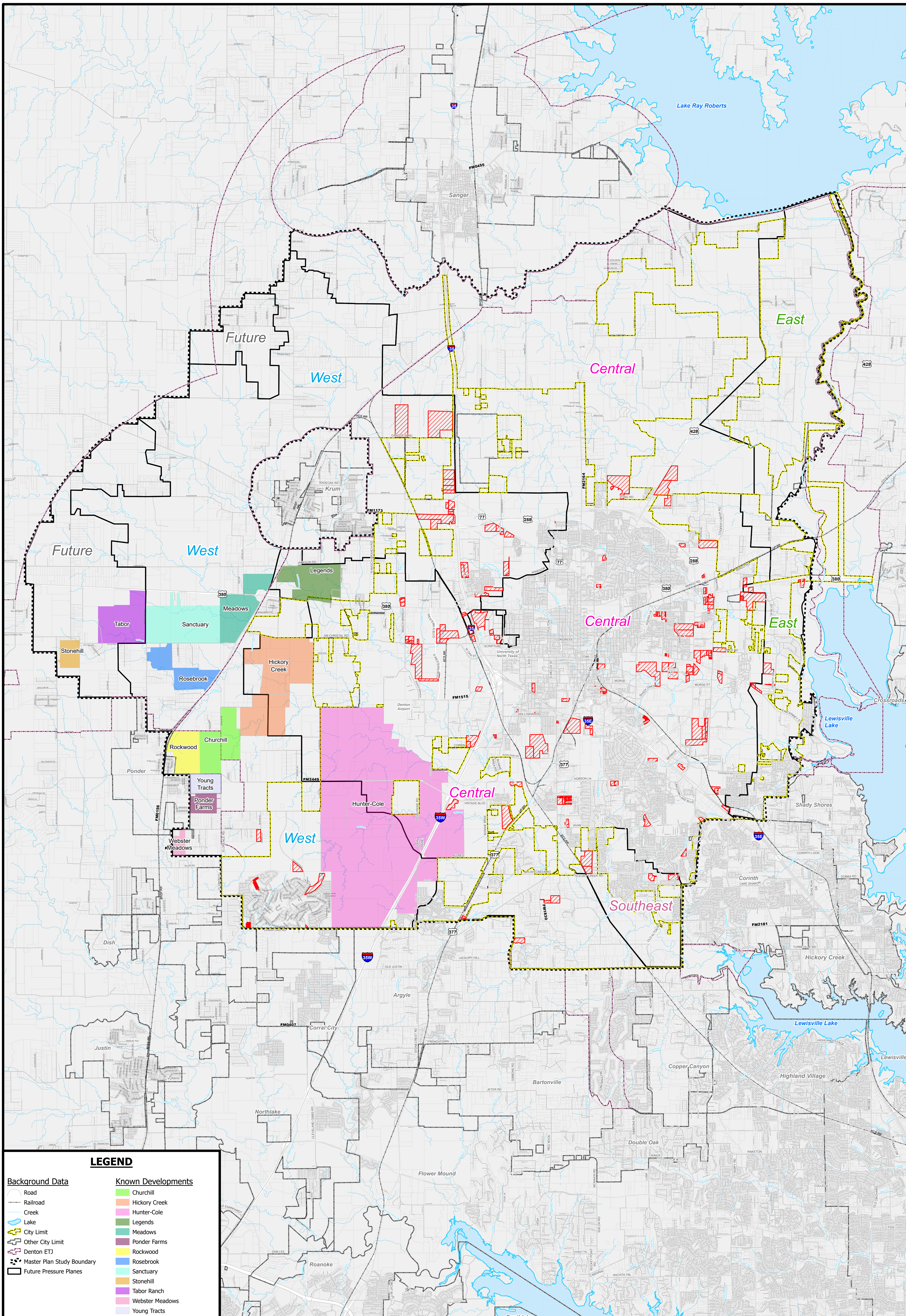
3.2.1. KNOWN DEVELOPMENTS AND MUDS

The City provided land use type, density, and phasing (if available) for all incoming known developments within the City Limits, including the larger multi-phase developments. Developers provided land use type, density, and phasing for any incoming Municipal Utility Districts (MUDs) identified beyond the City Limits. All incoming known developments are shown in **Exhibit C – Known Developments**. All available development and phasing information is provided in **Appendix A – Known Development Information**. The phasing information for the larger multi-phase developments and the MUDs is listed in **Table 3.3**.

Table 3.3 – Known Developments Cumulative Unit Phasing

	Development	Residential Units		
		5-Year	10-Year	25-Year
Multi-Phase Development	Hunter-Cole	3,899	7,400	18,850
	Legends	1,820	1,836	1,836
	Hickory Creek	1,423	2,923	6,823
MUD	Rosebrook[1,2]	1,621	0	0
	Churchill	525	1,400	2,075
	Meadows	1,330	1,830	1,830
	Ponder Farms	525	592	592
	Sanctuary	1,000	2,500	2,550
	Rockwood[3]	0	0	1,386
	Stonehill	0	0	646
	Tabor Ranch	2,220	2,820	2,820
	Webster Meadows	405	405	405
	Young Tracts	0	0	698

[1]Phasing updated from 2023 Wastewater Master Plan (WWMP) based on most recent data provided by developer
[2]The 2023 WWMP refers to Rosebrook as Astra
[3]The 2023 WWMP refers to Rockwood as Sherwood



CITY OF DENTON

CITY OF DENTON
WATER MASTER PLAN
KNOWN DEVELOPMENTS

December 2024

Kimley»Horn

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C

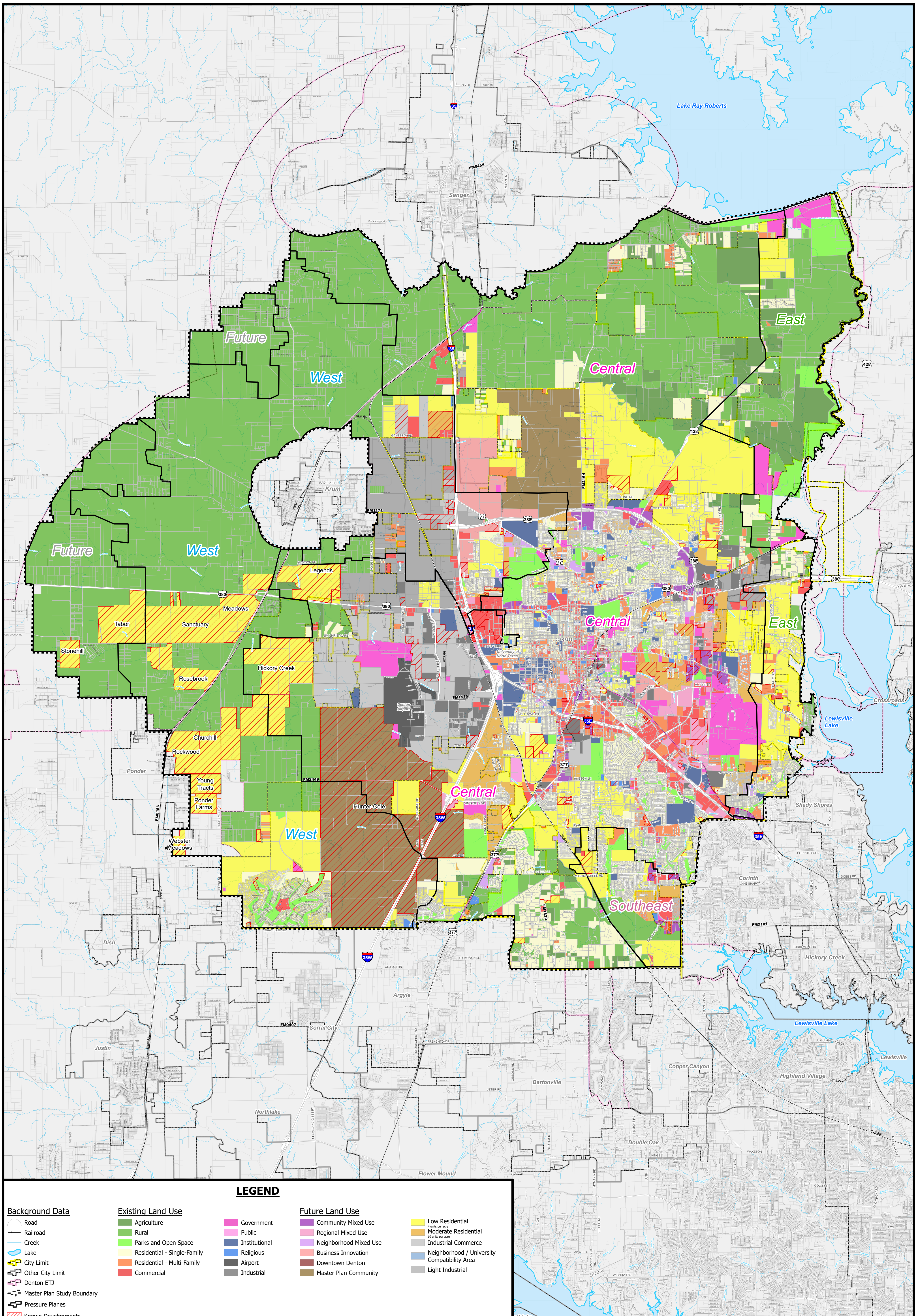
3.2.2. FUTURE LAND USE

Kimley-Horn utilized the future land use categories identified in the City's 2040 Comprehensive Plan. A brief description of each future land use type is provided in **Table 3.4.**

Table 3.4 – Future Land Use Category Descriptions

Future Land Use Category	Description
Low Residential	4 Residential Units/Acre
Moderate Residential	10 Residential Units/Acre
Master Plan Community	Large-scale developments with a mixture of residential and non-residential land use as determined by the developer
Downtown Denton	Combination of residential and non-residential land use specific to Downtown area
Regional Mixed Use	Combination of high density residential and non-residential land uses
Community Mixed Use	Primarily commercial land use with complementary residential land use
Neighborhood Mixed Use	Primarily low and high-density residential land use with complementary non-residential land use
Neighborhood / University Compatibility Area	UNT Campus and surrounding residential land use
Business Innovation	Primarily office and commercial land use
Light Industrial	Light industrial land use like manufacturing and warehousing
Industrial Commerce	Combination of light and heavy industrial land use

If there was a known incoming development and updated land use information was provided, the land use was adjusted from the 2040 Comprehensive Plan. **Exhibit D – Future Land Use** shows the distribution of future land use within the Study Area.



CITY OF DENTON
WATER MASTER PLAN
FUTURE LAND USE

December 2024

Kimley»Horn

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D

3.2.3. GROWTH PROJECTIONS AND PHASING

Population growth rates were determined for the 5, 10, and 25-year planning periods. For the 5-year period, Kimley-Horn determined an 8.6% compound annual growth rate based on the unit counts provided by the known developments (**Section 3.2.1**). Kimley-Horn worked with the City to establish a 2.9% growth rate for the 10-year planning period and a 2.0% growth rate for the 25-year period that accounts for the known multi-phase developments and additional growth throughout the City (**Figure 3.1**).

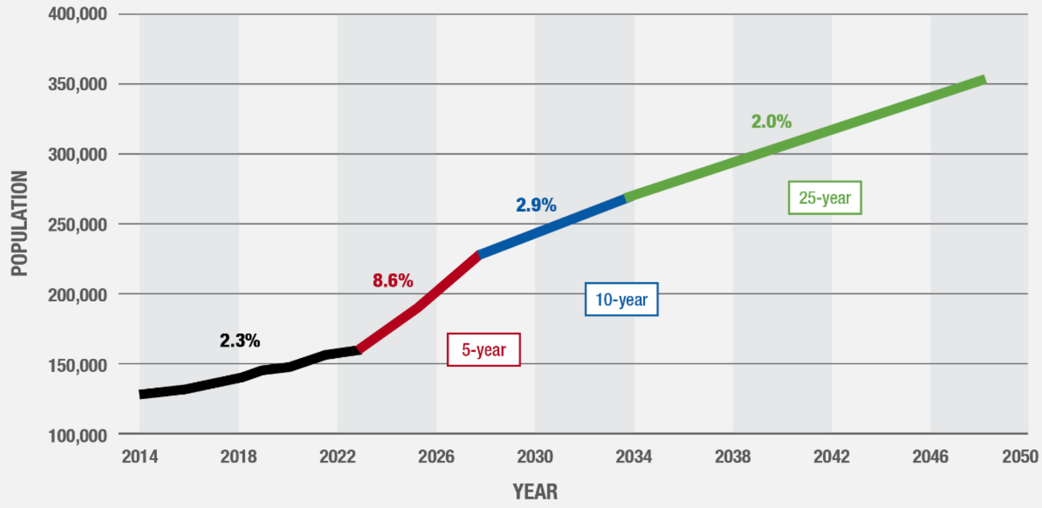
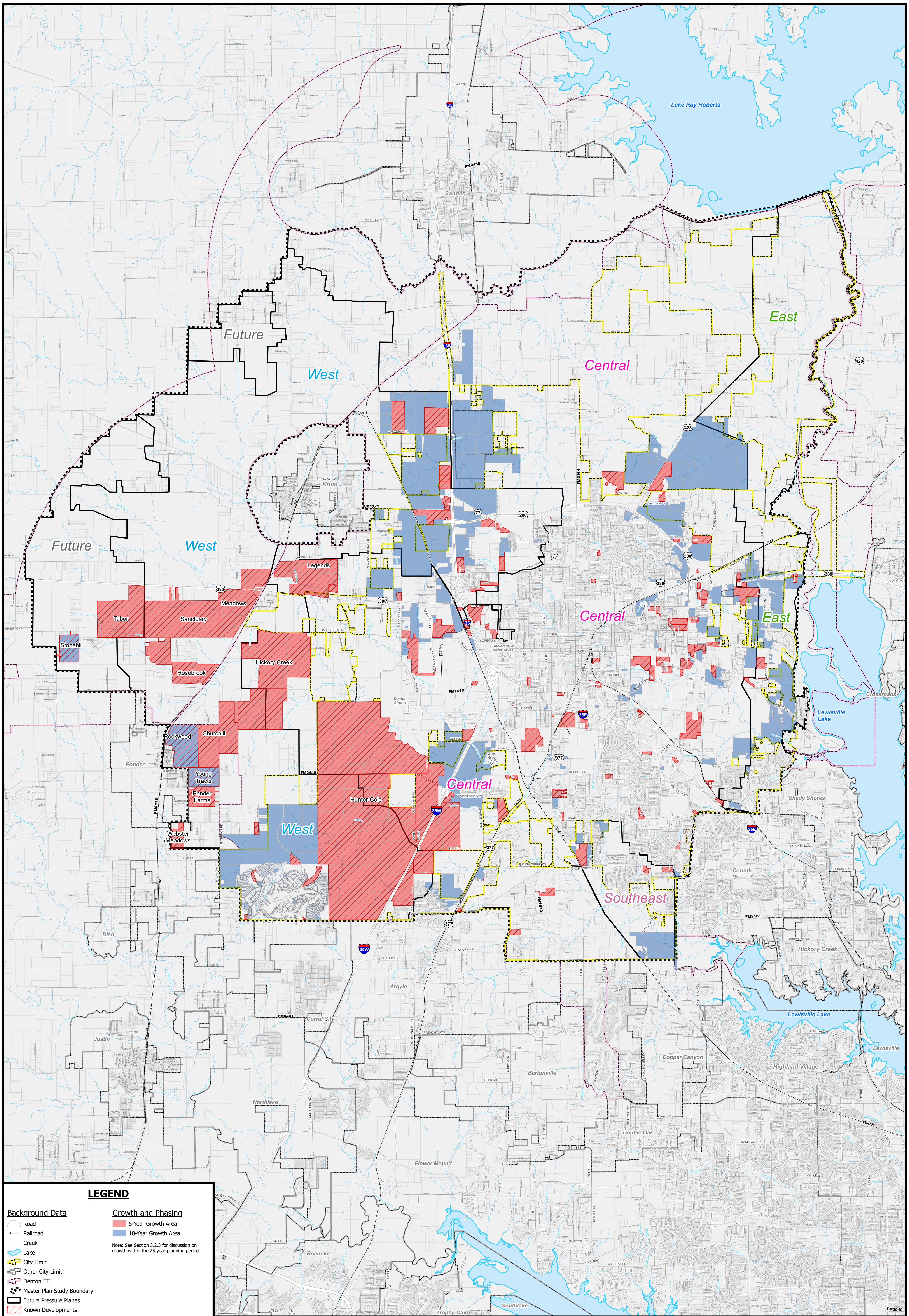


Figure 3.1 – Population Growth Rate

All single-phase known developments were assumed to fully develop within the 5-year planning period, while the known multi-phase developments and MUDs developed according to the 5-year phasing provided by developers (**Table 3.3**). For the 10-year planning period, known multi-phase developments and MUDS were developed according to the 10-year phasing provided by developers, with additional growth allocated to areas identified by the City until the 2.9% growth rate was achieved. For the 25-year planning period, known multi-phase developments and MUDS were developed according to the 25-year phasing provided by developers, with additional growth allocated to areas identified by the City until the 2.0% growth rate was achieved. The locations of the identified growth areas for the planning periods are shown in **Exhibit E – Growth and Phasing**.



CITY OF DENTON

CITY OF DENTON WATER MASTER PLAN GROWTH AND PHASING

December 2024

Kimley»Horn

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E

The future land use identified in **Section 3.2.2** was then applied to the growth areas within each planning period to determine the total developed acreage per land use type. If a parcel with an existing land use was not projected to redevelop, the existing land use was kept. The total acreage per land use type projected to develop within the next 25 years is listed in **Table 3.5**.

Table 3.5 – 25-Year Developed Acreage

	Land Use Category	Acreage
Existing (Non-redevelop)	Residential - Single-Family	13,740
	Residential - Multi-Family	2,640
	Commercial	2,890
	Government	1,890
	Public	130
	Institutional	1,600
	Religious	370
	Airport	690
	Industrial	1,260
	Parks and Open Space	2,870
Future	Low Residential	7,970
	Moderate Residential	620
	Master Plan Community	4,980
	Downtown Denton	0
	Regional Mixed Use	180
	Community Mixed Use	280
	Neighborhood Mixed Use	50
	Neighborhood/ University Compatibility Area	0
	Business Innovation	900
	Light Industrial	2,200
	Industrial Commerce	960
	Total:	**46,370**

Kimley-Horn then used the growth projections and future land use to determine projected retail demand per planning period (see **Section 4.1.3.1**).

CHAPTER 4

WATER SYSTEM ANALYSIS

4.1. EXISTING AND FUTURE WATER DEMAND

4.1.1. HISTORICAL WATER DEMAND

The City provided historical average day demand (ADD) for the past ten years. The ADD per capita in gallons per capita per day (GPCPD) can then be determined by dividing ADD by population each year. ADD per capita can vary significantly with rainfall. The City's historical total rainfall depth compared to ADD per capita per year is listed in **Table 4.1** and illustrated in **Figure 4.1.** Total rainfall depth compared to ADD per capita for just the summer months is illustrated in **Figure 4.2.**

Table 4.1 – Historical Rainfall and Average Water Demand

Year	Rainfall (in)	ADD (MGD)	ADD per Capita (GPCPD)
2014	28	16.8	136
2015	65	18.0	143
2016	43	17.0	133
2017	33	17.7	135
2018	47	19.1	142
2019	39	19.0	136
2020	47	19.9	140
2021	41	19.0	129
2022	31	22.7	152
2023	25	24.2	159

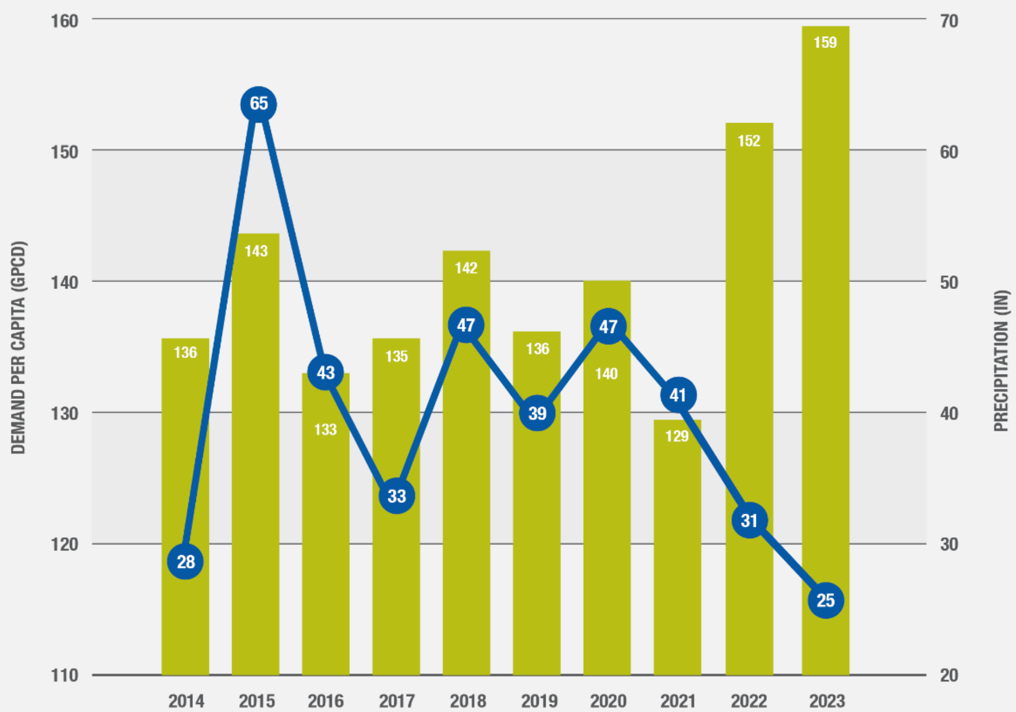


Figure 4.1 – Historical Rainfall and Demand Per Capita

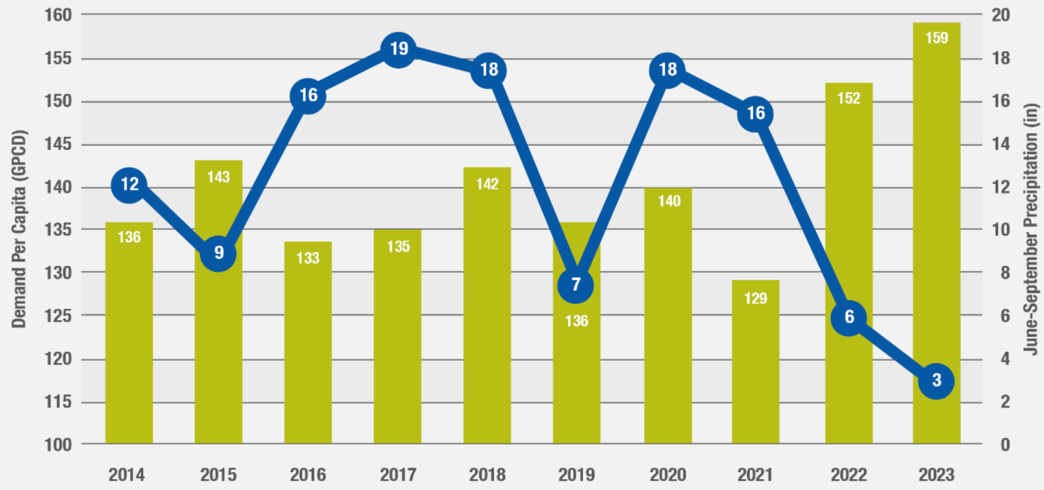


Figure 4.2 – Historical June to September Rainfall and Demand Per Capita

In addition to historical ADD, the City provided historical Maximum Day Demand (MDD) over the last ten years (**Table 4.2**). The average to maximum day peaking factor, obtained by dividing the historical MDD by the ADD per year, is also shown in **Table 4.2**. The highest observed average to maximum day peaking factor of 1.9 occurred in 2018. A peaking factor of 1.9 is therefore used in the water demand projections (**Section 4.1.3.1**).

Table 4.2 – Historical Peaking Factors

Year	ADD (MGD)	MDD (MGD)	Peaking Factor
2014	16.8	26.0	1.5
2015	18.0	34.3	1.9
2016	17.0	29.8	1.8
2017	17.7	27.4	1.5
2018	19.1	36.8	1.9
2019	19.0	31.9	1.7
2020	19.9	34.9	1.8
2021	19.0	29.6	1.6
2022	22.7	40.0	1.8
2023	24.2	41.9	1.7

Supervisory Control and Data Acquisition (SCADA) data from the 2022 MDD was also collected to determine the diurnal pattern, or pattern of use, per pressure plane. The hourly peaking factor is then identified from the diurnal pattern for each pressure plane. **Figure 4.3** shows the diurnal patterns for the Central, Northwest, and Southwest pressure planes. The East and Southeast pressure planes are included in the Central diurnal pattern since they are connected through pressure reducing valves (PRVs).

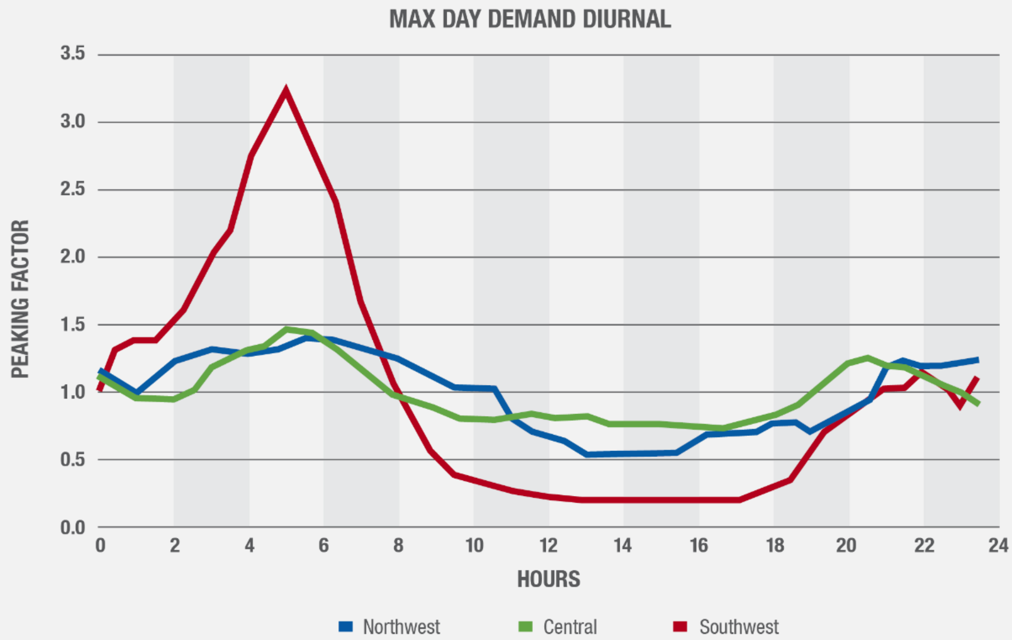


Figure 4.3 – Diurnal Demand

The diurnal patterns for the Central and Northwest pressure planes generally align, indicating similar patterns of use. The diurnal pattern for the Southwest Pressure Plane, which largely consists of the Robson Ranch residential development, indicates a much different pattern of use. The observed hourly peaking factor from the Southwest diurnal is over 3.0, compared to the hourly peaking factor of 1.5 observed in both the Central and Northwest diurnal patterns.

The high hourly peaking factor for the Southwest Pressure Plane is likely due to irrigation use at Robson Ranch. Kimley-Horn recommends the City coordinate with Robson Ranch to adjust irrigation controls. Adjusting irrigation controls will more evenly distribute irrigation demand and reduce the observed hourly peaking factor. For the future system analysis, Kimley-Horn assumes the high peaking factor in Southwest has been mitigated, and that the Southwest diurnal pattern aligns with the Northwest and Central diurnal patterns. An hourly peaking factor of 1.5 is used for all pressure planes in the future system analysis.

4.1.2. WATER LOADING CRITERIA

2023 customer water meter billing data provided by the City was used as the baseline for existing water demand for the hydraulic model and analysis. The customer meter data was associated with an address to geographically locate each account in the City and associate each account with an existing land use category. The customer meter demand was input into the hydraulic model at the appropriate location and was also used to develop an average water demand by land use type, or loading factor, for future hydraulic modeling loading and analysis. See **Table 4.3** for a summary of water loading factors by future land use type.

Table 4.3 – Future Land Use Loading Factors

Future Land Use Category	Loading Factor (gal/acre)
Low Residential (4 Residential Units/Acre)	1,280
Moderate Residential (10 Residential Units/Acre)	3,200
Master Plan Community	1,410
Downtown Denton	3,490
Regional Mixed Use	3,130
Community Mixed Use	2,485
Neighborhood Mixed Use	5,050
Neighborhood / University Compatibility Area	3,510
Business Innovation	1,540
Light Industrial	500
Industrial Commerce	1,000

4.1.3. WATER DEMAND PROJECTIONS

4.1.3.1. Retail Water Demand Projections

Water demand projections were made for the 5, 10, and 25-year planning periods, utilizing the growth projections as discussed in **Section 3.2** and loading factors from **Table 4.3.** As discussed in **Section 3.2**, the phasing provided by the developers for the proposed MUDs was incorporated into the 5-, 10-, and 25-year projected population growth and developed future land use. However, the Meadows MUD is anticipated to provide their own water service for the first 5 years. The demand for Meadows is therefore not incorporated into the City retail water demand projections until the 10-year planning period. Additionally, the Stonehill and Tabor Ranch MUDs are not anticipated to be served by the City within the 25-year planning period. The demands for Stonehill and Tabor Ranch are therefore not included in the City retail water demand projections. The projected retail average day and maximum day demand per planning period is outlined in **Table 4.4**.

Table 4.4 – Projected Retail Demand Per Planning Period

Planning Period	ADD (MGD)	MDD (MGD)[1]
Existing	24.2	46.5
5-Year	33.8	65.1
10-Year	39.5	76.1
25-Year	50.4	97.0

[1]*Average to maximum day peaking factor of 1.9 (see* ***Section 4.1.1****)*

The resulting per capita demand for each planning period is listed in **Table 4.5**.

Table 4.5 – Projected Retail Demand Per Capita

Planning Period	ADD (MGD)	Population[1]	Demand Per Capita (GPCPD)
Existing	24.2	152,350	159
5-Year	33.8	214,515	158
10-Year	39.5	257,034	154
25-Year	50.4	346,814	145

[1]*Population served by City's water system (see paragraph above).*

4.1.3.2. Wholesale Water Demand Projections

The City provides wholesale treated water to three entities through a contract with Upper Trinity Regional Water District (UTRWD):

- City of Krum
- City of Sanger
- Lake Cities Municipal Water Authority (LCMUA) – emergency only

Within the next 5 years, the City plans to provide wholesale treated water to the City of Ponder as well. **Table 4.6** outlines the projected wholesale demand per planning period.

Table 4.6 – Projected Wholesale Demand Per Planning Period

Wholesale Meter[1]	ADD (MGD)	MDD (MGD)	Peaking Factor
Existing Demand			
City of Krum[2]	0.35	0.70	2.0
City of Ponder	N/A	N/A	N/A
City of Sanger[2]	0.35	0.70	2.0
Total	**0.70**	**1.40**	
5-Year Demand			
City of Krum	0.52	1.04	2.0
City of Ponder	0.15	0.45	3.0[3]
City of Sanger	0.42	0.84	2.0
Total	**1.09**	**2.33**	
10-Year Demand			
City of Krum	0.68	1.36	2.0
City of Ponder	0.63	1.89	3.0
City of Sanger	0.50	1.00	2.0
Total	**1.81**	**4.25**	
25-Year Demand			
City of Krum	1.16	2.32	2.0
City of Ponder	1.09	3.27	3.0
City of Sanger	0.75	1.50	2.0
Total	**3.00**	**7.09**	

[1]LCMUA not included since it is emergency only
[2]Wholesale demand for Krum and Sanger based on 2018 WMP
[3]Peaking factor of 3.0 provided by Ponder

4.1.3.3. Total Water Demand Projections

The total average and maximum day demand for both retail and wholesale connections is summarized in **Table 4.7**.

Table 4.7 – Projected Demand per Planning Period

Planning Period	ADD (MGD)	MDD (MGD)
Existing	24.9	47.9
5-Year	34.9	67.4
10-Year	41.3	80.3
25-Year	53.4	104.1

4.2. EXISTING WATER SYSTEM

The City owns and operates two water treatment plants (WTPs), Lake Lewisville WTP Lake Ray Roberts WTP. The City also maintains approximately 700 miles of water lines and operates four elevated storage tanks (ESTs), one vertical standpipe, and four pump stations. Existing infrastructure is discussed in detail in **Section 4.2.1.**

The City water system currently consists of five (5) pressure planes (PP):

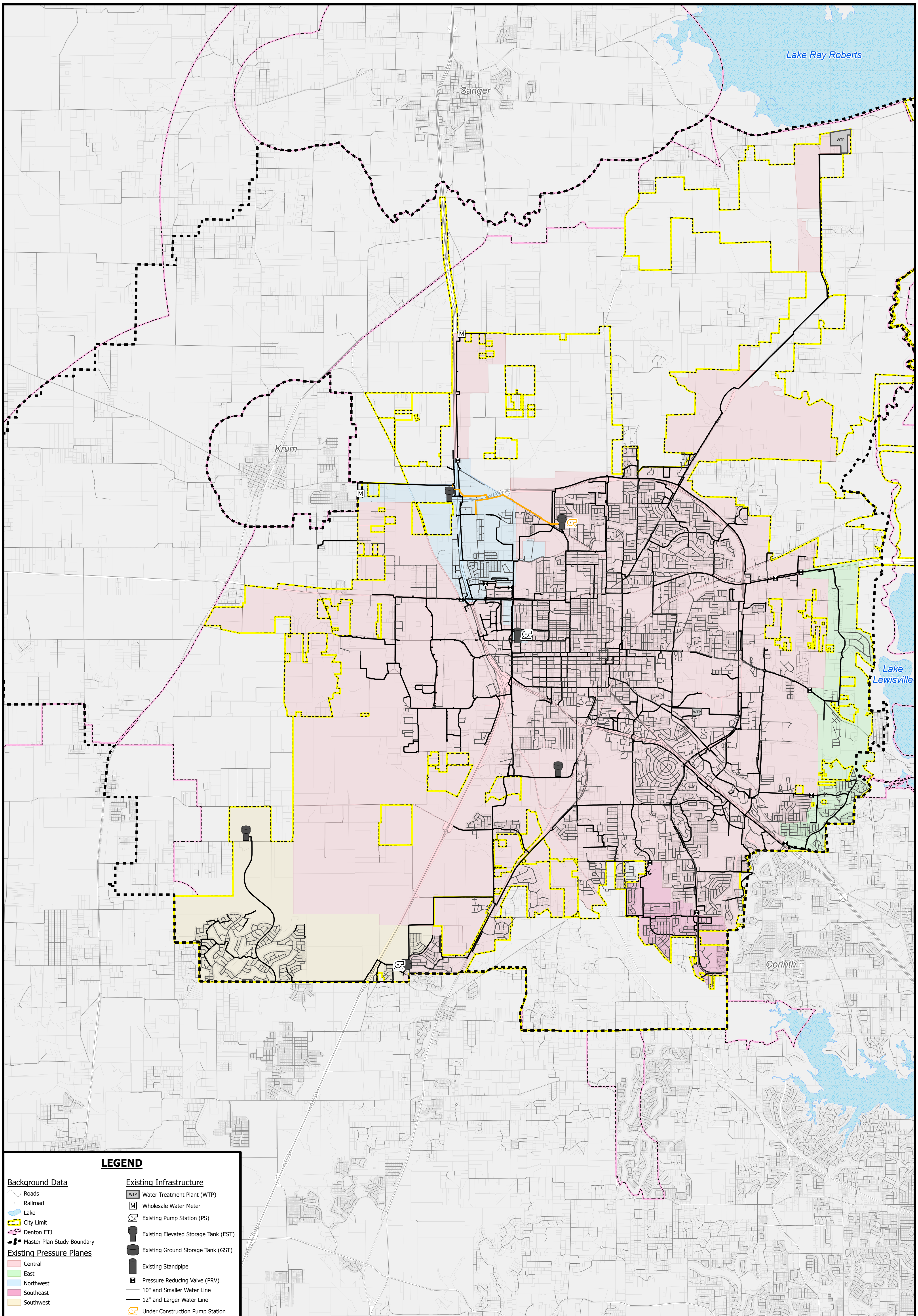
- Central
- East
- Northwest
- Southeast
- Southwest

The Lake Lewisville and Lake Ray Roberts WTPs supply the Central Pressure Plane through high service pump stations. A portion of the McKenna Park Standpipe serves as elevated storage for the Central PP, along with the Riney Road and Roselawn ESTs. The Central PP supplies water to the East and Southeast PPs through multiple pressure-reducing valves (PRVs). Central also supplies water to multiple storage tanks that serve the Northwest and Southwest PPs.

The Northwest PP is currently served by the McKenna Park Pump Station and Northwest EST. The Mckenna Park Standpipe supplies the Mckenna Park Pump Station. The Northwest Booster Pump Station, currently under construction, will also serve Northwest. The Riney Road EST will supply the Northwest Booster Pump Station. Once the Northwest Booster Pump Station is in service and the Jim Christal EST is constructed, the Mckenna Park Pump Station and Standpipe can be demolished.

The Southwest PP is served by the Southwest Pump Station and the Southwest EST. Central supplies water to the GST at the Southwest Pump Station through a pressure sustaining valve (PSV) and flow control valve (FCV).

Refer to **Exhibit F – Existing System** for an overview of the City's existing system and **Figure 4.4** for a schematic of major infrastructure in the City's existing system.



CITY OF DENTON
WATER MASTER PLAN
EXISTING SYSTEM

March 2025

Kimley»Horn

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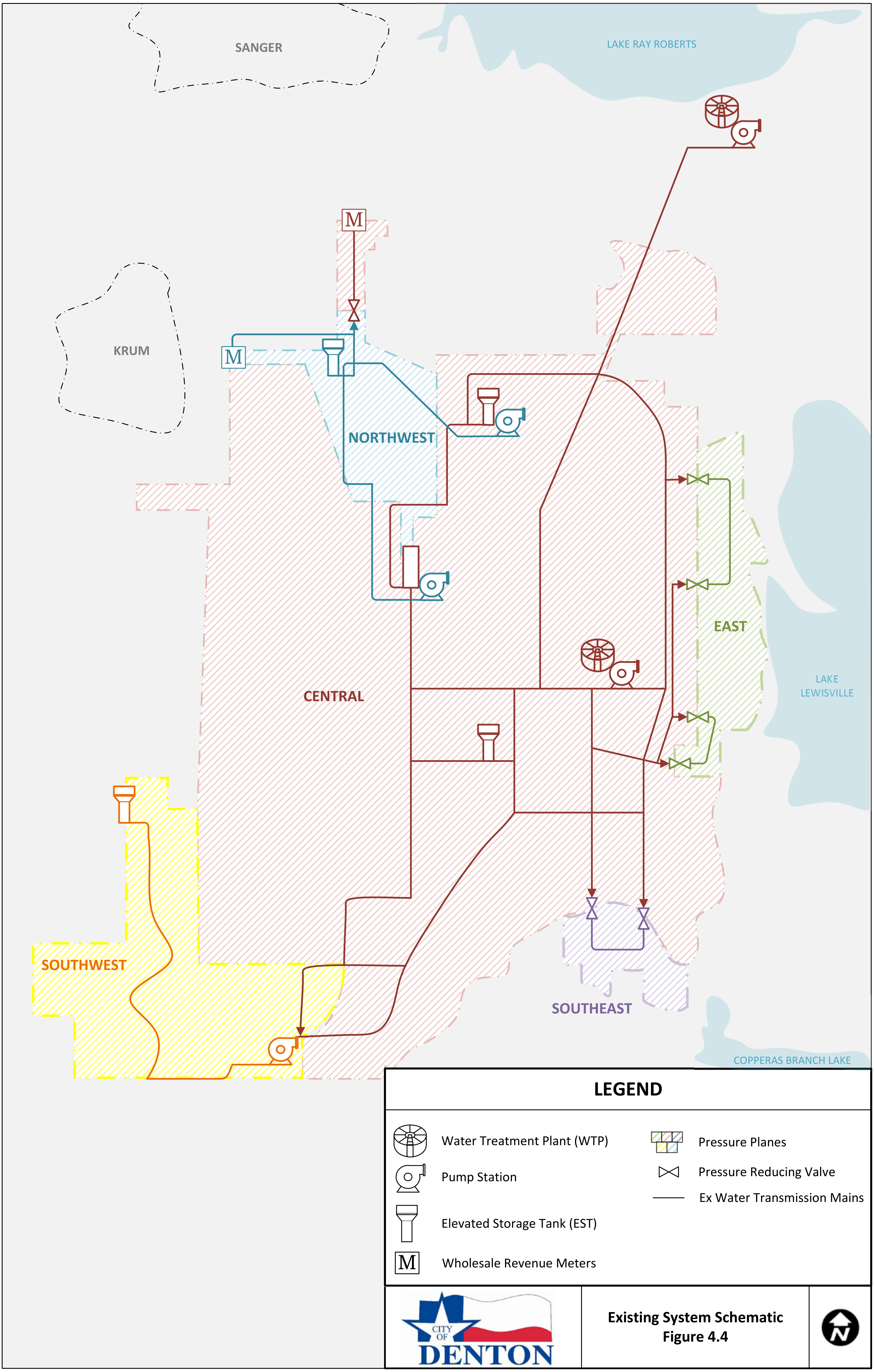
F



Existing System Schematic
Figure 4.4

4.2.1. EXISTING WATER INFRASTRUCTURE

4.2.1.1. *Existing Storage*

As discussed in **Section 4.2**, the Mckenna Park Standpipe serves Central as elevated storage and Northwest as ground storage for the Mckenna Park Pump Station. TCEQ 290 defines elevated storage as "that portion of water which can be stored at least 80 feet above the highest service connection in the pressure plane served by the tank." The highest service connection in Central is at an elevation of 723 feet. Based on this definition, approximately 0.7 MG of the total 2.0 MG capacity in the McKenna Park Standpipe serves as elevated storage for Central, with the remaining 1.3 MG serving as ground storage for the Mckenna Park Pump Station. **Tables 4.8 and 4.9** outline the existing ground and elevated storage per pressure plane, respectively.

Table 4.8 – Existing GST Capacity

Pressure Plane	Facility Name	Type	Capacity (MGD)
Central	Lake Lewisville WTP	Clearwell	2.0
		Clearwell	2.0
		Clearwell	2.0
	Lake Ray Roberts WTP	Clearwell	6.0
Northwest	McKenna Park	Standpipe	1.3
Southwest	Southwest	GST	2.0

Table 4.9 – Existing EST Capacity

Pressure Plane	Facility Name	Type	Hydraulic Grade Line (ft)	Capacity (MGD)
Central	McKenna Park	Standpipe	826	0.7
	Riney Road	EST	826	2.0
	Roselawn	EST	826	3.0
Northwest	Northwest	EST	900	1.0
Southwest	Southwest	EST	905	3.0

4.2.1.2. Existing Pumping

Kimley-Horn conducted pump performance testing and condition assessments on all the existing pump stations except the Mckenna Park Pump Station since it will only be used in emergency conditions once the Northwest Booster Pump Station is in service (**Section 4.2**). The results of the pump performance testing and condition assessments can be found in **Appendix B – Pump Performance Testing**. **Table 4.10** outlines existing pump capacity per pressure plane based on the operating point identified during pump testing or based on data provided by the City.

Table 4.10 – Existing Pumping Capacity

Pump Station	Pump	Capacity (gpm)	Data Source
Central Pressure Plane			
Lake Lewisville WTP	1	6,400	City Data
	2	3,500	Pump Performance Testing
	3	5,200	Pump Performance Testing
	4	6,000	Pump Performance Testing
	5	6,400	Pump Performance Testing
	6	6,300	Pump Performance Testing
	Total Capacity:	*33,800*	
Lake Ray Roberts WTP	1	11,800	City Data
	2	11,800	City Data
	3	6,300	Pump Performance Testing
	4	6,200	Pump Performance Testing
	5	*Future*	N/A
	6	*Future*	N/A
	Total Capacity:	*36,100*	
Northwest Pressure Plane			
McKenna Park	1	1,500	City Data
	2	1,500	City Data
	3	2,000	City Data
	Total Capacity:	*5,000*	
Southwest Pressure Plane			
Southwest	1	600	Pump Performance Testing
	2	600	Pump Performance Testing
	3	3,300	Pump Performance Testing
	4	3,300	Pump Performance Testing
	Total Capacity:	*7,800*	

Table 4.11 outlines the pumping capacity at the Northwest Booster Pump Station that is currently under construction.

Table 4.11 – Under Construction Pumping Capacity

Pump Station	Pump	Capacity (gpm)	Data Source
Northwest Pressure Plane			
Northwest	1	6,500	Record Drawing
	2	6,500	Record Drawing
	3	6,500	Record Drawing
	4	*Future*	N/A
	Total Capacity:	*19,500*	

4.3. WATER SYSTEM ANALYSIS

4.3.1. PRESSURE PLANE ANALYSIS

The Northwest and Southwest Pressure Planes serve similar elevation ranges and have only been distinguished as separate pressure planes because there is currently no connecting infrastructure. Kimley-Horn recommends that the two pressure planes be interconnected by a transmission main to form the West Pressure Plane. The overflow elevations of the Northwest EST (905 feet) and the Southwest EST (900 feet) are within 5 feet of each other, allowing the two ESTs to serve the combined West Pressure Plane in conjunction.

Combining the Northwest and Southwest Pressure Planes into the West Pressure Plane will allow the City to capitalize on existing and proposed storage and pumping infrastructure to satisfy TCEQ requirements and serve the proposed MUDs. The infrastructure required to connect the Northwest and Southwest pressure planes is outlined in the Capital Improvement Plan (CIP) (**Section 6.2**).

Additionally, high pressures were observed in the eastern section of the Central pressure plane when the ESTs are filling. Should observed maximum pressures increase in the future as additional pumps are installed at the Lake Ray Roberts WTP Pump Station, the City may consider installing PRVs in this area to reduce pressure.

4.3.2. DESIGN CRITERIA

Kimley-Horn worked with the City to establish design criteria for analysis of the existing and future conveyance infrastructure. Criteria established by the Texas Commission on Environmental Quality (TCEQ) must also be satisfied. City and TCEQ criteria are summarized in **Table 4.12**.

Table 4.12 – Design Criteria

	City Criteria	TCEQ Criteria
Treatment Capacity[1]	N/A	Overall treatment plant capacity to meet maximum day demand or 0.6 gpm per connection, whichever is higher
Minimum Pressure	40 psi	Normal conditions = 35 psi Emergency conditions = 20 psi
Maximum Velocity	Existing Water Lines – ≤7 ft/s Proposed Water Lines – ≤16" Diameter ≤ 5 ft/s >16" Diameter = 3 - 5 ft/s[2]	N/A
Pumping Facilities	N/A	Total capacity of at least 2.0 gpm per connection (Criteria 1) or 1,000 gpm and the ability to meet peak hourly demands with the largest pump out of service at each pressure plane, whichever is less (Criteria 2). Or total capacity of at least 0.60 gpm per connection if 200 gallons elevated storage per connection is met (Criteria 3).
Elevated Storage	Sufficient storage to satisfy ISO Fire Rating[3] plus MDD in conjunction with less than firm pumping capacity	Equal to 100 gallons per connection or equal to 200 gallons per connection for pumping requirement discount
Total Storage	N/A	Equal to 200 gallons per connection

[1]*TCEQ treatment capacity discussed in* **Section 5.4**
[2]*3 ft/s preferred, up to 5 ft/s allowed in some cases*
[3]*City must supply 3,500 gpm for 3 hours to maintain ISO Fire Rating*

4.3.3. TCEQ INFRASTRUCTURE ANALYSIS

Kimley-Horn analyzed the existing infrastructure against the TCEQ design criteria outlined in **Table 4.12**. Additional improvements were identified to accommodate the future growth projections outlined in **Section 3.2**. Since the Central PP supplies the East and Southeast PPs through PRVs, the East and Southeast PPs are included with the Central PP for the TCEQ analysis. Additionally, the Northwest and Southwest PPs are combined into the West PP, as discussed in **Section 4.3.1.** Should the City decide not to construct the proposed infrastructure required to connect the Northwest and Southwest PPs, the pumping and storage capacities required by TCEQ would need to be evaluated separately.

4.3.3.1. Connection Count

To determine compliance with the TCEQ design criteria, existing and future connection counts were determined. Per TCEQ guidance, each water meter is counted as a connection except for multi-family meters. For multi-family meters, each residential unit associated with that multi-family meter is counted as a separate connection. The current and projected connection counts based on TCEQ guidance are listed in **Table 4.13**.

Table 4.13 – Connection Count

Planning Period	Connections (Central PP)	Connections (West PP)	Connections (Total)
Existing	48,762	5,078	53,840
5-Year	61,187	15,336	76,523
10-Year	66,914	23,193	90,107
25-Year	79,987	36,823	116,810

4.3.3.2. TCEQ Criteria – Pumping

Table 4.14 summarizes the existing and proposed pumping capacity per pressure plane compared to required capacity. Required capacity is based on TCEQ Criteria 3 of meeting peak hour demand (PHD) with firm capacity (see **Table 4.12**). Since the Central PP pumps supply the West PP and wholesale customers, the required capacity for the Central PP includes the MDD for both the West PP and wholesale customers in addition to the PHD for the Central PP.

Table 4.14 – Pumping Capacity Per Pressure Plane

Planning Period	Required Capacity – TCEQ (MGD)	Firm Capacity (MGD)
Central Pressure Plane		
Existing	68	84
5-Year	93	101
10-Year	109	121
25-Year	138	140
West Pressure Plane		
Existing	9	14
5-Year	21	30
10-Year	32	36
25-Year	49	51

Tables 4.15 and 4.16 outline the pumping improvements necessary to meet TCEQ criteria for pumping capacity in each planning period for the Central and West Pressure Planes, respectively.

Table 4.15 – Central Pressure Plane Pumping Improvements

Pump Station	Pump	Existing Capacity (gpm)	5-Year Capacity (gpm)	10-Year Capacity (gpm)	25-Year Capacity (gpm)
Lake Lewisville WTP	1	6,400	6,400	6,400	6,400
	2	3,500	3,500	3,500	3,500
	3	5,200	5,200	5,200	5,200
	4	6,000	6,000	6,000	6,000
	5	6,400	6,400	6,400	6,400
	6	6,300	6,300	6,300	6,300
Lake Ray Roberts WTP	1	11,800	11,800	11,800	11,800
	2	11,800	11,800	11,800	11,800
	3	6,300	6,300	6,300	**11,800**[3]
	4	6,200	6,200	6,200	**13,900**[4]
	5	*Future*	**13,900**[1]	13,900	13,900
	6	*Future*	*Future*	**13,900**[2]	13,900
Total Capacity (gpm):		***69,900***	***83,800***	***97,700***	***110,900***
Firm Capacity (gpm):		***58,100***	***70,800***	***83,800***	***97,000***
Total Capacity (MGD):		***101***	***121***	***141***	***160***
Firm Capacity (MGD):		***84***	***101***	***121***	***140***

[1]Empty slot (1 of 2) filled at Lake Ray Roberts WTP High Service Pump Station
[2]Empty slot (2 of 2) filled at Lake Ray Roberts WTP High Service Pump Station
[3]Pump upgraded to fully utilize pump slot capacity of 17.0 MGD
[4]Pump upgraded to fully utilize pump slot capacity of 20.0 MGD

Table 4.16 – West Pressure Plane Pumping Improvements

Pump Station	Pump	Existing Capacity (gpm)	5-Year Capacity (gpm)	10-Year Capacity (gpm)	25-Year Capacity (gpm)
Jim Christal	1	*Future*	*Future*	*Future*	**2,000**
	2	*Future*	*Future*	*Future*	**2,000**
	3	*Future*	*Future*	*Future*	*Future*
	4	*Future*	*Future*	*Future*	*Future*
McKenna Park	1	1,500	*Removed*	*Removed*	*Removed*
	2	1,500	*Removed*	*Removed*	*Removed*
	3	2,000	*Removed*	*Removed*	*Removed*
Northwest	1	*Construction*	6,500	6,500	6,500
	2	*Construction*	6,500	6,500	6,500
	3	*Construction*	6,500	6,500	6,500
	4	*Future*	*Future*	*Future*	**6,500**[3]
Southwest	1	*Future*	*Future*	**2,800**[1]	2,800
	2	1,200	1,200	**2,800**[2]	2,800
	3	3,300	3,300	3,300	3,300
	4	3,300	3,300	3,300	3,300
Total Capacity (gpm):		***12,800***	***27,300***	***31,700***	***42,200***
Firm Capacity (gpm):		***9,500***	***20,800***	***25,200***	***35,700***
Total Capacity (MGD):		***18***	***39***	***46***	***61***
Firm Capacity (MGD):		***14***	***30***	***36***	***51***

[1]Empty slot filled at Southwest Booster Pump Station
[2]Pump upgraded to fully utilize pump slot capacity of 4.0 MGD
[3]Empty slot filled at Northwest Booster Pump Station

4.3.3.3. *TCEQ Criteria – Elevated Storage*

Table 4.17 summarizes the existing and proposed elevated storage capacity per pressure plane compared to required capacity. Required capacity was analyzed based on the TCEQ criteria of providing 100 gallons per connection for each pressure plane (**Table 4.12**).

Table 4.17– EST Capacity Per Pressure Plane

Planning Period	Connection Count	Required Capacity – City (MG)	Required Capacity – TCEQ (MG)	Capacity (MG)
Central Pressure Plane				
Existing	48,762	4.2	4.9	5.7
5-Year	61,187	6.0	6.1	8.0
10-Year	66,914	4.6	6.7	8.0
25-Year	79,987	7.7	8.0	8.0
West Pressure Plane				
Existing	5,078	0.6	0.5	4.0
5-Year	15,336	0.6	1.5	4.0
10-Year	23,193	0.9	2.3	4.0
25-Year	36,823	3.1	3.7	4.0

Table 4.18 outlines the EST capacity improvements per pressure plane.

Table 4.18 – EST Capacity Improvements Per Pressure Plane

Facility	Type	Existing Capacity (MG)	5-Year Capacity (MG)	10-Year Capacity (MG)	25-Year Capacity (MG)
Central Pressure Plane					
Jim Christal	EST	*Future*	3.0	3.0	3.0
McKenna Park	Standpipe	0.7	*Removed*	*Removed*	*Removed*
Riney Road	EST	2.0	2.0	2.0	2.0
Roselawn	EST	3.0	3.0	3.0	3.0
	Total Capacity (MG):	5.7	8.0	8.0	8.0
West Pressure Plane					
Northwest	EST	1.0	1.0	1.0	1.0
Southwest	EST	3.0	3.0	3.0	3.0
	Total Capacity (MG):	4.0	4.0	4.0	4.0

4.3.3.4. *Ground Storage Improvements*

TCEQ does not outline ground storage capacity requirements. **Table 4.19** outlines the ground storage improvements planned in each planning period.

Table 4.19 – Ground Storage Improvements

Facility Name	Type	Existing Capacity (MG)	5-Year Capacity (MG)	10-Year Capacity (MG)	25-Year Capacity (MG)
Lake Lewisville WTP	Clearwell	6.0	6.0	6.0	6.0
Lake Ray Roberts WTP	Clearwell	6.0	12.0[1]	24.0[3]	36.0[5]
McKenna Park	Standpipe	1.3	0.0[2]	0.0	0.0
Southwest	GST	2.0	2.0	4.0[4]	4.0
Total Capacity (MG):		15.3	20.0	34.0	46.0

[1]Additional clearwell storage included in Lake Ray Roberts WTP 20 MGD expansion to 50 MGD
[2]McKenna Park Pump Station and Standpipe demolished in the 5-year planning period
[3]Additional clearwell storage included in Lake Ray Roberts WTP 10 MGD expansion to 60 MGD
[4]Included with Southwest Booster Pump Station pump upgrades
[5]Additional clearwell storage included in the Lake Ray Roberts WTP 10 MGD expansion to 70 MGD and 10 MGD expansion to 80 MGD

4.3.3.5. *TCEQ Criteria – Total Storage*

Table 4.20 summarizes the existing and proposed total storage capacity per pressure plane compared to required capacity. Required capacity was analyzed based on the TCEQ criteria of providing 200 gpm per connection for each pressure plane (**Table 4.12**).

Table 4.20 – Total Storage Capacity Per Pressure Plane

Planning Period	Connection Count	Required Capacity – TCEQ (MG)	Provided Capacity (MG)
Central Pressure Plane			
Existing	48,762	9.8	17.7
5-Year	61,187	12.2	26.0
10-Year	66,914	13.4	38.0
25-Year	79,987	16.0	50.0
West Pressure Plane			
Existing	5,078	1.0	7.3
5-Year	15,336	3.1	6.0
10-Year	23,193	4.6	8.0
25-Year	36,823	7.4	8.0

Table 4.21 outlines the total storage capacity improvements per pressure plane.

Table 4.21 – Total Storage Capacity Improvements Per Pressure Plane

Facility Name	Type	Existing Capacity (MG)	5-Year Capacity (MG)	10-Year Capacity (MG)	25-Year Capacity (MG)
Central Pressure Plane					
Jim Christal	EST	*Future*	3.0	3.0	3.0
Lake Lewisville WTP	Clearwell	6.0	6.0	6.0	6.0
Lake Ray Roberts WTP	Clearwell	6.0	12.0	24.0	36.0
McKenna Park	Standpipe	0.7	*Removed*	*Removed*	*Removed*
Riney Road	EST	2.0	2.0	2.0	2.0
Roselawn	EST	3.0	3.0	3.0	3.0
Total Capacity (MG):		17.7	26.0	38.0	50.0
West Pressure Plane					
McKenna Park	Standpipe	1.3	*Removed*	*Removed*	*Removed*
Northwest	EST	1.0	1.0	1.0	1.0
Southwest	EST	3.0	3.0	3.0	3.0
Southwest	GST	2.0	2.0	4.0	4.0
Total Capacity (MG):		7.3	6.0	8.0	8.0

4.3.4. OPERATIONAL ANALYSIS

4.3.4.1. Hydraulic Model Creation

To evaluate the existing water system, Kimley-Horn built the City's hydraulic model utilizing WaterGEMS™. The information required to build the model and the corresponding data sources used are listed in **Table 4.22.**

Table 4.22 – Hydraulic Model Build Data

Infrastructure	Required Data	Data Source
Piping	Length Age Material Diameter	City GIS
Junctions	Elevation	TNRIS Topographic Data
Pumps	Pump Curves Inlet Elevations	City Data Pump Performance Testing[1] Record Drawings
Tanks	Elevation Head Range Diameter	Record Drawings

*[1]See **Appendix B – Pump Performance Testing** for the results of the tests.*

4.3.4.2. *Hydraulic Model Calibration*

Kimley-Horn and City staff conducted nineteen (19) fire flow tests with six (6) pressure loggers installed to record the system response at various locations throughout the water system (see **Exhibit G – Field Testing Locations)**. Fire flow tests were located as far as possible from the "energy source", either the EST or pump station, to move as much water as possible across the system to induce the maximum amount of headloss, or pressure drop.

Pressure loggers were installed between the fire flow test locations and the energy source to catch the pressure drop incrementally. For each test, 1-2 hydrants were flowed for 2-5 minutes while the pressure drop was recorded by a pressure logger at a nearby hydrant (referred to as the static hydrant). The static pressure is the pressure observed right before the test begins. Residual pressure is the pressure observed as the hydrant flows. The difference between the static and residual pressure is the observed pressure drop.

To calibrate the model, a model scenario was set up that simulated the day of fire flow testing – tank levels, pump flows, etc. were input into the model to match system conditions per test. The model then simulated each fire flow test and reported how closely it was able to replicate the pressures recorded by each pressure logger. Model parameters, such as pipe roughness and valve settings, were then adjusted until the simulated pressure was within ~5 psi of the observed pressure recorded at each pressure logger. The calibrated model was then used to simulate existing and future conditions as outlined in **Section 4.3.4.3**.

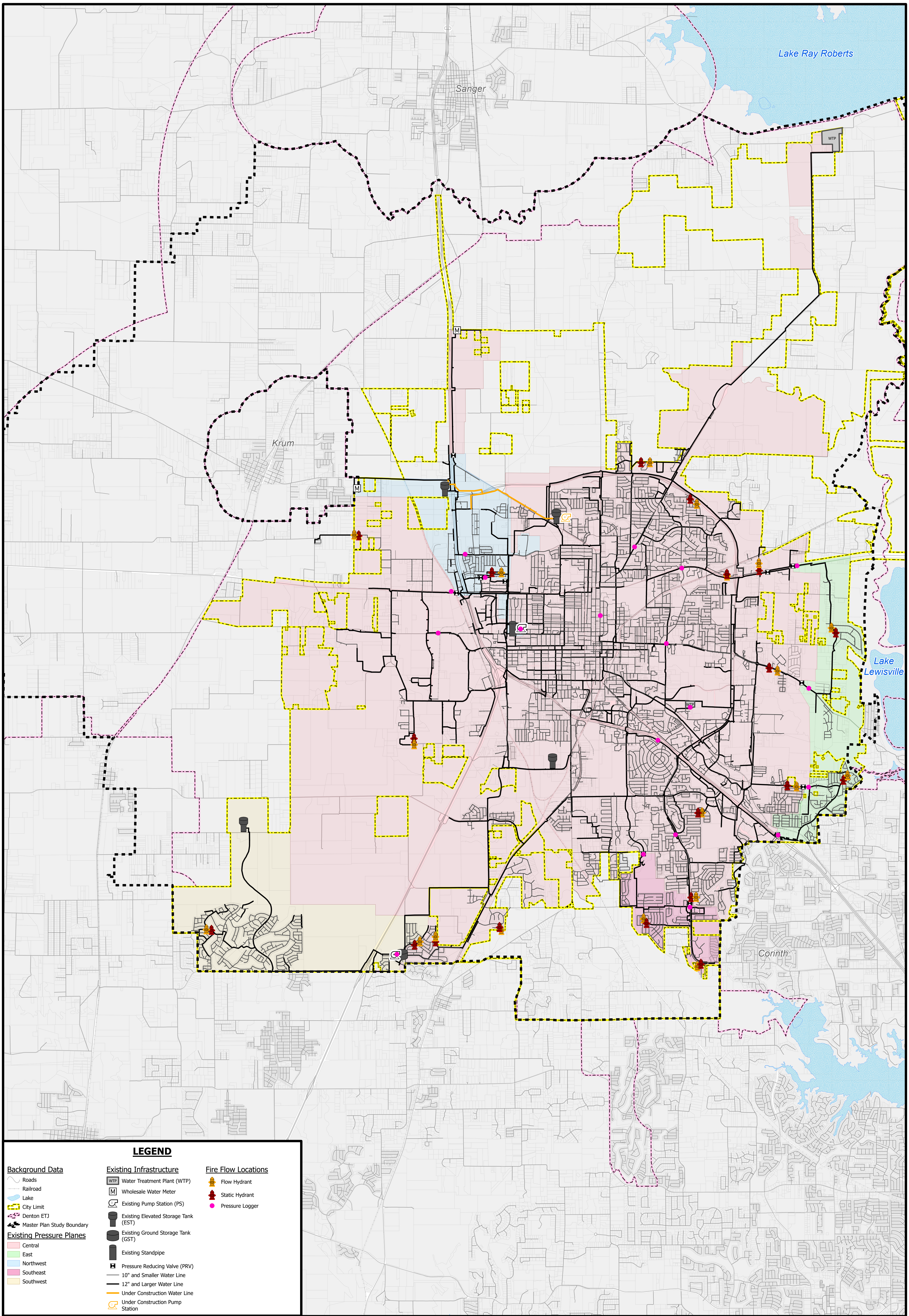
4.3.4.3. *Hydraulic Model Scenarios*

An Average Day Demand (ADD) and Maximum Day Demand (MDD) scenario was modeled for the existing, 5, 10, and 25-year planning periods based on the demand listed in **Table 4.4**. Demands were allocated in the model to reflect the growth areas and known incoming developments shown in **Exhibit E**.

Any future transmission main required to serve a growth area or known incoming development was included in the corresponding model scenario based on planning period. Any proposed facility improvement required per TCEQ outlined **Section 4.3.3** was also included in the corresponding modeling scenario.

For each scenario, operational controls were adjusted to ensure the appropriate amount of flow was supplied between the Ray Roberts and Lake Lewisville WTPs to align with the outlined WTP improvements listed in **Table 5.4**. Additionally, operational controls were adjusted to ensure GSTs were sufficiently filled, ESTs were balanced and cycled appropriately, and that the pressures within each pressure plane remained in an acceptable range. Sizing of proposed transmission mains was adjusted to meet the velocity design criteria outlined in **Table 4.12.**

1. **Average Day Demand (ADD)** – Run for 24 hours under normal operating conditions for the existing, 5, 10, and 25-year scenarios.
2. **Maximum Day Demand (MDD)** – Run for 24 hours under normal operating conditions for the existing, 5, 10, and 25-year scenarios. The diurnal shown in **Figure 4.3** is applied in the model so that the PHD will occur during the MDD scenario.
   MDD Plus Fire Flow – MDD plus 1,500 gpm fire flow in the 5-year scenario. Junctions unable to flow at 1,500 gpm while maintaining TCEQ minimum pressure of 20 psi throughout the system fail fire flow. Conveyance projects required to increase available fire flow are included in the Water Capital Improvement Plan (CIP).



CITY OF DENTON

CITY OF DENTON
WATER MASTER PLAN
FIELD TESTING LOCATIONS

March 2025

Kimley»Horn

This map product is for information purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and represents only the approximate relative location of property boundaries.

G

CHAPTER 5

WATER TREATMENT ANALYSIS

5.1 EXISTING WATER TREATMENT PLANTS

5.1.1 EXISTING WATER TREATMENT OVERVIEW

The City owns and operates two water treatment plants (WTPs) – the Lake Lewisville WTP and the Lake Ray Roberts WTP. The locations of the existing WTPs are shown in **Exhibit F – Existing System.** Both WTPs currently treat surface water from their respective lakes using conventional treatment technologies that meet existing regulatory requirements. Combined, the WTPs can provide approximately 48 MGD of treated water to the existing distribution system (**Table 5.1**).

Table 5.1 – Existing Water Treatment Capacity

Facility Name	Capacity (MGD)
Lake Lewisville WTP	28
Lake Ray Roberts WTP	20
Total	**48**

The City has received the rating of "Superior Public Water System" by TCEQ, the highest rating given to water systems in the State of Texas. Both WTPs are key to the City providing safe, reliable drinking water well into the future while maintaining this important rating.

5.1.1.1 Lake Lewisville Water Treatment Plant

EXHIBIT H - LAKE LEWISVILLE WTP EXISTING SITE

CITY OF DENTON WATER MASTER PLAN

CITY OF DENTON

Kimley»Horn
TBPE Firm No. 928 P: 817-335-6511
801 Cherry St, Suite 1300 Ft. Worth, TX 76102

No.	Revision	By	Date

DATE:	AUGUST 2024
DESIGN:	JMD
DRAWN:	TDH
CHECKED:	RJJ
KHA NO.:	061024067

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H

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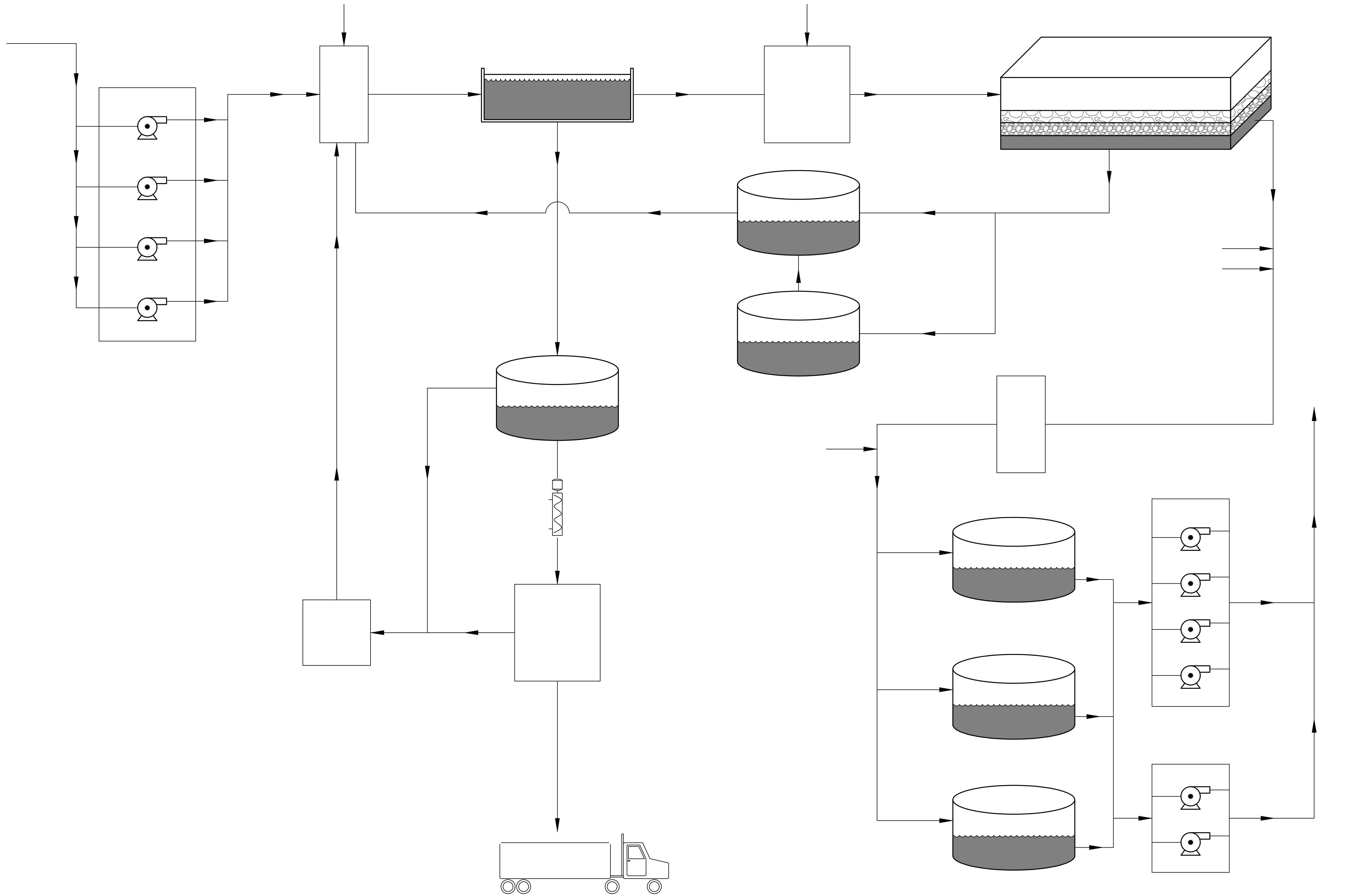

Kimley-Horn
TBPE Firm No. 928 P: 817-335-6511
801 Cherry St., Suite 1300 Ft. Worth, TX 76102

No.	Revision	By	Date

CITY OF DENTON

CITY OF DENTON WATER MASTER PLAN

EXHIBIT I - LAKE LEWISVILLE WTP EXISTING PROCESS FLOW DIAGRAM

DATE:	AUGUST 2024
DESIGN:	JMD
DRAWN:	TDH
CHECKED:	RJJ
KHA NO.:	061024067

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5.1.1.2 Lake Ray Roberts Water Treatment Plant

Kimley»Horn
TBPE Firm No. 928
801 Cherry St, Suite 1300 Ft. Worth, TX 76102
P: 817-335-6511

No.	Revision	By	Date

CITY OF DENTON

CITY OF DENTON
WATER MASTER
PLAN

EXHIBIT J - LAKE RAY ROBERTS WTP EXISTING SITE

DATE:	AUGUST 2024
DESIGN:	JMD
DRAWN:	TDH
CHECKED:	RJJ
KHA NO.:	061024067

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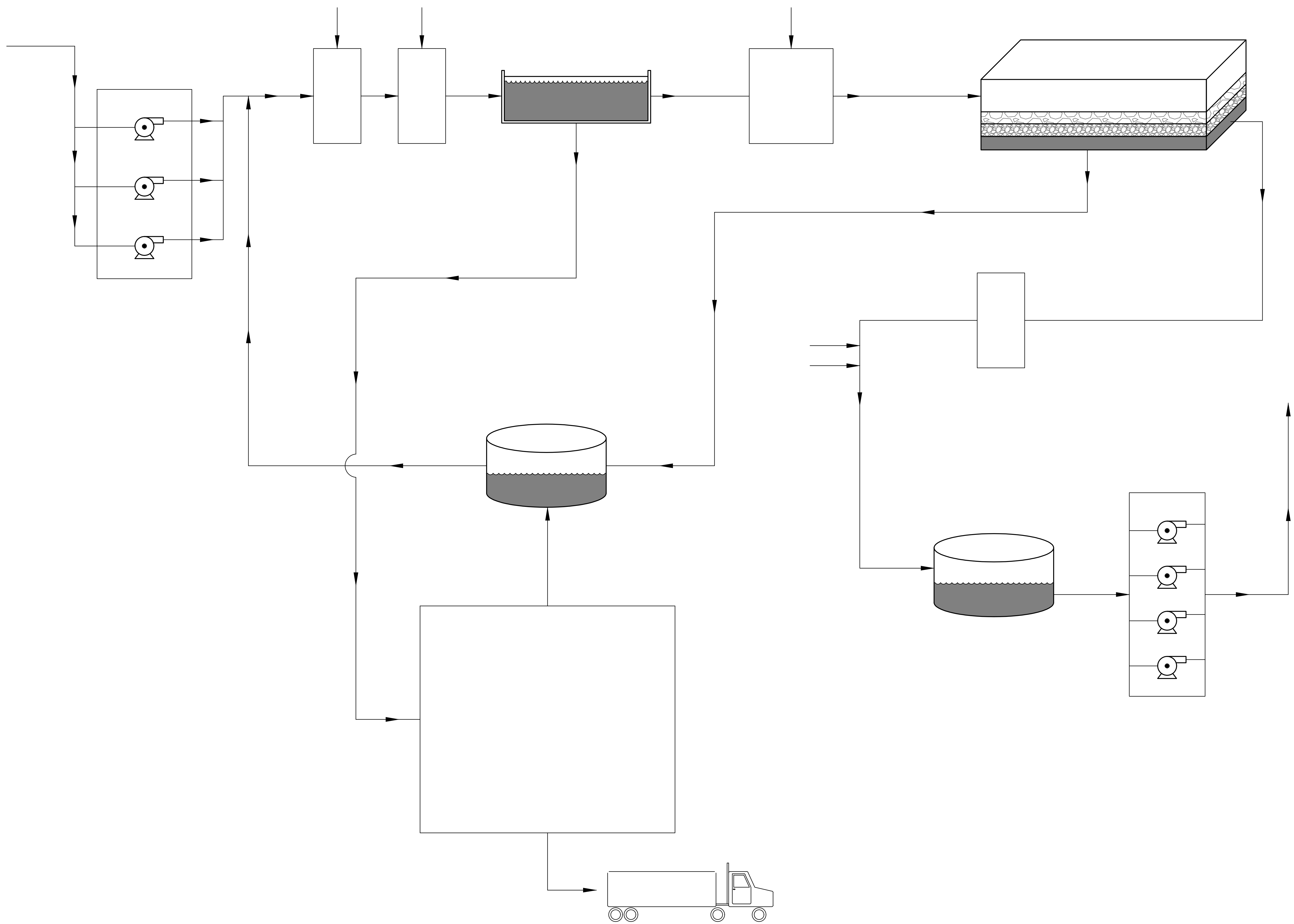

Kimley-Horn
TBPE Firm No. 928
801 Cherry St., Suite 1300 Ft. Worth, TX 76102
P: 817-335-6511

No.	Revision	By	Date

CITY OF DENTON

CITY OF DENTON WATER MASTER PLAN

EXHIBIT K - LAKE RAY ROBERTS WTP EXISTING PROCESS FLOW DIAGRAM

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DESIGN:	JMD
DRAWN:	TDH
CHECKED:	RJJ
KHA NO.:	061024067

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K

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5.1.2 EXISTING WATER QUALITY

Influent and effluent flow values and water quality data from both WTPs were reported between 2017 and 2022. Influent water quality can have impacts on the effectiveness of water treatment processes. Influent total organic carbon (TOC) information has a direct impact on the WTP's ability to meet regulatory TOC effluent requirements. High organic matter can increase chlorine demand and create disinfection byproducts (DBPs) if it is not removed within the water treatment process. It can require adjustments in chlorine dosage or use of alternative disinfectants.

Influent turbidity and alkalinity data are also taken to understand and control the amount of chemical addition needed at various locations in the treatment process. Higher turbidity increases coagulant demand for flocculation. Additionally, another issue with high turbidity levels is the larger amount of sludge that's generated from treating the water. See **Figure 5.1** for a visual representation of turbidity levels. Treated water quality parameters are collected to show compliance with drinking water quality standards, and treated water effluent flow values are collected to show compliance with the rated capacity of the WTPs.

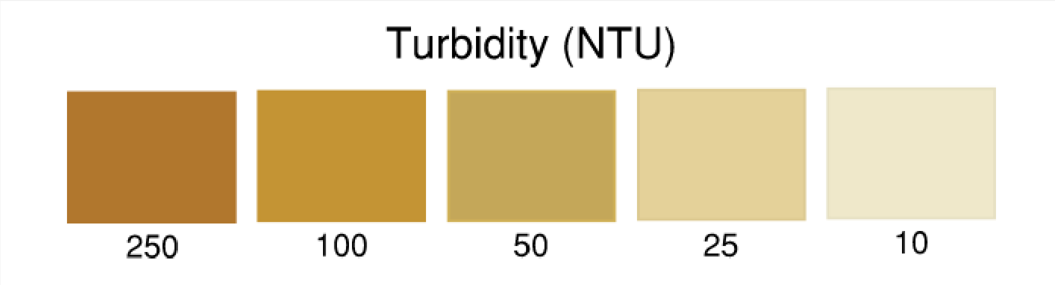


Figure 5.1 – Example Turbidity Levels

5.1.2.1 Lake Lewisville Water Treatment Plant

The Lake Lewisville WTP has historically produced under the 30 MGD rated capacity. The annual maximum effluent flows are illustrated in **Figure 5.2** The daily effluent flow average between 2017 and 2022 was 10.5 MGD. The maximum daily effluent flow that occurred during that time frame was 25.8 MGD and occurred on July 20, 2020.

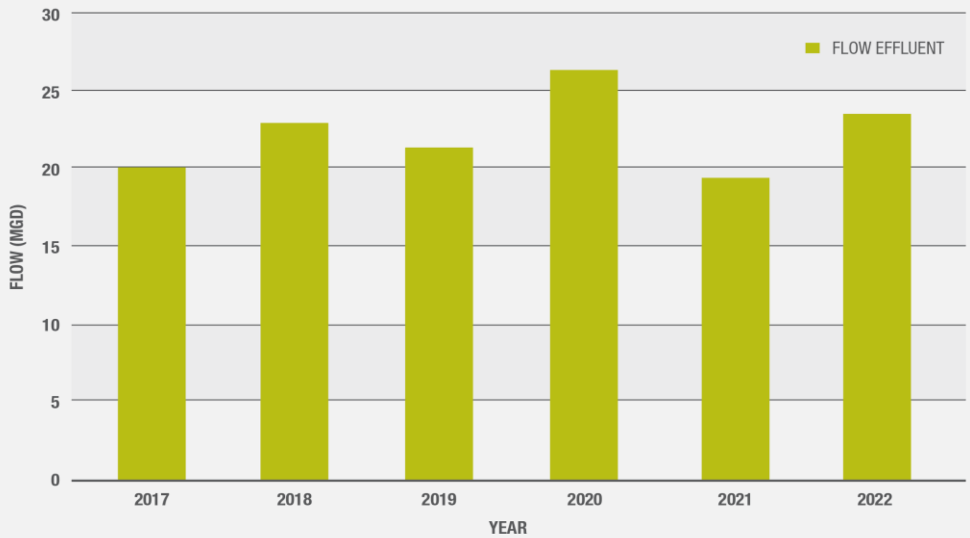


Figure 5.2– Lake Lewisville WTP Maximum Annual Flows

The Lake Lewisville WTP has historically had minor issues with source water quality. The plant sees an average of 5.6 mg/l of influent TOC, with a maximum of 7.76 mg/l in June of 2018. These values are considered low TOC for raw water. The plant sees a range of alkalinity from 70 mg/l as $CaCO_3$ to 123 mg/l as $CaCO_3$, which is a typical range for a surface water source. The WTP sees under 50 NTU of turbidity on average but can receive high turbidity during high flow periods with low water levels in the lake. This situation typically occurs during the summer months. This is due to the location of the raw water intake structure. May 2021 had the highest recorded turbidity at 202 NTU. This is considered extremely high turbidity for surface. Influent and effluent TOC concentration, influent alkalinity, and influent turbidity are illustrated in **Figure 5.3**, **Figure 5.4, Figure 5.5** for the Lake Lewisville WTP.

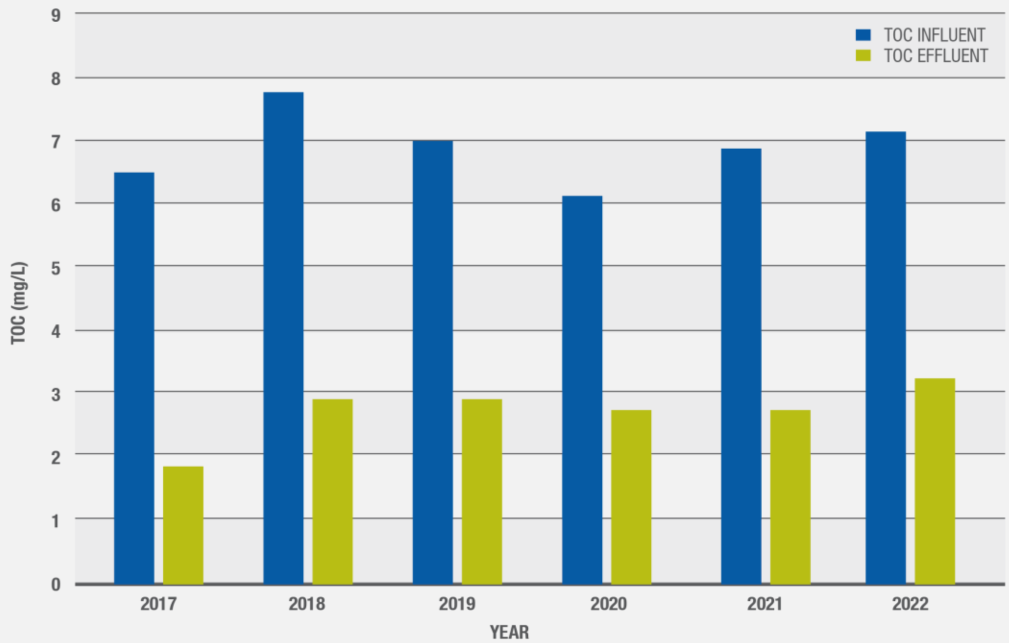


Figure 5.3 – Lake Lewisville WTP Maximum TOC Concentration

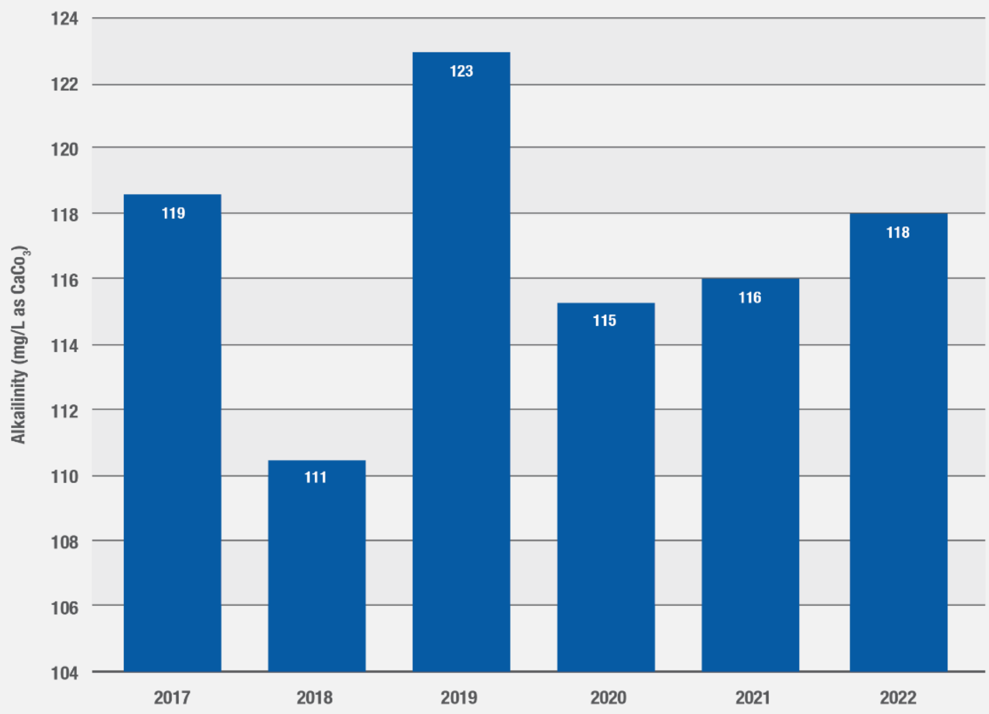


Figure 5.4 – Lake Lewisville WTP Maximum Influent Alkalinity

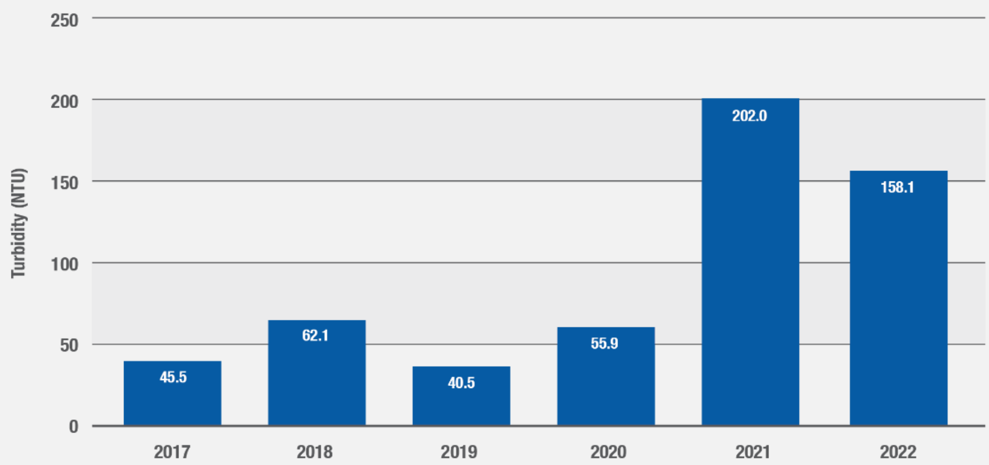


Figure 5.5 – Lake Lewisville WTP Maximum Influent Turbidity

5.1.2.2 Lake Ray Roberts Water Treatment Plant

The Lake Ray Roberts WTP has historically produced slightly under its 20 MGD rated capacity. The daily effluent flow averaged between 2017 and 2022 was 9.0 MGD. The maximum daily effluent flow that occurred during that time frame was 17.4 MGD and occurred on March 16, 2021. The annual maximum effluent flows are illustrated in **Figure 5.6**.

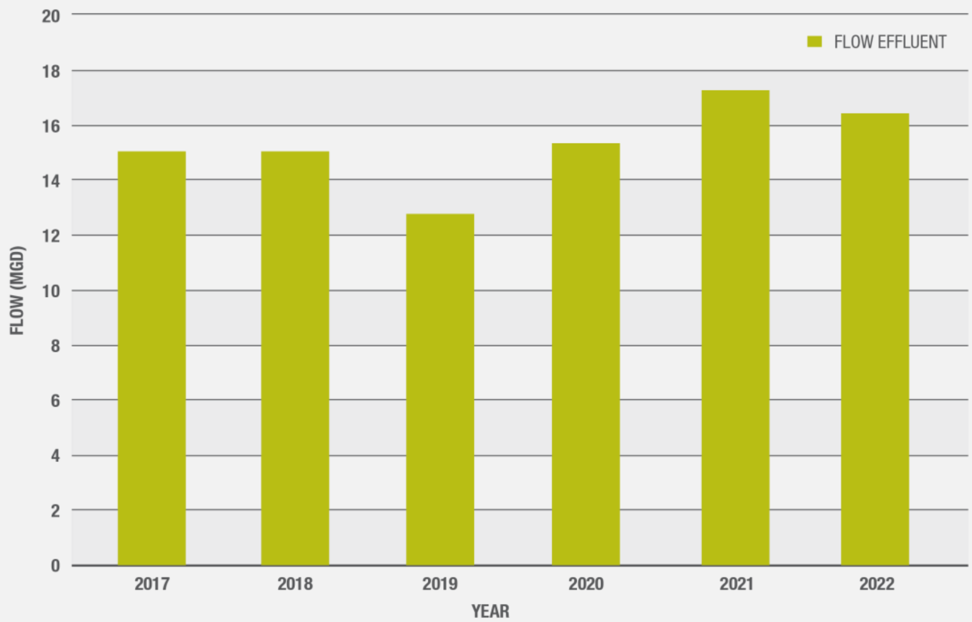


Figure 5.6 – Lake Ray Roberts WTP Maximum Annual Flows

Ray Roberts WTP has high-quality source water. The plant sees a range of 3.5 mg/l to 6 mg/l of influent TOC, which is very low. The plant also sees a range of alkalinity from 80 mg/l as $CaCO_3$ to 130 mg/l as $CaCO_3$, which is a typical range for a surface water source. The plant also sees very low turbidity values with turbidity reaching about 25 NTU on its highest days. The influent water quality for Ray Roberts WTP has consistent influent water quality as compared to the Lake Lewisville WTP. Influent and effluent TOC concentration, influent alkalinity, and influent turbidity are illustrated in **Figure 5.7**, **Figure 5.8**, and **Figure 5.9** for the Lake Ray Roberts WTP. Additional detailed data charts and graphs that expand on these figures have been included in **Appendix D – Water Treatment Plant Data Summary**.

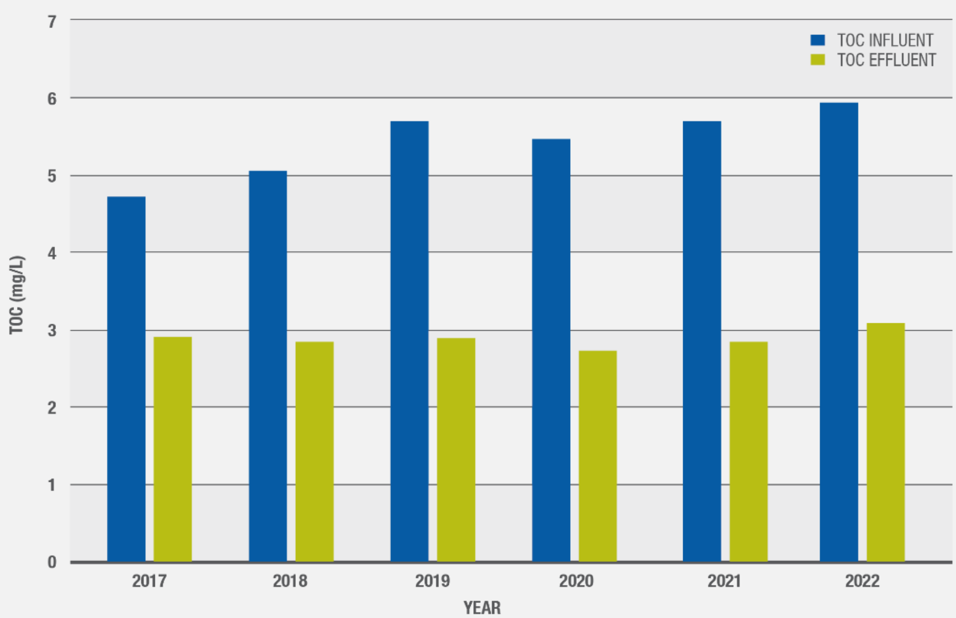


Figure 5.7 – Lake Ray Roberts WTP Maximum TOC Concentration

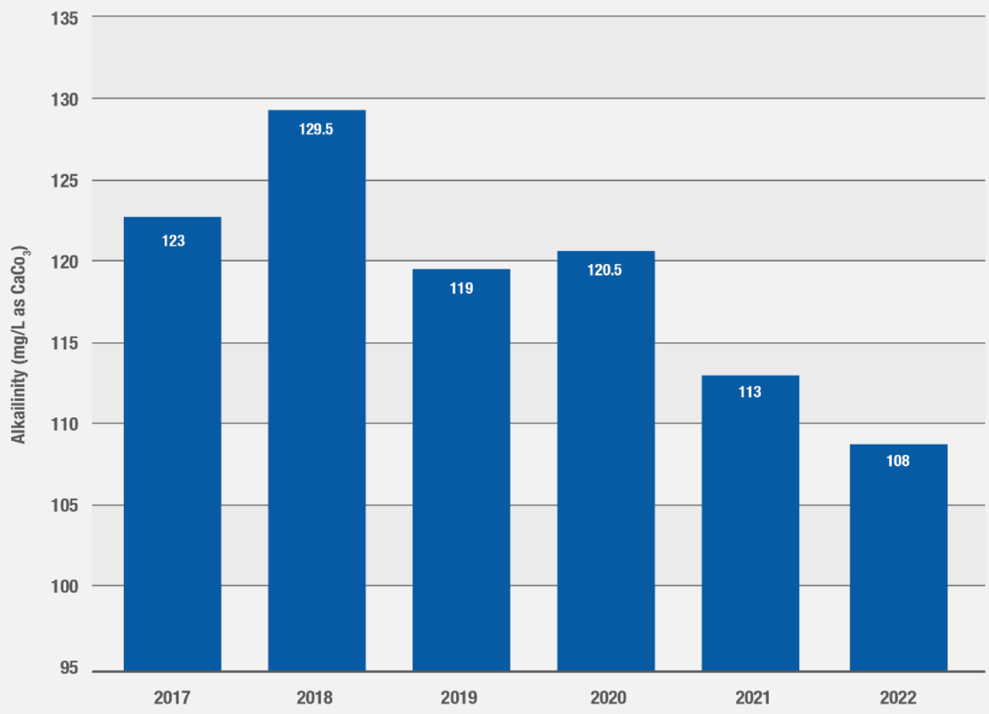


Figure 5.8 – Lake Ray Roberts WTP Maximum Influent Alkalinity

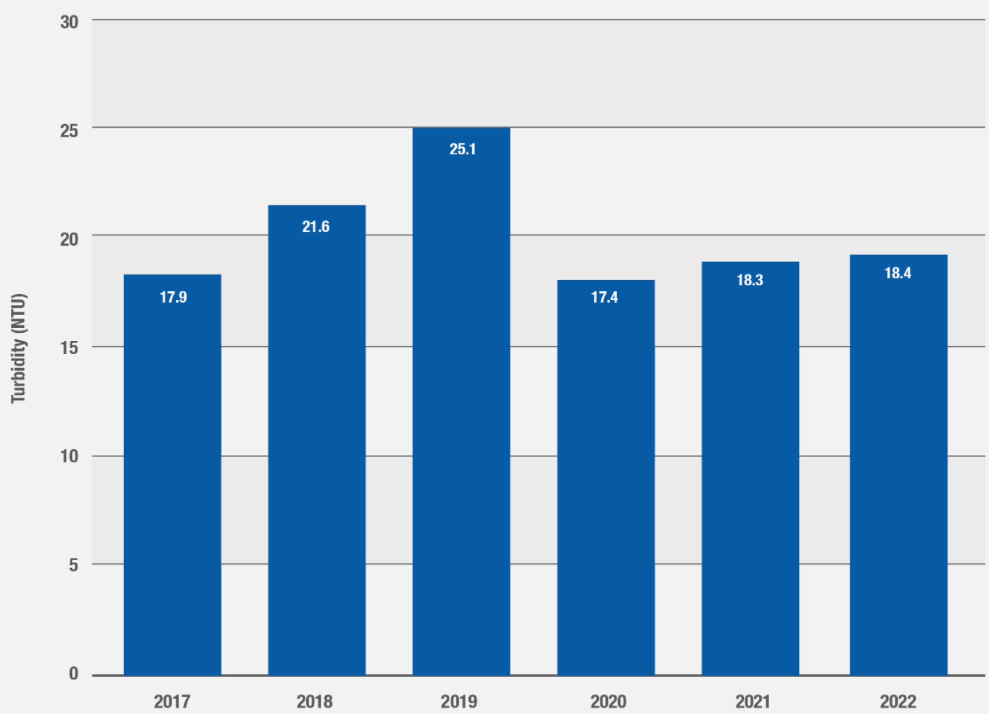


Figure 5.9 – Lake Ray Roberts WTP Maximum Influent Turbidity

5.2 REGULATORY REVIEW

The United States Environmental Protection Agency (US EPA) and TCEQ are the regulatory bodies responsible for implementing regulations that apply to the City. The US EPA sets national standards and guidelines for water quality, treatment processes, and monitoring. TCEQ works in partnership with the US EPA to enforce federal regulations and establish their own requirements to address state specific needs. Both agencies continuously review and update regulations to address emerging issues and protect public health, including setting Maximum Contaminant Levels (MCLs) and monitoring emerging contaminants. Understanding current and potential future regulations are important considerations for the WTPs.

5.2.1 TCEQ REQUIREMENTS

Chapter 290 of the Texas Administrative Code (TAC), “Public Drinking Water”, written by TCEQ mandates the minimum and goal requirements for water treatment plants and water systems in the State of Texas. Because of the water treatment and disinfection capabilities at the Lake Ray Roberts and Lake Lewisville WTPs, the City has been designated as a “Superior Public Water System” by the State of Texas. The following sections discuss a few of the major regulatory considerations for the WTPs.

5.2.2 MAXIMUM CONCENTRATION LEVELS

Maximum Contaminant Levels (MCLs) are regulatory standards set by TCEQ and US EPA that determine maximum concentrations of specific constituents in the WTP effluent. Additionally, there are Maximum Contaminant Level Goals (MCLGs) that are established by TCEQ and US EPA. An MCLG is the non-enforceable level at which no known or adverse effects on the health of persons are anticipated to occur and which allows for an adequate margin of safety. It does not account for limits of detection and treatment technology effectiveness. An enforceable MCL is set as close as feasible to the MCLG (taking costs and benefits into consideration).

5.2.3 EMERGING CONTAMINANTS AND REGULATORY CHANGES

Emerging contaminants are substances that are not currently regulated by TCEQ but are being studied due to their potential impact on human health and the environment. These contaminants include constituents such as pharmaceutical drugs and synthetic chemicals. Specifically, per- and polyfluoroalkyl substances (PFAS) and lead-copper rule are two of the most impactful regulatory updates expected. In addition, the Fifth Unregulated Contaminant Monitoring Rule (UCMR 5) requires the collection of samples from public water systems for 30 chemical contaminants between 2023 and 2025. The data will inform future regulations and actions to protect public health under the Safe Drinking Water Act.

5.2.3.1 PFAS

In April of 2024, the EPA established the first-ever enforceable limits for certain PFAS chemicals in drinking water. These regulations set Maximum MCLs and MCLGs for various PFAS substance groups in drinking water. The MCLs and MCLGs for the various PFAS substance groups are listed in **Table 5.2**.

Table 5.2 – PFAS MCLs and MCLGs

Compound	MCLG	MCL
PFOA	Zero	4.0 parts per trillion (ppt)
PFOS	Zero	4.0 ppt
PFHxS	10 ppt	10 ppt
PFNA	10 ppt	10 ppt
HFPO-DA (Gen X)	10 ppt	10 ppt
Mixture of two or more: PFHxS, PFNA, HFPO-DA, and PFBS	Hazard Index of 1 (unitless)	Hazard Index of 1 (unitless)

Public water systems will have three (3) years, 2024-2027, to begin monitoring for the compounds, and five (5) years, 2029, to be in compliance with the MCLs. The EPA did not specify which treatment technologies would need to be used to remove these compounds, but instead left it up to the Utility to determine the best solution for their plants. Three technologies that EPA lists as options for removal of PFAS substances are GAC, reverse osmosis, and ion exchange systems.

With this update, monitoring will occur at each entry point to the distribution system. The frequency of sampling would consist of four times per year for surface water systems or use of existing PFAS drinking water occurrence data. Water systems will be required to notify customers within 30 days if there is an exceedance on the MCLs. Sampling results will be included in the consumer confidence reports that are released annually by public water systems.

Kimley-Horn recommends starting PFAS sampling and monitoring, with a plan to address any findings.

5.2.3.2 Lead-Copper Rule

The lead-copper rule for drinking water is an important regulation that is currently being revisited by US EPA. The upcoming regulations are expected to be finalized before October 16, 2024, and they aim to strengthen the existing regulations and address the challenges associated with lead and copper in drinking water. The US EPA is considering the following proposed updates:

- Increasing the frequency and accuracy of sampling requirements.
- Lowering action levels.
- Improving public notice procedures when there are excess contaminant levels.
- Enhancing corrosion control treatment.

5.2.4 DIRECT POTABLE REUSE

Direct potable reuse (DPR) is a promising solution to address potential water supply shortages in the future. It involves treating wastewater effluent to a high standard and then directly supplying it to a WTP for further treatment before distribution. As DPR gains traction, US EPA and TCEQ are actively working on developing guidelines and regulations to ensure the effectiveness and safety of DPR systems. These regulations would establish standards for water quality, treatment processes, monitoring, and reporting to protect public health and ensure the reliability of DPR as a sustainable water source.

Specifically, TCEQ has set minimum log removal value (LRV) treatment levels for DPR of 5.5-log Cryptosporidium oocysts, 6-log removal or inactivation of Giardia cysts, and 8-log removal or inactivation of viruses. These increased values are compared to the current TCEQ rule found in §290.42(d)(1) which consists of a 2-log removal of Cryptosporidium oocysts, a 3-log removal or inactivation of Giardia cysts, and a 4-log removal or inactivation of viruses before the water is supplied to any consumer. These requirements are to ensure the concentration of pathogens in the drinking water is below harmful levels. Approval for DPR is a case-by-case approach in which TCEQ authorizes based on specific plant and source water quality data. Each DPR exception sets site-specific design, operation, maintenance, and reporting requirements for the selected treatment as specified in 30 TAC 290.39(l)(4).

Should the City choose to diversify its water supply portfolio through DPR in the future, several factors may be considered to meet the outlined TCEQ & EPA regulations:

- The DPR facility must have at least one operator that holds a Class B Surface Water Operator License.
- Treatment must include at least two physical/removal processes and two inactivation or oxidation processes.
- Common treatment technologies used in DPR facilities include:
  - Physical Removal
    - Biological Filtration (BAF)
    - Membrane Treatment
      - Microfiltration
      - Ultrafiltration
      - Reverse Osmosis
  - Inactivation/Oxidation
    - Chlorination/Chloramination
    - Ultraviolet (UV)
    - Ozonation

Additional information and descriptions on treatment technologies can be found in **Section 5.3**. It is important to note that the selection of treatment technologies for a DPR project depends on influent water quality parameters, and TCEQ requires a pilot-scale study of the selected treatment units before approval for DPR can be given. The City does plan to complete a pilot-scale study within the next 5 years, as shown in the Capital Improvement Plan (see **Section 6.2**).

5.3 TREATMENT PROCESS

Treatment process selection is important for WTP expansion site planning. This section discusses the advantages and disadvantages to any existing or potential future treatment technology.

5.3.1 CONVENTIONAL VS MEMBRANE TREATMENT

In the context of water treatment process selection for WTP expansion site planning, the two water purification methods discussed are conventional treatment and membrane treatment.

5.3.1.1 Conventional

Conventional treatment consists of coagulation, flocculation, sedimentation, and filtration. These methods are used to remove particles and impurities from the water, improving its overall quality. Conventional treatment is currently used at both WTPs. However, it is not as effective as membrane treatment at removing certain contaminants like dissolved salts, PFAS, and organic compounds. Additionally, more advanced treatment technologies should be considered if DPR will be used. Typically, conventional water treatment basins are larger when comparing to membrane treatment. Disinfection can occur at various steps within the treatment process.

5.3.1.2 Membranes

Nanofiltration and Reverse Osmosis (RO) are considered “high-pressure membranes”. Nanofiltration and RO membranes can remove nearly all bacteria and humic substances due to pore sizes down to 0.001 microns. Because of this physical separation, membranes can help minimize disinfection bioproducts like trihalomethanes and haloacetic acids because they reduce organic material. Ceramic membranes have shown removal of iron and manganese without the need for pretreatment chemicals. These factors cause RO to provide a higher level of purification compared to conventional treatment.

Microfiltration and Ultrafiltration membranes are considered “low-pressure membranes”. Microfiltration and Ultrafiltration membranes will remove nearly all Cryptosporidium oocysts, Giardia cysts, and receive the regulated 2-log removal of viruses. These membranes will not remove dissolved solids and PFAS unlike the high-pressure membranes but require less pre-treatment and power when compared to the high-pressure membranes.

Membranes require a significant amount of energy for operation due to the high-pressure differential needed to force water through the membrane. Additionally, increased pre-treatment is required for membranes to optimize its performance and protect the membranes from fouling. Disinfection cannot occur before the membranes.

Due to the reduced footprint and higher quality effluent, the City is planning to implement membrane treatment for any future improvements at either WTP. Since membrane treatment produces a higher quality effluent, this would provide a step towards a multi-barrier approach to meet the DPR regulations outlined in **Section 5.2.4** should the City choose to move forward with DPR in the future.

5.3.2 DISINFECTION

Disinfection is a critical step in the treatment process to ensure the removal of harmful pathogens and the provision of safe drinking water. Common disinfection methods include chlorination, chloramination, ozone, and UV disinfection. The selection of the appropriate disinfection method should consider factors such as the target pathogens, water quality, and regulatory requirements.

Chlorination involves the addition of chlorine or chlorine compounds to the water to kill microorganisms. It effectively kills a broad spectrum of microorganisms and can provide the TCEQ-required chlorine residual. However, chlorination can react with organic materials in the water, leading to the formation of disinfection byproducts (DBPs). These DBPs can have taste and odor implications.

Chloramination, a combination of chlorine and ammonia, is also used for disinfection and provides a more persistent residual disinfectant and reduces the formation of certain DBPs compared to chlorination alone. It also typically results in minimized taste and odor. However, chloramination requires careful control of the chlorine and ammonia ratio to reduce formation of di and tri-chloramines and may promote nitrification in the distribution system.

Ozone utilizes oxygen composed of three oxygen atoms (O_3) for disinfection. Ozone effectively inactivates a broad spectrum of microorganisms by oxidation. Additionally, ozone doesn't impart a taste or odor to the treated water. However, ozone has a shorter residual life in water compared to chlorine or chloramines, making it less effective for continued disinfection within the distribution network. Therefore, ozone is often used as a primary disinfectant followed by a residual disinfectant like chlorine or chloramines to ensure ongoing protection throughout the water delivery system. Both WTPs use a combination of ozone and chloramines for disinfection.

UV disinfection utilizes ultraviolet light to inactivate microorganisms by damaging their DNA. It is not utilized often for water treatment in Texas due to TCEQ’s requirement for a minimum chlorine residual in the treated effluent. Because of this, UV disinfection is not normally recommended. However, DPR influent water quality may require a combination of UV and ozonation which is needed for advanced oxidation processes. UV in combination with ozone produces highly reactive hydroxyl radicals (OH-) which effectively oxidize and break down microorganisms and other contaminants.

5.3.3 SOLIDS HANDLING

Belt filter presses use two semi-permeable belts on a series of rollers that squeeze water through the belts as they rotate around rollers. Polymer is mixed into the sludge before it enters the press. Typically, there is a gravity thickening upstream of the belt filter presses, which is recommended for application at the WTPs. Belt filter presses normally have a small 5-10 hp motor, require backwash water to clean the belts after each use, generally require an operator to be present during dewatering, and require more polymer than centrifuges to operate.

Centrifuges use two chambers that spin at different speeds to use centrifugal force to separate water from solids. Centrifuges are completely enclosed, and they do not require an operator to be present during dewatering. The water content of the solids exiting a centrifuge is typically 10-15% lower that belt filter presses which decreases hauling costs. The two motors on a centrifuge are usually 150-200 hp which can significantly increase electricity cost.

5.4 PROPOSED TREATMENT CAPACITY

As outlined in **Table 4.12**, required treatment capacity per TCEQ criteria is based on providing 0.6 gpm per connection or meeting MDD, whichever is higher. **Table 5.3** summarizes required capacity per planning period.

Table 5.3 – TCEQ Analysis (Treatment)

Planning Period	Connection Count	Req'd by Connections[1] – TCEQ (MGD)	Req'd by MDD – TCEQ (MGD)[2]	TCEQ Req'd (MGD)
Existing	53,840	47	48	48
5-Year	76,523	68	67	68
10-Year	90,107	82	80	82
25-Year	116,810	108	104	108

[1]*Projected number of connections per planning period are outlined in* **Table 4.13,** *includes wholesale*
[2]*Projected MDD per planning period is outlined in* **Table 4.7**

The City plans to significantly expand the Lake Ray Roberts WTP over the next 25 years to meet TCEQ requirements and serve projected demand. The only planned improvements at the Lake Lewisville WTP include a rehabilitation to increase the operational capacity from 28 MGD back to the rated capacity of 30 MGD. **Table 5.4** outlines the future WTP capacity based on planned improvements per planning period. The future WTP capacity compared to the TCEQ required capacity per year is shown in **Figure 5.10**.

Table 5.4 – WTP Improvements per Planning Period

	Existing Capacity (MGD)	5-Yr Capacity (MGD)	10-Yr Capacity (MGD)	25-Yr Capacity (MGD)
Lake Ray Roberts	20	50[1]	60[3]	80[4]
Lake Lewisville	28	30[2]	30	30
Total	**48**	**80**	**90**	**110**

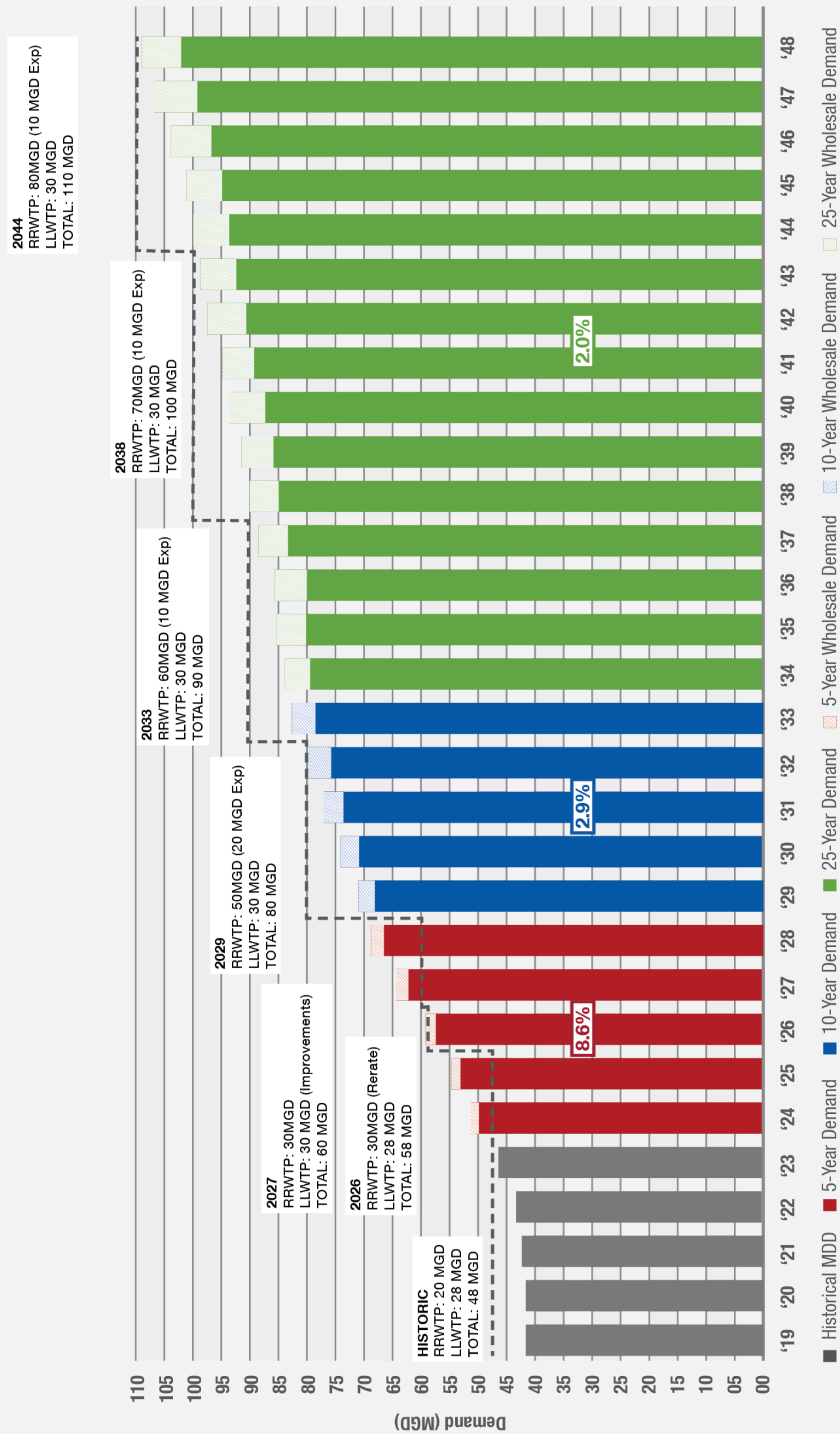
[1]*Includes rerate to 30 MGD plus 20 MGD expansion to 50 MGD*
[2]*Rehabilitation to rated capacity of 30 MGD*
[3]*10 MGD expansion to 60 MGD*
[4]*Includes 10 MGD expansion to 70 MGD and 10 MGD expansion to 80 MGD*

Within the 5-year planning period, the City is planning to complete the Lake Ray Roberts WTP rerate to 30 MGD and subsequently expand it to 50 MGD. This will be implemented alongside the rehabilitation of the Lake Lewisville WTP back to its permitted 30 MGD capacity.

The City does not plan to complete any additional improvements at the Lake Lewisville WTP beyond the rehabilitation within the 25-year planning period. However, additional improvements may be identified once a condition assessment has been completed. If significant improvements are required several options may be considered at the Lake Lewisville site (see **Section 5.5.2**).

This report documents the City's current plan to meet future demand by expanding the Lake Ray Roberts WTP over the 25-year planning period with minimal improvements at the Lake Lewisville site. Although some options for the Lake Lewisville site are discussed in **Section 5.5.2**, the only projects in the Capital Improvement Plan (CIP) are the expansions at the Lake Ray Roberts WTP and rehabilitation at the Lake Lewisville WTP (**Section 6.2)**. The outlined improvements at the Lake Ray Roberts WTP are discussed in detail in **Section 5.5.3**.

Figure 5.10 – Existing and Proposed WTP Capacity



5.5 FACILITIES SITE DEVELOPMENT

5.5.1 LAKE LEWISVILLE WTP REHABILITATION

As discussed in **Section 5.4**, the City is planning to significantly expand the Lake Ray Roberts WTP to serve future development. The only planned improvement at the Lake Lewisville WTP is to increase the operational capacity from 28 MGD back to the rated capacity of 30 MGD. However, Kimley-Horn recommends the City also conduct a comprehensive condition assessment on the existing plant infrastructure to identify any additional improvements required to keep the plant in service through the 25-year planning period. The assessment will include a thorough evaluation of the existing equipment and facilities to determine their current condition and identify any additional areas of concern. This comprehensive assessment will catalog the condition of the plant's aging infrastructure and provide data-driven recommendations for its future.

The existing operational limitations for the Lake Lewisville WTP are caused by hydraulic issues at the filters and caustic mixing structure, which are bottlenecking the other operations at the WTP. The hydraulic issues at the filters were presented by City staff at the site visit that occurred in 2023. City staff indicated that flooding through the floor drains occurs in the filter gallery during high flows due to the floor drains begin connected to the backwash waste lines. City staff also indicated issues with the ability to thicken sludge properly which limits solids handling production. The lagoon west of the WTP is utilized as temporary sludge storage during high flow scenarios.

The rehabilitation of the Lake Lewisville WTP will focus on the identified findings of the proposed condition assessment. In addition, the rehabilitation will need to include the following processes:

- Improvement of filter backwash operations and volume. Based on discussions with City staff, the WTP is limited to backwashing one filter at a time. Improvements in backwash operations and volume will allow the backwash of multiple filters simultaneously.
- Additional dewatering capacity. This will likely include additional gravity thickening and belt presses.

5.5.2 LAKE LEWISVILLE WTP IMPROVEMENTS

Given its proximity to the Pecan Creek Water Reclamation Plant, implementing DPR at the Lake Lewisville site would require significantly less conveyance infrastructure than implementing DPR at the Ray Roberts site. However, due to the requirements outlined in **Section 5.2.4**, significant upgrades would be required at the Lake Lewisville site to implement DPR. Depending on the results of the condition assessment and the City's timeline for DPR implementation, the City may choose to evaluate several options at the Lake Lewisville site.

The City recently acquired the pond area adjacent to the existing Lake Lewisville WTP site. The pond can be drained and developed to provide additional acreage for flexibility in future improvements. Any of the options presented below would equip the WTP with membrane treatment technology, allowing for DPR implementation in the future.

If the condition assessment results indicate most existing infrastructure is at the end of its useful life, it may be more economical to abandon or demolish the existing WTP and construct a 30 MGD (or more) membrane facility over the pond area. The construction could occur while the existing WTP remained in service. Once the new facility was constructed, the existing WTP could be demolished to make room for future improvements.

If the condition assessment results indicate most existing infrastructure has a significant remaining useful life, two additional options have been outlined that would preserve some of the existing infrastructure. Both options would need to occur after Lake Ray Roberts WTP capacity has been expanded and allow portions of Lake Lewisville WTP to be taken out of service while maintaining adequate water supply to customers. The following options for the Lake Lewisville WTP improvements are:

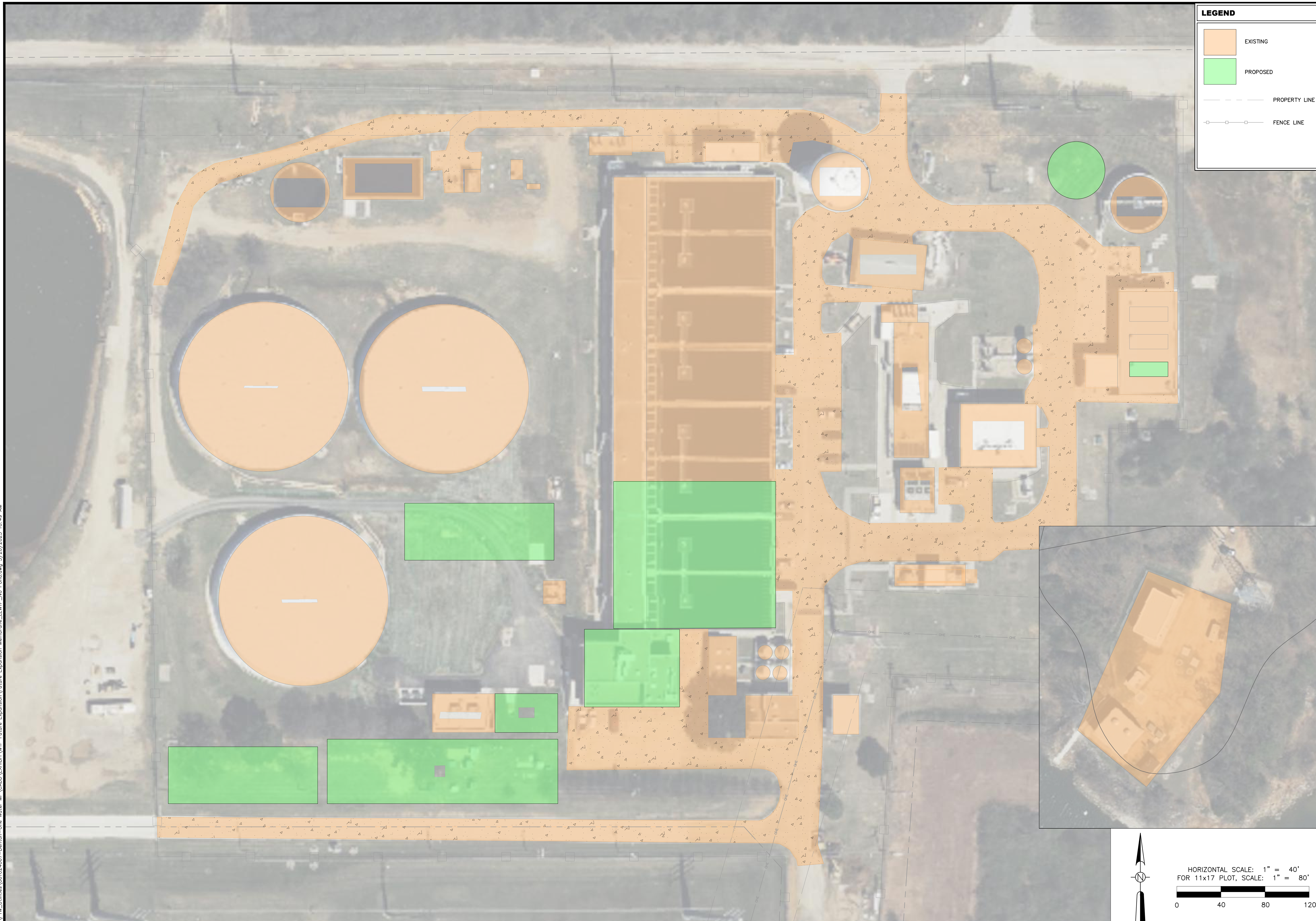
- **Option 1** would utilize portions of the existing WTP and require partial demolition of treatment units to make room for membrane technology improvements.
- **Option 2** would allow the majority of the WTP to remain in service while membrane technology improvements were being constructed in the area of the existing pond west of the WTP that the City recently acquired.

More details on the options and a planning level site plan for each are shown below.

5.5.2.1 Lake Lewisville WTP Membrane Improvements - Option 1

Starting from the beginning of the process, the existing high service pump station and operations building would be demolished, and pre-ozone contactors would be constructed in its place. Next, some of the filters, flocculation basins, and sedimentation basins would be demolished and replaced with a membrane filtration building. The remaining flocculation and sedimentation basins and filters could serve as pretreatment for the membranes and/or as the first step in membrane concentrate processing. From there, the membrane concentrate would be pumped to the existing and new gravity thickeners before being further processed by the existing and new belt filter presses. After disinfection and chemical addition, the treated water would be pumped through the new transfer pump station to the existing clearwells for storage. The future transfer pump station will help solve the existing hydraulic, chemical mixing, and storage challenges the WTP currently faces. From there, the new high service pump station will distribute the treated water through the transmission mains. Ancillary additions include a new administration building, additional electrical building, and additional liquid oxygen storage. A potential site layout for rehabilitation, partial demolition, and construction of membrane treatment at the existing WTP is shown in **Exhibit L – Lake Lewisville WTP Option 1**.

Option 1 would not require the use of the existing pond acreage located west of the existing WTP. This area of the site could be reserved for future improvements.



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No.	Revision	By	Date

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CITY OF DENTON WATER MASTER PLAN

EXHIBIT L - LAKE LEWISVILLE WTP OPTION 1

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5.5.2.2 Lake Lewisville WTP Membrane Improvements - Option 2

Option 2 takes advantage of the existing pond acreage and its proximity to the WTP, allowing for greenfield construction of a new membrane facility while keeping the existing plant in operation. This option would involve abandoning the existing operations and high service pump station building, flocculation and sedimentation basins, and chemical building. It would include construction of a new admin building, pre-ozone contactors, membrane building, maintenance building, transfer pump station, and a new high service pump station. Additional solids handling equipment, such as an additional gravity thickener and belt filter press, would also be constructed. Ancillary infrastructure would include construction of roads, parking lot, chemical storage, and electrical building. A potential site layout for utilizing the existing pond as the location of Option 2 is shown in **Exhibit M – Lake Lewisville WTP Option 2**.

Once the new membrane facility is fully operational, the rapid mix basins, flocculation and sedimentation basis, filters, and old HSPS can be taken offline and/or demolished. If the units are demolished, the additional acreage could be reserved for future improvements.

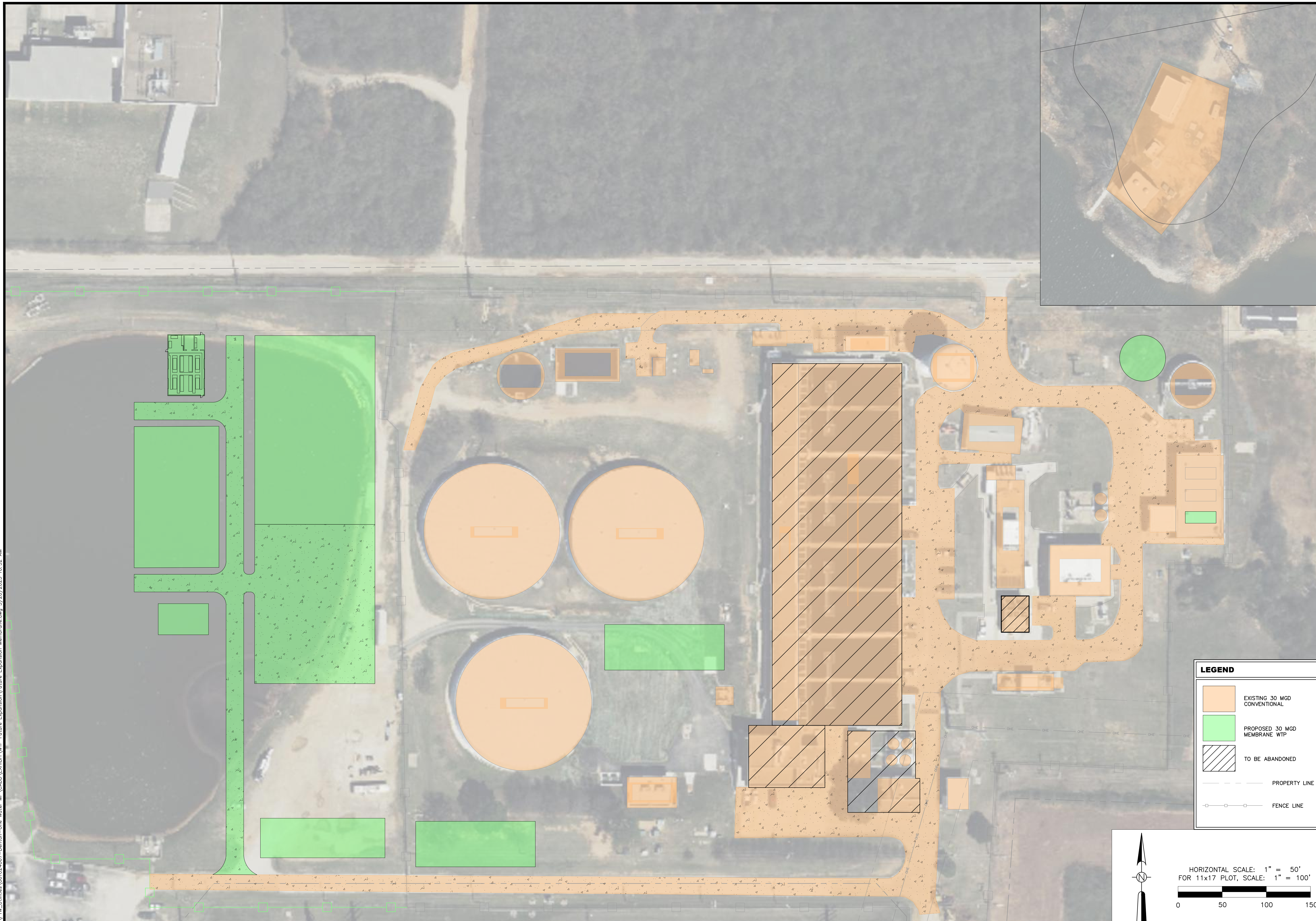

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EXHIBIT M - LAKE LEWISVILLE WTP OPTION 2

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5.5.3 LAKE RAY ROBERTS WTP EXPANSION

The Lake Ray Roberts WTP will be the primary location for the planned increase in water treatment capacity for the City. This WTP was selected due to the amount of undeveloped land at the site already owned by the City. The phasing of the building and treatment facility footprints for the 25-year planning period at the Lake Ray Roberts WTP is shown in **Exhibit N – Lake Ray Roberts WTP Expansion North** and **Exhibit O – Lake Ray Roberts WTP Expansion South**.

The Lake Ray Roberts WTP expansion includes the construction of pre-ozone contactors, membrane buildings, intermediate ozone contactors, transfer pump station, filters, and membrane concentrate dewatering facility along with ancillary infrastructure such as roads, parking lot, chemical storage, washwater reclamation basin, emergency generators, ozone building, maintenance building, and electrical building. In addition, new flocculation and sedimentation basins would be constructed to serve as pretreatment for the membranes and/or as the first step in membrane concentrate processing. A new influent pipeline is also recommended for additional capacity to the plant and to add redundancy.

As discussed in **Section 5.4**, the Lake Ray Roberts WTP is currently undergoing a rerate to increase the rated capacity from 20 MGD to 30 MGD. Additionally, the City is finalizing a design contract for the first phased expansion of the Lake Ray Roberts WTP for an additional 20 MGD. The project phasing for the incremental expansion at the Lake Ray Roberts WTP is listed in **Table 5.5**.

Table 5.5 – Lake Ray Roberts WTP Expansion Projects

Additional Treatment Capacity (MGD)	Projected Project Start Date	Expansion Commission Date
20	2024	2029
10	2028	2033
10	2033	2038
10	2039	2044

Because the existing conventional treatment operates differently than membrane filters, different pretreatment methods could be required between the two trains. The disinfection process should not be affected by different treatment types, but the solids handling would operate differently when dewatering solids from sedimentation basins and membrane concentrate.

The Lake Ray Roberts WTP uses sludge lagoons for dewatering. Mechanical solids handling is recommended for the expansion because the existing sludge lagoons will not support the proposed expansions. Construction of additional sludge lagoon capacity for the expansion is not feasible with the current acreage at the WTP.

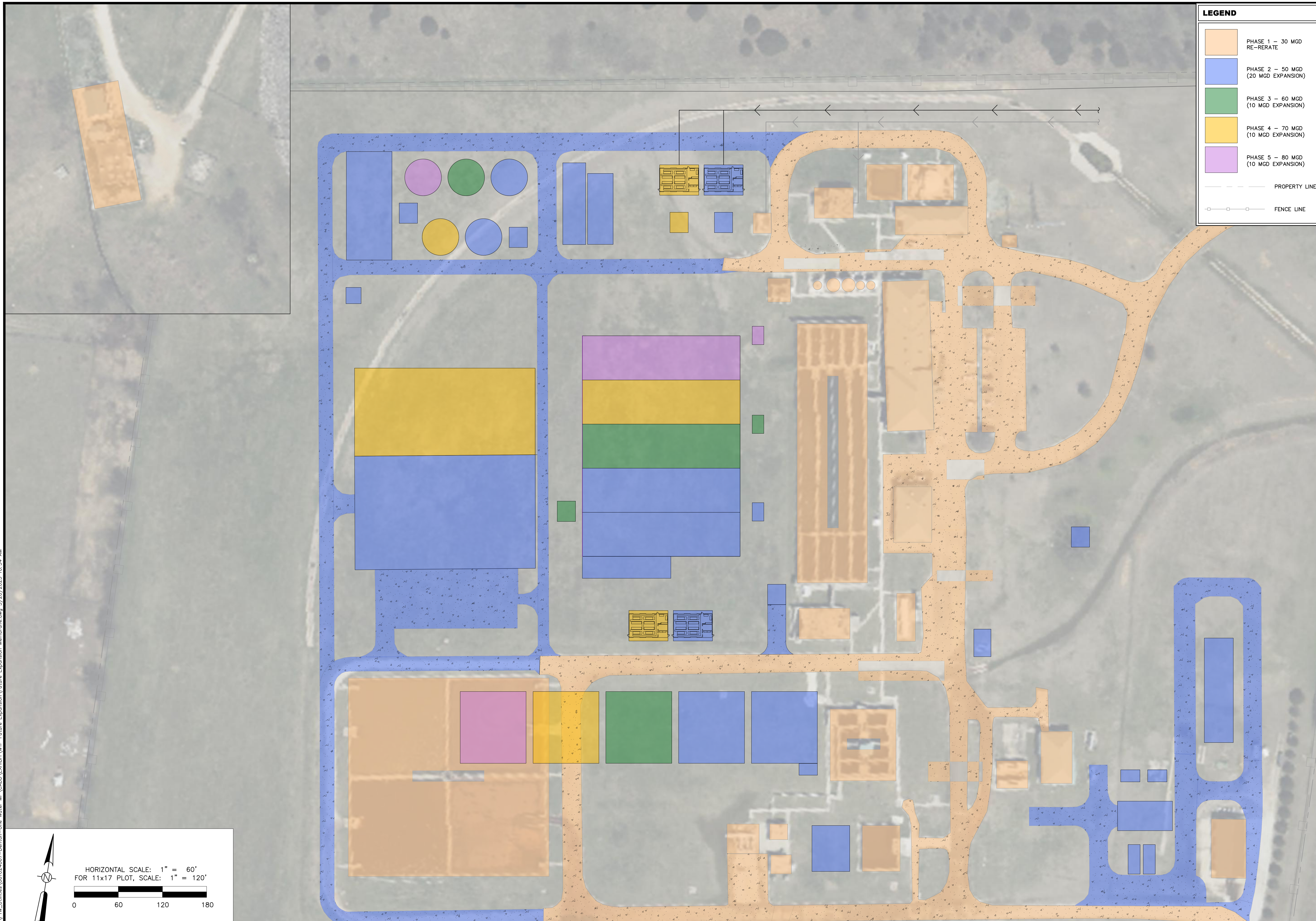

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EXHIBIT N - LAKE RAY ROBERTS WTP EXPANSION NORTH

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No.	Revision	By	Date

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CITY OF DENTON WATER MASTER PLAN

EXHIBIT O - LAKE RAY ROBERTS WTP EXPANSION SOUTH

DATE:	AUGUST 2024
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CHAPTER 6

WATER CAPITAL IMPROVEMENT PLAN

6.1. FUTURE WATER SYSTEM

As discussed in **Section 4.3.3**, significant facility improvements are proposed over the next 25 years to satisfy City and TCEQ design criteria. Additionally, future conveyance infrastructure was identified to serve future development throughout the City and satisfy City sizing criteria. The hydraulic model was set up with the 5-year, 10-year, and 25-year scenarios in accordance with the planned CIP. The hydraulic model was loaded with water demands in accordance with the growth and loading criteria described in **Sections 3.2** and **4.1** and analyzed in accordance with the design criteria described in **Section 4.3.2**.

6.1.1. CONVEYANCE PHASING METHODOLOGY

The phasing of proposed infrastructure was informed by the following considerations:

- TCEQ design criteria for pumping capacity, elevated storage, and total storage (See **Section 4.3.3**)
- Phasing of known developments (See **Section 3.2.1**)
- System operations (See **Section 4.3.4**)

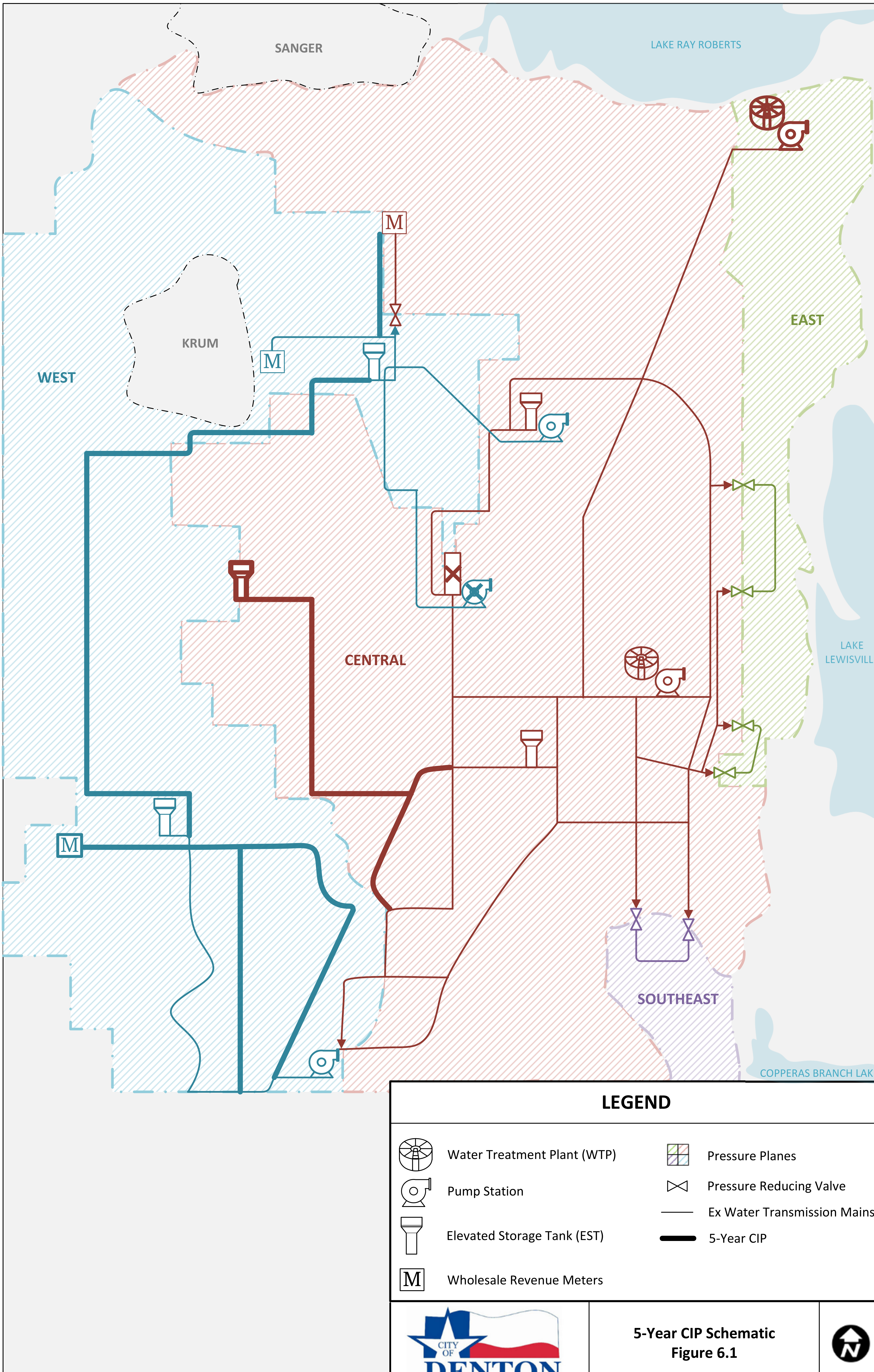
For individual project phasing information, see the detailed project descriptions in **Appendix C – Opinion of Probable Construction Costs**.

6.1.2. PROPOSED WATER SYSTEM MODIFICATIONS

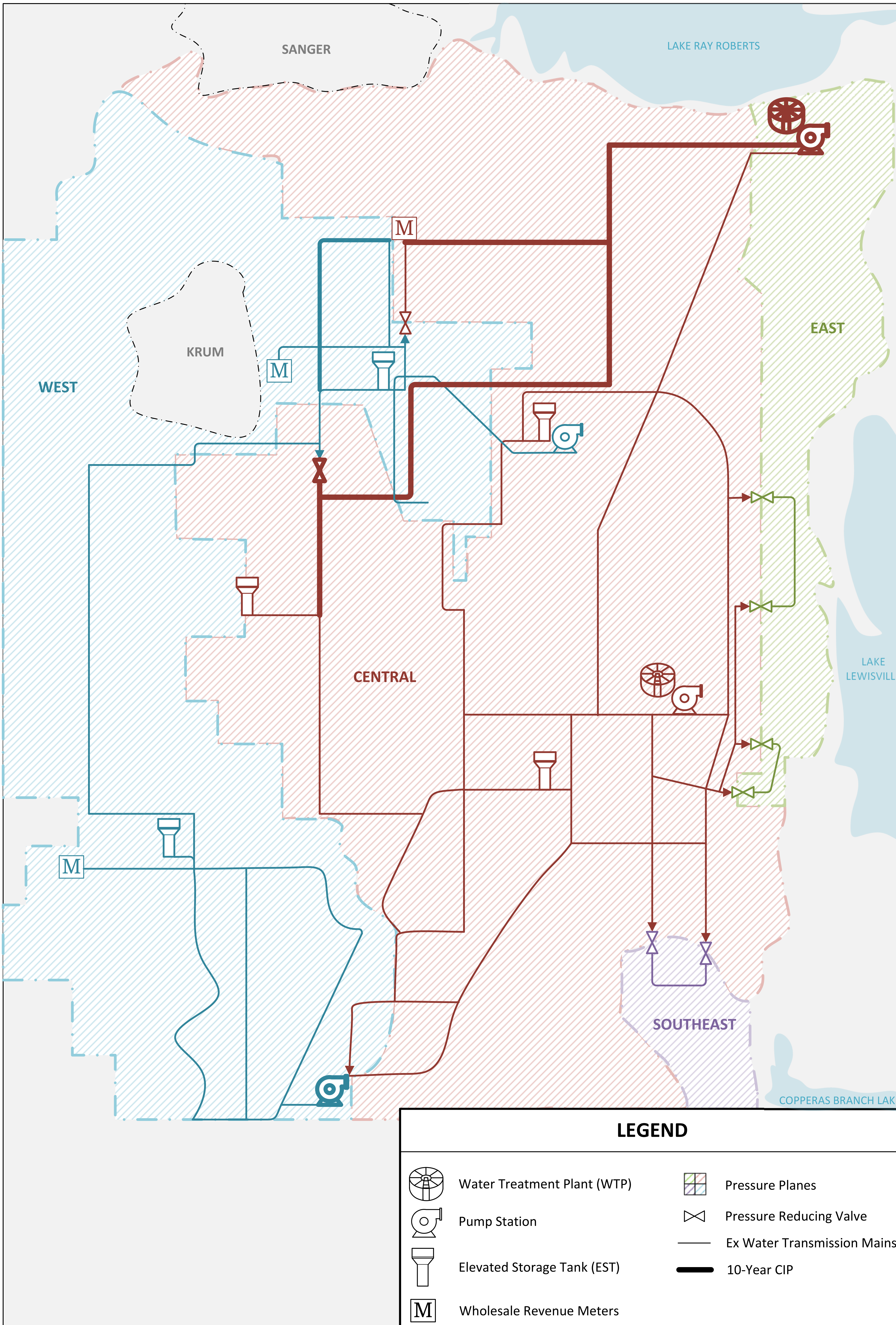
The proposed infrastructure in the 5-Year CIP will produce systematic changes to the Denton Water System including an expansion of Lake Ray Roberts WTP and High Service Pump Station, connection of the Northwest and Southwest pressure planes to form the West Pressure Plane, and construction of the Jim Christal EST. **Figure 6.1** provides a schematic of major systematic changes in the 5-Year CIP.

The proposed infrastructure in the 10-Year CIP will produce systematic changes to the Denton Water System in the Central Pressure Plane including an additional expansion to Lake Ray Roberts WTP and High Service Pump Station, and construction of a second transmission main from Lake Ray Roberts WTP. In the West Pressure Plane, the Southwest Booster Pump Station will be expanded with additional ground storage and pump replacements. **Figure 6.2** provides a schematic of major systematic changes in the 10-Year CIP.

The proposed infrastructure in the 25-Year CIP that will produce systematic changes to the Denton Water System in the Central Pressure Plane includes an expansion of the Lake Ray Roberts WTP and High Service Pump Station. In the West Pressure Plane, pumping capacity will increase by filling the final pump slot at the Northwest Booster Pump Station and constructing the Jim Christal Pump Station. **Figure 6.3** provides a schematic of major systematic changes in the 25-Year CIP.



5-Year CIP Schematic
Figure 6.1



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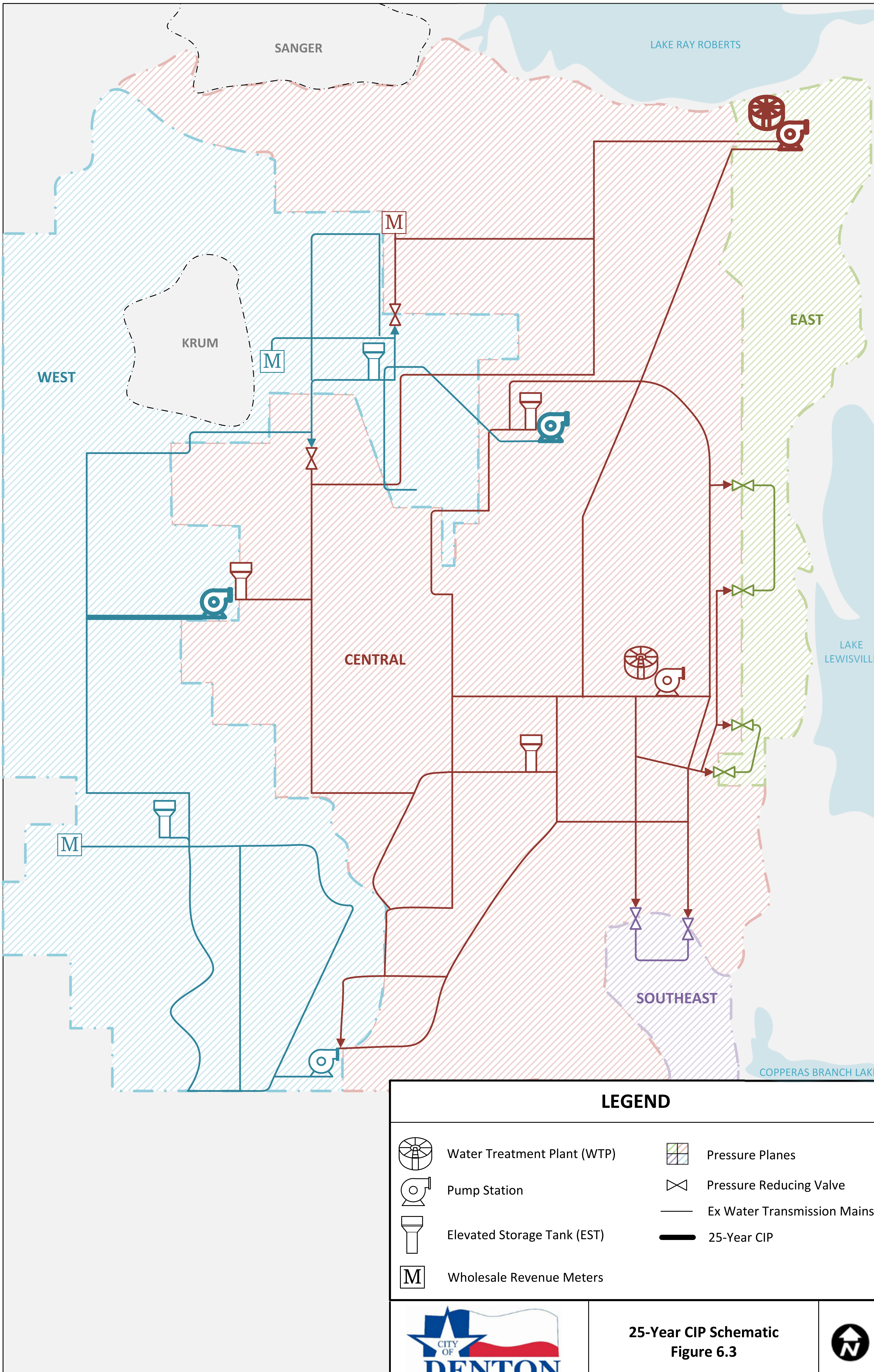
10-Year CIP Schematic
Figure 6.2



25-Year CIP Schematic
Figure 6.3

6.2. CAPITAL IMPROVEMENT PLAN

The Capital Improvement Plan (CIP) is divided into three sections: 5-Year, 10-Year, and 25-Year. Projects shown may need to be accelerated or deferred depending on newly proposed developments or the overall growth rate experienced in each pressure plane. All proposed projects are shown in **Exhibit P – Capital Improvement Plan**. The projects displayed per pressure plane are shown in **Exhibit Q – Capital Improvement Plan per Pressure Plane**.

The project priority, name, and total cost is listed in **Tables 6.1, 6.2,** and **6.3** for the 5, 10 and 25-year planning periods, respectively. For each project, individual project descriptions and detailed costs have been included in **Appendix C – Opinion of Probable Construction Costs (OPCC)**. The unit pricing used in the OPCCs was determined based on industry standards, City staff input, and construction bid tabs from recent projects. Unit pricing is also included in **Appendix C**. The opinion of probable costs for each capital project assumes no design completed, is based on dollar amounts from 2024, and does not include annual construction cost increases. Several funding mechanisms may be used to construct the projects included in the CIP, including but not limited to impact fees, cost shares, or developer funding.

Table 6.1 – 5-Year CIP Projects

Project No.	Project Name	Project Cost
1	Lake Ray Roberts WTP Rerate to 30 MGD	Funded
2	Lake Lewisville WTP Rehabilitation	TBD[1]
3	Lake Ray Roberts WTP 20 MGD Expansion to 50 MGD	$195,845,000
4	24" Robson Ranch Transmission Main	$16,055,000
5	16" Northwest I-35 Frontage Rd Water Line	$4,524,000
6	Roselawn EST Rehabilitation	$3,780,000
7	Northwest Pressure Plane Swap	N/A
8	24" Tom Cole Rd Transmission Main	$30,206,000
9	42" Jim Christal EST Transmission Main	$12,345,000
10	Jim Christal 3.0 MG EST	$20,527,000
11	McKenna Park Standpipe and Pump Station Demolition	$500,000
12	12" Underwood Rd Water Line	$3,393,000
13	12" Cole Ranch Water Line	$9,469,000
14	16" C Wolfe Rd Water Line	$6,488,000
15	36" I-35W Transmission Main	$31,336,000
16	24/30" West Allred Rd Transmission Main	$29,952,000
17	16" Ponder Water Line	$4,303,000
18	16/30" Rosebrook/Sanctuary Transmission Main	$53,142,000
19	24" Rosebrook Transmission Main	$9,419,000
20	24" North/South Transmission Main	$26,281,000
21	12" Old Stoney Rd Water Line	$2,582,000
22	12" Rosebrook Water Line	$5,981,000
23	12" Cooper Creek Rd Water Line	$14,862,000
24	12" N Mayhill Rd Water Line	$3,044,000
25	12" Duchess Dr Water Line	$2,205,000
26	12" Shady Oaks Dr Water Line	$3,067,000
27	12/16" US 380 Water Line	$9,594,000
28	12" Stuart Ridge Water Line	$4,846,000
29	Lake Ray Roberts HSPS Improvements Phase 1	$5,530,000
	5-Year Projects Subtotal:	**$509,276,000**

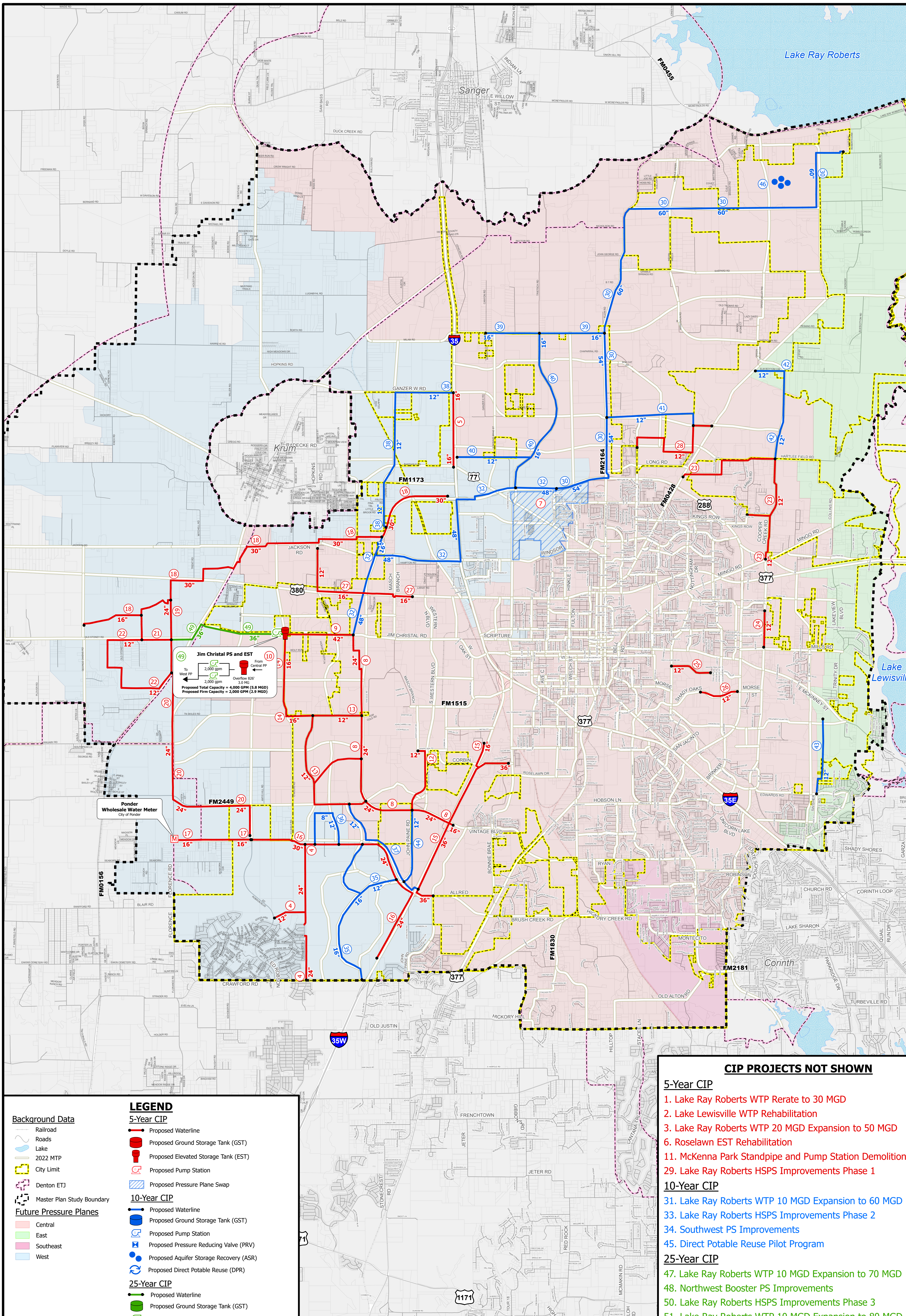
[1]Cost to be determined once condition assessment is complete, see **Section 5.5.1**

Table 6.2 – 10-Year CIP Projects

Project No.	Project Name	Project Cost
30	Lake Ray Roberts WTP 54/60" Transmission Main	$118,639,000
31	Lake Ray Roberts WTP 10 MGD Expansion to 60 MGD	$97,922,500
32	48" Loop 288 Transmission Main	$64,555,000
33	Lake Ray Roberts HSPS Improvements Phase 2	$5,530,000
34	Southwest PS Improvements	$10,087,000
35	12/16" Hunter Ranch Water Line	$9,374,000
36	12" Hunter Ranch Water Line	$2,864,000
37	12" Central Allred Rd Water Line	$6,063,000
38	12" Northwest Water Line	$13,304,000
39	16" Milam Rd Water Line	$9,968,000
40	16" North Central Water Line	$11,902,000
41	12" N Locust Rd to E Sherman Dr Water Line	$3,959,000
42	12" North Cooper Creek Rd Water Line	$8,295,000
43	12" Swisher Rd Water Line	$3,360,000
44	12" John Paine Rd Water Line	$3,221,000
45	Direct Potable Reuse Pilot Program	$5,000,000
46	Aquifer Storage Recovery Pilot Program	$5,000,000
	10-Year Projects Subtotal:	**$379,043,500**

Table 6.3 – 25-Year CIP Projects

Project No.	Project Name	Project Cost
47	Lake Ray Roberts WTP 10 MGD Expansion to 70 MGD	$97,922,500
48	Northwest Booster PS Improvements	$945,000
49	Jim Christal PS and 36" Transmission Main	$31,026,000
50	Lake Ray Roberts HSPS Improvements Phase 3	$7,910,000
51	Lake Ray Roberts WTP 10 MGD Expansion to 80 MGD	$97,922,500
	25-Year Projects Subtotal:	**$235,726,000**



CIP PROJECTS NOT SHOWN

5-Year CIP

1. Lake Ray Roberts WTP Rerate to 30 MGD
2. Lake Lewisville WTP Rehabilitation
3. Lake Ray Roberts WTP 20 MGD Expansion to 50 MGD
6. Roselawn EST Rehabilitation
11. McKenna Park Standpipe and Pump Station Demolition
29. Lake Ray Roberts HSPS Improvements Phase 1

10-Year CIP

31. Lake Ray Roberts WTP 10 MGD Expansion to 60 MGD
33. Lake Ray Roberts HSPS Improvements Phase 2
34. Southwest PS Improvements
45. Direct Potable Reuse Pilot Program

25-Year CIP

47. Lake Ray Roberts WTP 10 MGD Expansion to 70 MGD
48. Northwest Booster PS Improvements
50. Lake Ray Roberts HSPS Improvements Phase 3
51. Lake Ray Roberts WTP 10 MGD Expansion to 80 MGD

CITY OF DENTON

CITY OF DENTON WATER MASTER PLAN CAPITAL IMPROVEMENT PLAN

February 2025

Kimley»Horn

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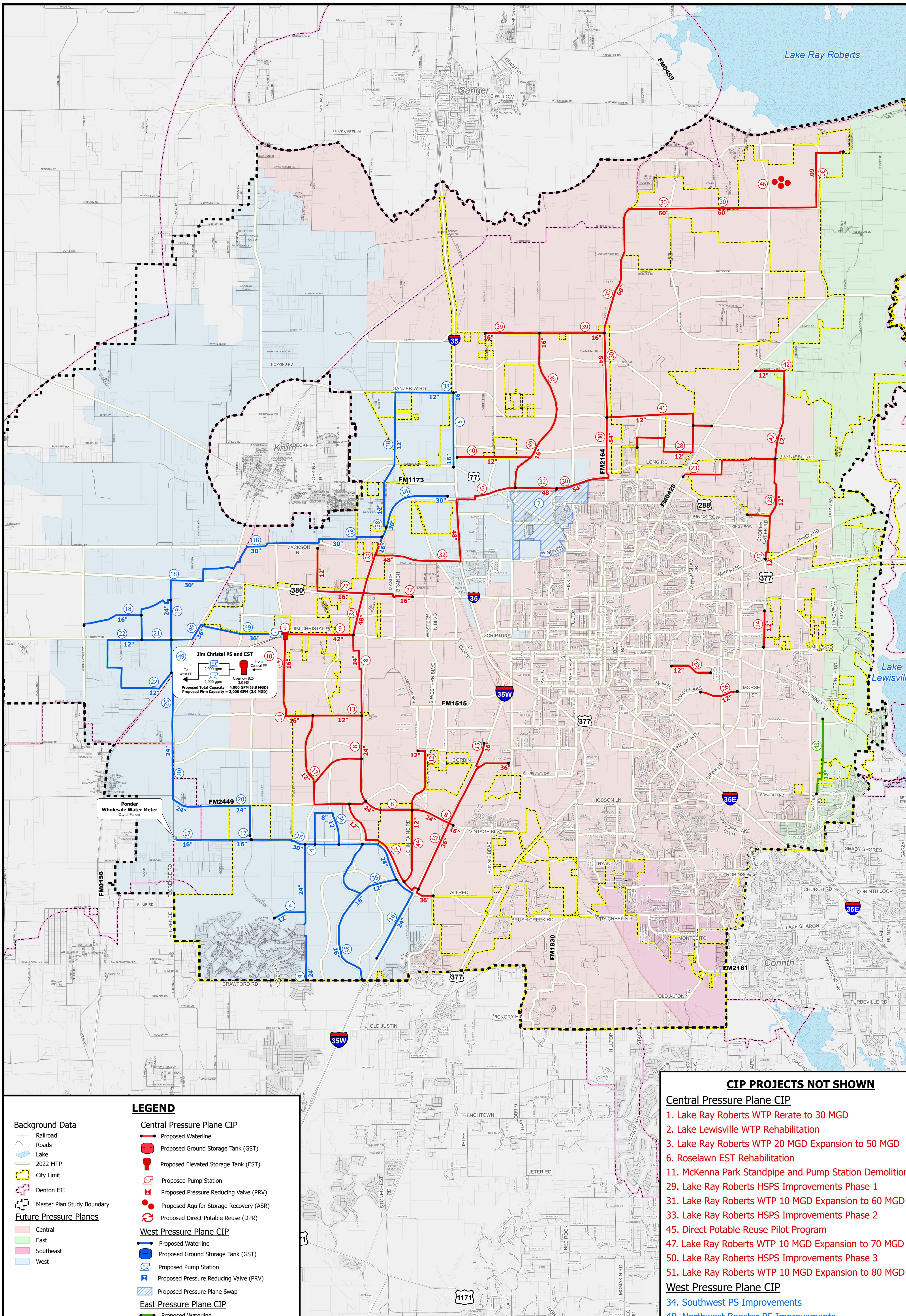

LEGEND

Background Data
- Railroad
- Roads
- Lake
- 2022 MTP
- City Limit
- Denton ETJ
- Master Plan Study Boundary

Future Pressure Planes
- Central
- East
- Southeast
- West

Central Pressure Plane CIP
- Proposed Waterline
- Proposed Ground Storage Tank (GST)
- Proposed Elevated Storage Tank (EST)
- Proposed Pump Station
- Proposed Pressure Reducing Valve (PRV)
- Proposed Aquifer Storage Recovery (ASR)
- Proposed Direct Potable Reuse (DPR)

West Pressure Plane CIP
- Proposed Waterline
- Proposed Ground Storage Tank (GST)
- Proposed Pump Station
- Proposed Pressure Reducing Valve (PRV)
- Proposed Pressure Plane Swap

East Pressure Plane CIP
- Proposed Waterline

CIP PROJECTS NOT SHOWN

Central Pressure Plane CIP
1. Lake Ray Roberts WTP Rerate to 30 MGD
2. Lake Lewisville WTP Rehabilitation
3. Lake Ray Roberts WTP 20 MGD Expansion to 50 MGD
6. Roselawn EST Rehabilitation
11. McKenna Park Standpipe and Pump Station Demolition
29. Lake Ray Roberts HSPS Improvements Phase 1
31. Lake Ray Roberts WTP 10 MGD Expansion to 60 MGD
33. Lake Ray Roberts HSPS Improvements Phase 2
45. Direct Potable Reuse Pilot Program
47. Lake Ray Roberts WTP 10 MGD Expansion to 70 MGD
50. Lake Ray Roberts HSPS Improvements Phase 3
51. Lake Ray Roberts WTP 10 MGD Expansion to 80 MGD

West Pressure Plane CIP
34. Southwest PS Improvements
48. Northwest Booster PS Improvements

CITY OF DENTON

CITY OF DENTON WATER MASTER PLAN CAPITAL IMPROVEMENT PLAN PER PRESSURE PLANE

February 2025

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