Initially Prepared 2026 Llano Estacado Regional Water Plan

March 2025

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Initially Prepared 2026 Llano Estacado Regional Water Plan

Prepared for the Llano Estacado (Region O) Regional Water Planning Group

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Acronyms and Abbreviations

°F	degrees Fahrenheit
µg/L	micrograms per liter
ac-ft	acre-feet
ac-ft/yr	acre-feet per year
AIM	Assistance in Irrigation Management
ASR	aquifer storage and recovery
bbl	barrel
BCWF	Bailey County Well Field
BMP	best management practices
BRA	Brazos River Authority
Brazos WAM	Brazos River Basin water availability model
cfs	cubic feet per second
CM	capacity maintenance
CR	County Road
CRMWA	Canadian River Municipal Water Authority
CRP	Clean Rivers Program
CRU	collective reporting units
DB27	Texas Water Development Board State Water Planning Database
DBS&A	Daniel B. Stephens & Associates
DCP	drought contingency plan
DFC	desired future conditions
DOR	drought of record
DPR	direct potable reuse
EA	environmental assessment
EID	environmental information document
EMST	Ecological Mapping Systems of Texas
EPA	U.S. Environmental Protection Agency
ETHP	Edward-Trinity High Plains (ETHP) Aquifer
FEMA	Federal Emergency Management Administration
FIRM	flood insurance rate maps
fpm	feet per mile
GAM	groundwater availability model
GCD	groundwater conservation district
GIS	geographic information system
GMA	groundwater management area
gpd	gallons per day
gpdc	gallons per person per day (per capita)
gpm	gallons per minute
HB	U.S. House Bill
HDR	HDR Engineering, Inc.
HLAS	Hancock Land Application Site
hp	horsepower
HPAS	High Plains Aquifer System
HPWD	High Plains Underground Water Conservation District No. 1
IFR	Infrastructure Financing Report
IPaC	Information for Planning and Consultation
kW-hr	kilowatt-hour
LAH	Lake Alan Henry
LAHPS	Lake Alan Henry Pumping Station
LEPA	low-energy precision application
LERWP	Llano Estacado Regional Water Plan

LERWPG	Llano Estacado Regional Water Planning Group
MAG	modeled available groundwater
mcf	thousand cubic feet
MG	million gallon
mg/L	milligrams per liter
mgd	million gallons per day
mm/d	millimeters per day
MMWA	Mackenzie Municipal Water Authority
MWP	major water provider
NAICS	North American Industry Classification System
NHD	National Hydrography Data
NOAA	National Oceanic and Atmospheric Administration
North Fork	North Fork of the Double Mountain Fork of the Brazos River
NRCS	Natural Resources Conservation Service
NWI	National Wetland Inventory
NWP	Nationwide Permit
NWTP	North Water Treatment Plant
PGMA	Priority Groundwater Management Area
PPS	Post Pump Station
PDSI	Palmer Drought Severity Index
RRA	Red River Authority
RCWF	Roberts County Well Field
RO	reverse osmosis
RWPA	regional water planning area
RWPG	regional water planning groups
SB	Senate Bill
SCADA	Supervisory Control and Data Acquisition
SEWRP	Southeast Water Reclamation Plant
SFWQ	Salt Fork Water Quality
SGCN	species of greatest conservation need
SLPS	Southland Pump Station
South Fork	South Fork of the Double Mountain Fork of the Brazos River
SPAG	South Plains Association of Governments
SPS	Southwestern Public Service
STATSGO	State Soil Geographic dataset
SWIFT	State Water Implementation Fund for Texas
SWP	State Water Plan
SWSP	strategic water supply plan
SWTP	South Water Treatment Plant
Task Force	State of Texas Water Conservation Task Force
TAC	Texas Administrative Code
TAWC	Texas Alliance for Water Conservation
TCEQ	Texas Commission on Environmental Quality
TDA	Texas Department of Agriculture
TDS	total dissolved solids
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TSDC	Texas State Data Center
TWC	Texas Water Code
TWDB	Texas Water Development Board
TXNDD	Texas Natural Diversity Database
TxPCI	Texas Playa Conservation Initiative
UCF	unified cost model

USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey
UWCD	Underground Water Conservation District
WAM	water availability model
WCP	water conservation plan
WMS	water management strategy
WRMWD	White River Municipal Water District
WUG	water user group
WWP	wholesale water provider
WWTP	wastewater treatment plant

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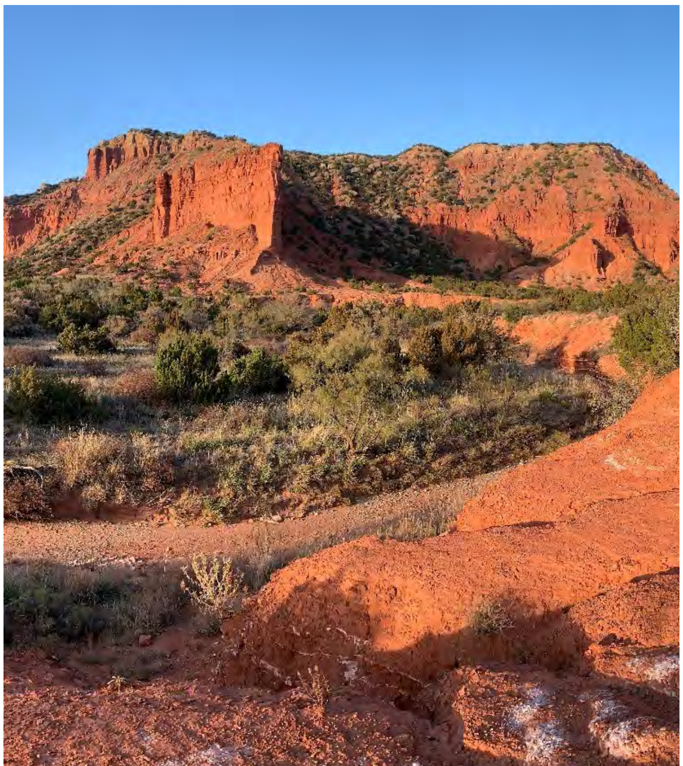

Executive Summary

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Executive Summary

[31 TAC §357.50]

Background

The citizens of Texas created the Texas Water Development Board (TWDB) by legislative act and constitutional amendment in 1957. The Texas Legislature charged the TWDB with preparing a comprehensive and flexible long-term plan for the development, conservation, and management of the state's water resources. The TWDB must prepare a comprehensive state water plan based on regional water plans every 5 years. The TWDB produced the current state water plan, *Water for Texas 2022 State Water Plan* (2022 State Water Plan), based on approved regional water plans pursuant to the requirements of Senate Bill 1 (SB1). The 75th Legislature enacted SB1 in 1997, which subsequent legislation has further modified. As stated in SB1, the purpose of the regional water planning effort is to accomplish the following:

> *"Provide for the orderly development, management, and conservation of water resources and preparation for and response to drought conditions in order that sufficient water will be available at a reasonable cost to ensure public health, safety, and welfare; further economic development; and protect the agricultural and natural resources of that particular region."*

SB1 also provides that future regulatory and financing decisions of the TWDB and the Texas Commission on Environmental Quality (TCEQ) be consistent with approved regional plans.

The TWDB is the state agency designated to coordinate the overall statewide planning effort. The Llano Estacado Region (Region O) Area, which is comprised of 21 counties (Figure ES-1), is one of Texas' 16 regional water planning areas (RWPAs) established by the TWDB. Counties in the region include Bailey, Briscoe, Castro, Cochran, Crosby, Dawson, Deaf Smith, Dickens, Floyd, Gaines, Garza, Hale, Hockley, Lamb, Lubbock, Lynn, Motley, Parmer, Swisher, Terry, and Yoakum.

The goal of the regional water planning process is to ensure that Texas has adequate water supplies in times of drought.

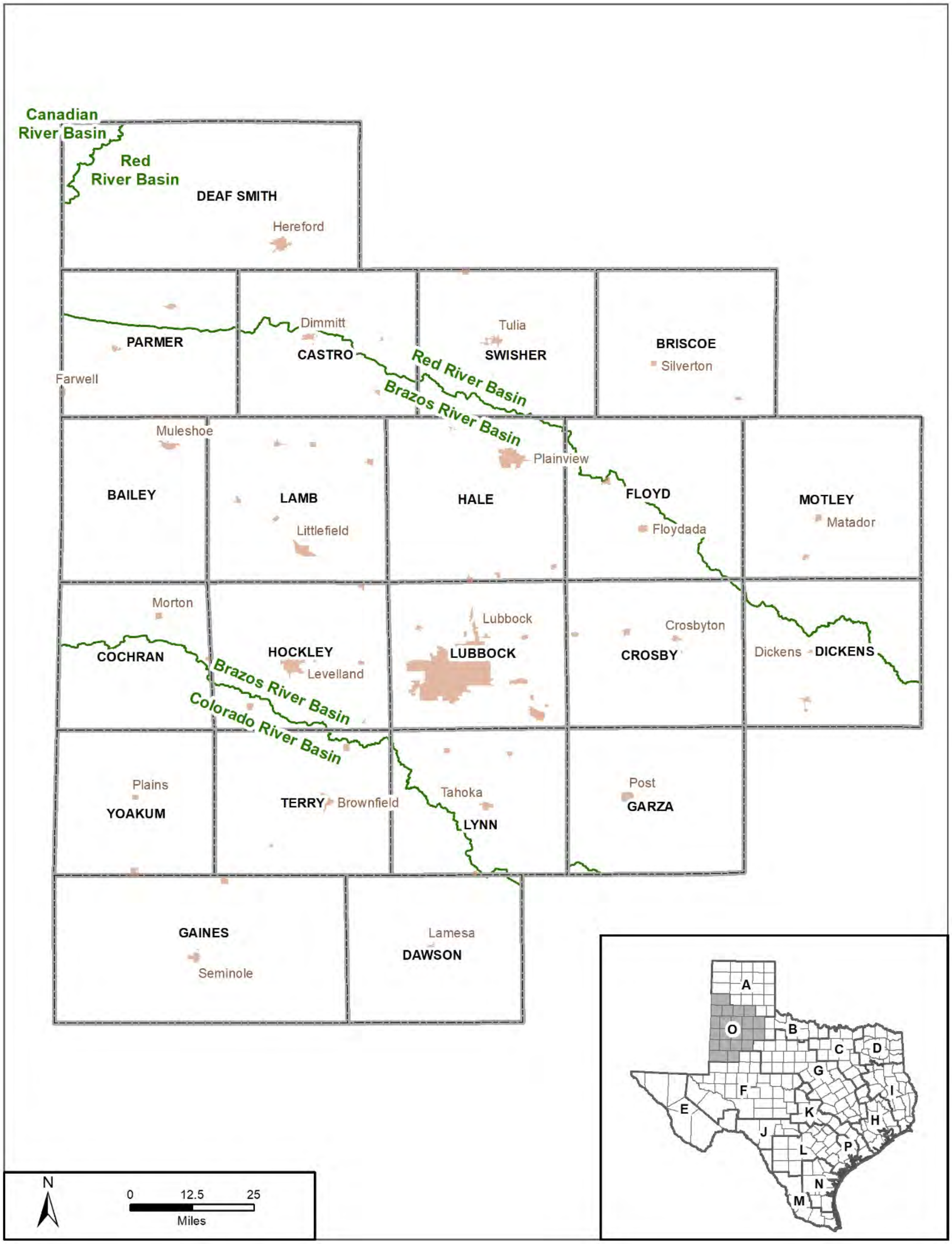

Figure ES-1. Llano Estacado Regional Water Planning Area

The TWDB originally appointed the volunteer members to the Llano Estacado Regional Water Planning Group (LERWPG) to represent a wide range of legislatively defined stakeholder interests. When members leave the planning group, the LERWPG appoints new members through solicitation of nominations. The LERWPG acts as the steering and decision-making body of the regional planning effort. An Executive Committee leads the LERPWG as governed by the LERWPG bylaws. During the development of the 2026 Llano Estacado Regional Water Plan (LERWP), members of the LERWPG Executive Committee included Chairman Dr. Ken Rainwater, PE, Vice-Chairman Chris Grotegut, DVM, and Secretary-Treasurer Lincoln DeVault.

The South Plains Association of Governments (SPAG) serves as the political subdivision and administrator for developing the LERWP. Kelly Criswell, SPAG's Deputy Executive Director, currently serves as the LERWP administrator for SPAG, assisted by Yvonne Ngundu and Piata Bryant during LERWP development. The LERWPG selected HDR Engineering, Inc. (HDR) as the prime consultant for the planning and engineering tasks necessary for plan development.

At the time of LERWP completion, 21 voting members served on the LERWPG. The LERWPG consists of up to 25 voting members who represent 14 interest groups, including the following.

- public,
- counties,
- small municipalities (less than 10,000 population),
- medium-sized municipalities (10,000 to less than 30,000 population),
- large municipalities (30,000 and above),
- industries,
- agricultural interests,
- environmental interests,
- small business,
- electric generating utilities,
- river authorities,
- municipal water supply districts,
- water utilities, and
- each groundwater management area (GMA) that is at least partially located within the Llano Estacado Region water planning area.

The LERWPG also includes several non-voting members who participate in LERWPG deliberations and contribute knowledge and insight to the group. Table ES-1 lists the voting and non-voting members and interest groups represented on the LERWPG who contributed to the development of the 2026 LERWP (both current and recently resigned).[1]

Non-voting LERWPG members include the TWDB project manager, representatives from Texas Parks and Wildlife Department (TPWD), Texas Department of Agriculture (TDA), TCEQ, the Texas State Soil and Water Conservation Board, a designated liaison from an adjacent regional water planning group (Brazos G), and the regional water planning group's technical consultant. The LERWPG bylaws specify the terms of office of LERWPG members and methods of replacement.

[1] LERWPG. 2025. Llano Estacado Regional Water Planning Group SPAG http://www.llanoplan.org/

Table ES-1. Current and Recently Resigned Llano Estacado Regional Water Planning Group Membership, as of March 2025

Interest Group	Name	Affiliation
Voting Members		
Agricultural	Mark Kirkpatrick	Agricultural Producer, Garza County
Agricultural	Chris Grotegut, DVM	Veterinarian / Agricultural Producer, Deaf Smith County
Agricultural	Lincoln Devault	Farwell, TX
Agricultural	Harry DeWit (former)	Blue Sky Farms
Agricultural	Benjamin (Ben) Weinheimer, Sr. PE	Texas Cattle Feeders Association
Agricultural	Michael Lawrence	Dairy, Muleshoe, TX
Counties	Charles (Charlie) Morris (former)	Dickens County Commissioner #3
Electric Generating Utilities	Bret Yeary, PE	Golden Spread Electric Cooperative
Environmental	Jim Steiert	West Texas Rural Telephone Cooperative
Groundwater Management Areas #2	Ronnie Hopper (former)	Agricultural Producer, Hale County
Groundwater Management Areas #6	Carrie Dodson	Gateway Groundwater Conservation District
Industries	Joey Hardin	RAW Oil & Gas
Water Utilities	Kent Satterwhite, PE (former)	Canadian River Municipal Water Authority
Water Utilities	Nathaniel (Shane) Jones	White River Municipal Water District
Water Utilities	Drew Satterwhite, PE	Canadian River Municipal Water Authority
Municipalities (Small) Less than 10,000	Alan Monroe	City of Friona
Municipalities (Medium) 10-30,000	Neil Weems	City of Plainview
Municipalities (Medium) 10-30,000	Jeffrey Snyder (former)	City of Plainview
Municipalities (Large) 30,000 or more	Wood Franklin	City of Lubbock
Municipalities (Large) 30,000 or more	Aubrey A. Spear PE (former)	City of Lubbock
Public	Melanie Barnes, PhD	Texas Tech University / Retired 2019
Public	Ken Rainwater, PhD, PE	Texas Tech University
River Authorities	Jeffrey (Jeff) Sammon (former)	Brazos River Authority
River Authorities	Chris Higgins	Brazos River Authority
Small Business	Don McElroy	Irrigation Pumps & Power
Water Districts	Jason Coleman, PE	High Plains Underground Water Conservation District No. 1
Non-voting Members		
TWDB Project Manager	John Maurer	n/a
TWDB Project Manager	Jean Devlin (former)	n/a
Texas Department of Agriculture (TDA)	Briann Schenk	n/a
Texas Department of Agriculture (TDA)	Carol Faulkenberry (former)	n/a
Texas Commission on Environmental Quality (TCEQ)	Jason Lindeman	n/a
Texas Parks and Wildlife Department (TPWD)	Heather Johnson	n/a

Interest Group	Name	Affiliation
Texas Parks and Wildlife Department (TPWD)	John Clayton (former)	n/a
Texas State Soil and Water Conservation Board	Glenn Baker	n/a
Texas State Soil and Water Conservation Board	Rusty Ray (former)	n/a
Designated liaison from adjacent regional water planning group (Brazos G)	Vacant	n/a

The regional water plans are developed on a 5-year cycle, with previous plans developed in 2001, 2006, 2011, 2016, and 2021. In accordance with legislative and rule requirements, the regional water planning groups must submit an adopted plan to the TWDB every 5 years on a date set by the TWDB executive administrator. The 2026 regional water plans are due October 20, 2025. The TWDB will then compile the 16 regional water plans into the 2027 State Water Plan.

The TWDB requires a planning horizon of 50 years from 2030 to 2080. This planning period allows for long-term forecasting of future water demands and supplies sufficiently in advance of needs, which provides appropriate time for entities to implement water management measures. As required by statute, the TWDB has promulgated planning rules and guidelines to focus the efforts and provide for general consistency among the planning areas so that the TWDB can aggregate the regional plans into the 2027 State Water Plan.

The *2026 Llano Estacado Regional Water Plan (LERWP)* is organized in accordance with TWDB guidelines by chapter as follows.

Chapter 1 Planning Area Description

Chapter 2 Population and Water Demand Projections

Chapter 3 Water Availability and Existing Water Supplies

Chapter 4 Identification of Water Needs

Chapter 5 Water Management Strategies

Chapter 6 Impact of Regional Water Plan and Consistency with Resource Protection

Chapter 7 Drought Response Information, Activities, and Recommendations

Chapter 8 Recommendations for Unique Stream Segments, Unique Reservoir Sites, and Other Legislative Policy Recommendations

Chapter 9 Implementation and Comparison to Previous Regional Water Plans

Chapter 10 Public Participation and Adoption of Plan

Description of the Llano Estacado Region

The 21-county Llano Estacado Region has an area of 20,294 square miles, approximately 7.5 percent of the state's land area, and is located in the upstream parts of four major river basins (Brazos, Canadian, Colorado, and Red). Of the total area, 8,732 square miles are located in the Brazos River Basin, 6,681 square miles are located in the Red River Basin, 4,787 square miles are located in the Colorado River Basin, and 94 square miles are located in the Canadian River Basin.

The boundaries of the region are on the west by the Texas-New Mexico border, on the north by TWDB Planning Region A (Panhandle), on the south by TWDB Planning Region F, and on the east by TWDB Planning Regions B and G (Brazos). The region extends beyond the Caprock Escarpment and the eastern extent of the Ogallala Aquifer into the Rolling Plains, and although the region is located in the upstream parts of the Brazos, Canadian, Colorado, and Red River basins, almost no surface water exists within the region.

The translation of “Llano Estacado” from Spanish to English is “Staked Plain.” Llano Estacado is one of the largest mesas or tablelands on the North American continent. The elevation rises from 3,000 feet in the southeast to over 5,000 feet in the northwest. Precipitation varies from an annual average of 16 inches in Gaines and Yoakum Counties in the southwestern part of the region to 22 inches in Motley County in the northeast.

Agricultural commodities, including livestock production, staple crops, including cotton, corn, and wheat, and other agribusiness are the major industries in the region. The major water use is irrigation. Non-agricultural water use is provided through cities, wholesale water providers (WWPs), or developed locally from the region’s aquifers. The LERWPG has four designated WWPs (1,000 acre-feet per year [ac-ft/yr] or more of wholesale water).

- Canadian River Municipal Water Authority (CRMWA)
- City of Lubbock
- Mackenzie Municipal Water Authority (MMWA)
- White River Municipal Water District (WRMWD)

In response to the TWDB’s new sixth cycle of planning requirements in 31 Texas Administrative Code (TAC) §357.30(4), the LERWPG designated these WWPs, as well as the Red River Authority (RRA), as major water providers (MWPs), which are defined by the TWDB as public or private entities, water user groups (WUGs), or WWPs that provide water to any defined water use category and are not limited by a volumetric threshold.

Population and Water Demand Projections

In order to develop water plans to meet future water needs, it is necessary to make projections of future population and water demands for the region. The TWDB publishes population and water demand projections for each county for use by the regional water planning groups.

In 2030, the Llano Estacado Region accounted for 1.6 percent of the state’s total population and about 13.5 percent of the state’s annual water demand. Projections show that population will increase (Figure ES-2) while water demand will decrease over the planning horizon from 2030 to 2080 (Figure ES-3), predominantly because of expected decreases in agricultural irrigation water requirements. Irrigation demands are expected to decline due to reduced groundwater availability in the region, continued implementation of more water-efficient conservation practices and irrigation technologies, and conversion to dryland farming. Figure ES-4 and Figure ES-5 depict the total water demands of the region as a percent of the total water demand in 2030 and 2080, respectively.

According to TWDB projections, the population of the Llano Estacado Region is projected to increase from 564,047 in 2030 to 817,498 by 2080 (an increase of 44.9 percent). Annual total water demands for the region are projected to decrease from 2,345,019 acre-feet (ac-ft) in 2030 to 935,378 ac-ft in 2080 (Table ES-2; Figure ES-3). Gaines County projections indicate the highest water demand in the region of 279,263 ac-ft/yr in 2030 decreasing to 131,134 ac-ft/yr in 2080. Dickens County has the lowest projected water demand of 8,171 ac-ft/yr in 2030 decreasing to 8,106ac-ft/yr in 2080. There are no counties with a projected increase in water demand in the region.

Population projections for each municipal WUG and water demands for each WUG and WWP in the Llano Estacado Area are presented in Appendix A, which contains detailed reports from DB27.

Table ES-2. Projected Population and Water Demands in the Llano Estacado Region

Water User Group	2030	2040	2050	2060	2070	2080
Population	564,047	607,386	648,854	700,823	757,033	817,498
Water User Groups	**Water Demand (acre-feet per year)**					
IRRIGATION	2,174,030	1,860,438	1,367,030	873,626	783,088	725,085
LIVESTOCK	47,000	51,611	52,320	51,982	51,715	51,433
MANUFACTURING	7,830	8,119	8,419	8,731	9,053	9,387
MINING	9,425	9,537	9,601	9,726	4,374	4,439
MUNICIPAL	96,411	103,553	110,693	119,427	128,806	138,905
STEAM ELECTRIC POWER	10,323	6,625	6,625	6,129	6,129	6,129
Llano Estacado Region Total	**2,345,019**	**2,039,883**	**1,554,688**	**1,069,621**	**983,165**	**935,378**

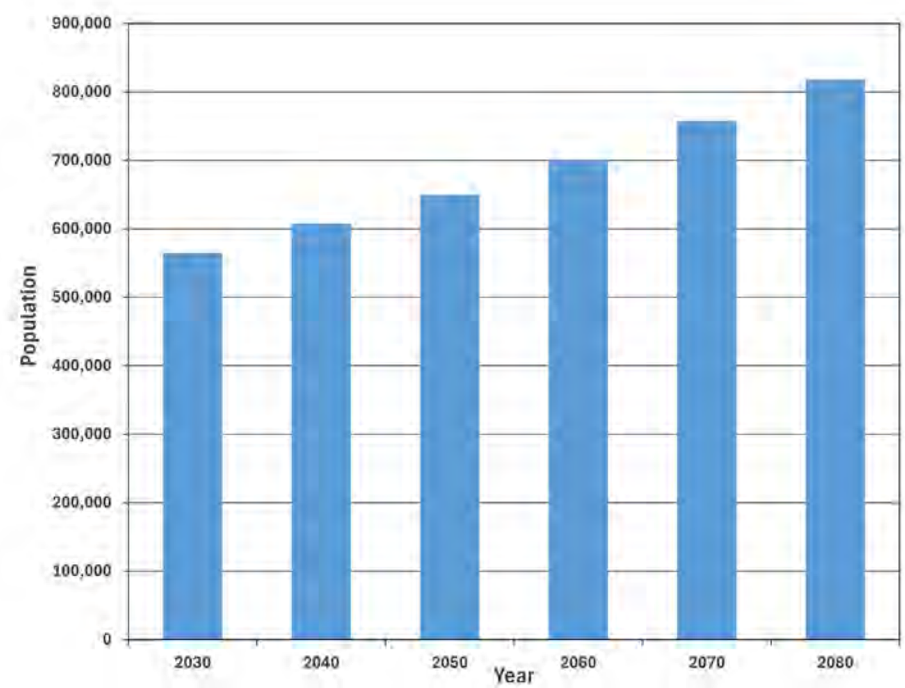

Figure ES-2. Llano Estacado Region Projected Population

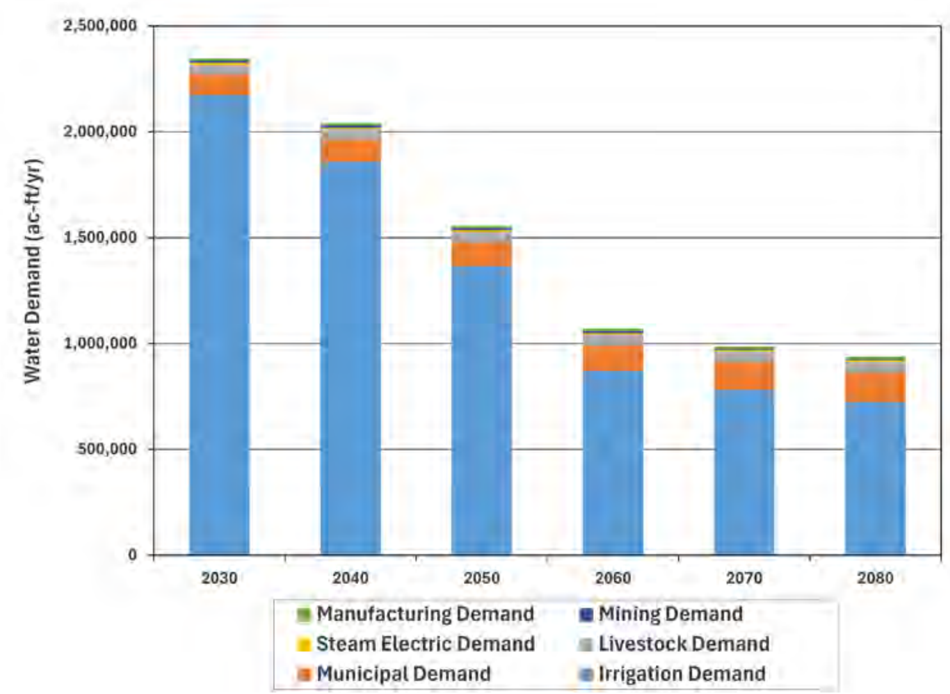

Figure ES-3. Llano Estacado Region Projected Total Water Demand

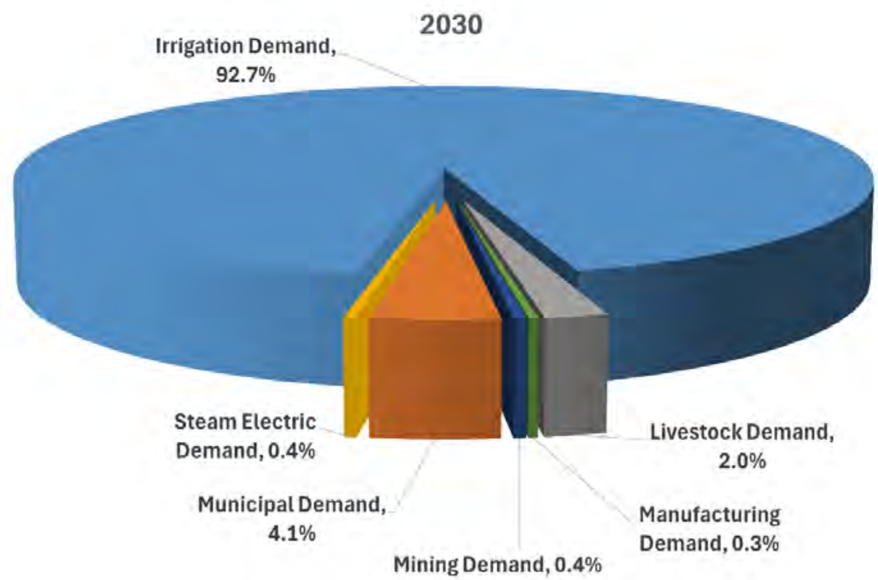

Figure ES-4. Total Water Demand in 2030

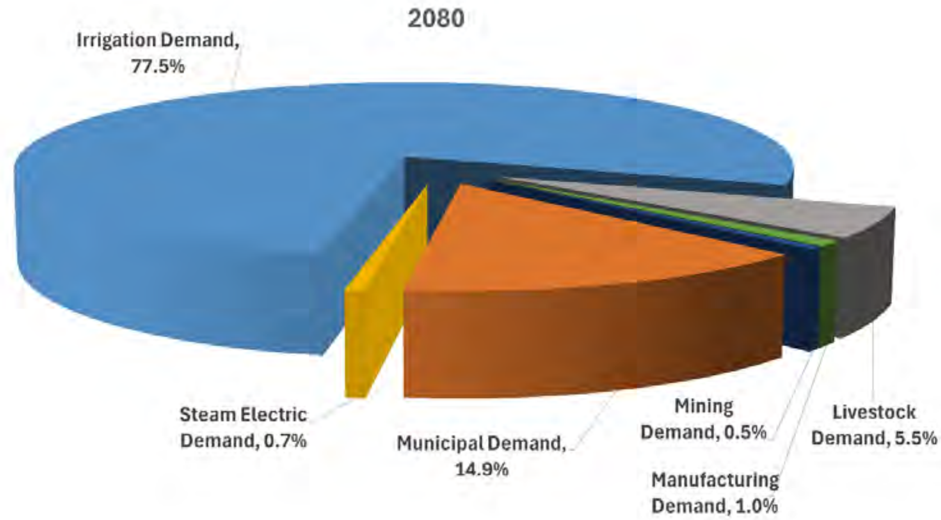

Figure ES-5. Total Water Demand in 2080

Water Supply

Surface Water Supplies

Although the Llano Estacado Region lies within the headwater areas of the Canadian, Red, Brazos, and Colorado river basins, the region has very little surface water and rainfall is less than 22 inches per year. Surface water is not adequate to result in any sustained runoff to streams, although there is some spring-fed baseflow in the North Fork of the Double Mountain Fork of the Brazos River (North Fork), as well as wastewater effluent discharge. Even though streamflow in the region is relatively low, four dams and reservoirs (Lake Alan Henry [LAH], Lake Mackenzie, Lake Meredith, and White River Reservoir) have been built within and near the region to capture and store surface water that is available from the streams on which they are located. According to the TCEQ's *State of Texas Water Quality Inventory*[2], the primary water quality concerns in the region are elevated levels of dissolved solids, suspended solids, and nutrients.

Surface water supplies were determined through TCEQ's water availability models (WAMs) of the Brazos and Red River basins (Table ES-3). In the recent drought of record (DOR), White River Reservoir, Mackenzie Reservoir, and the few run-of-river water rights in the region were unreliable supply sources. The Panhandle Region (Region A) assessed Lake Meredith to have a firm yield of 24,600 ac-ft/yr in 2030[3]. LAH's firm yield was calculated at 11,300 ac-ft/yr in 2030.

[2] https://www.tceq.texas.gov/waterquality/assessment

[3] Panhandle Region (Region A) Technical Memo, Table 1-3.

Table ES-3. Surface Water Supplies

Source	Annual Quantity Available (acre-feet)					
	2030	2040	2050	2060	2070	2080
Lake Alan Henry	11,300	11,000	10,700	10,400	10,100	9,800
Lake Mackenzie	2,900	2,900	2,900	2,900	2,900	2,900
White River Reservoir	0	0	0	0	0	0
Lake Meredith*	24,600	24,600	24,600	24,600	24,600	24,600
Reservoir Total	**14,200**	**13,900**	**13,600**	**13,300**	**13,000**	**12,700**
Brazos Basin Run-of River (Crosby County)	0	0	0	0	0	0
Brazos Basin Run-of-River (Dickens County)	0	0	0	0	0	0
Brazos Basin Run-of-River (Garza County)	0	0	0	0	0	0
Brazos Basin Run-of-River (Lubbock County)	0	0	0	0	0	0
Brazos Basin Run-of-River (Lynn County)	0	0	0	0	0	0
Red Basin Run-of-River (Briscoe County)	96	96	96	96	96	96
Red Basin Run-of-River (Floyd County)	18	18	18	18	18	18
Red Basin Run-of-River (Motley County)	4	4	4	4	4	4
Red Basin Run-of-River (Parmer County)	0	0	0	0	0	0
Run-of-River Total	**118**	**118**	**118**	**118**	**118**	**118**
Surface Water Total	**14,318**	**14,018**	**13,718**	**13,418**	**13,118**	**12,818**

* Lake Meredith is located in the Panhandle Region (Region A). Yield values: Region A Technical Memo Table 1-3

Groundwater Supplies

Groundwater is the region's primary source of water (Figure ES-6). Groundwater resources in the Llano Estacado Region include the High Plains (Ogallala and Edwards-Trinity High Plains [ETHP]) Aquifer, the Seymour Aquifer, and the Dockum (Santa Rosa) Aquifer. The Blaine Aquifer is located in the upper northwest corner of Motley County but does not provide a significant source of water for the Llano Estacado Region. Additionally, limited supplies are available from other local aquifers that are not differentiated aquifers. Most of the communities within the region obtain water from the Ogallala Aquifer as their primary source of drinking water; however, approximately 95 percent of the water obtained in the region from the Ogallala Aquifer is used for irrigation.

Groundwater availability for the planning process is based on the modeled available groundwater (MAG) volumes that may be produced on an average annual basis to achieve desired future conditions (DFCs) as adopted by GMAs. The Llano Estacado Region is located within GMA 2 with Motley and Dickens counties located within GMA 6 to the east. In August 2021, GMA 2 officials adopted a DFC for the ETHP Aquifer to be an average drawdown of 28 feet. The drawdown is calculated from the end of 2013 conditions to the year 2080.

In 2030, just over 2 million ac-ft of groundwater are available in the Llano Estacado Region, with the ETHP Aquifer accounting for 95 percent of the supply. By 2080, this volume is reduced to 982 thousand ac-ft (Figure ES-6). In addition to the vast groundwater supplies, CRMWA serves as an important interregional supply for the Llano Estacado Region. CRMWA supplies include Lake Meredith and groundwater in the Panhandle Region (Region A).

Reuse Supplies

In the Llano Estacado Region, 12 counties have water availability from direct reuse. Lubbock County has the largest direct reuse availability with 19,040 ac-ft in 2030, decreasing to 10,080 ac-ft in 2080. Lubbock County is the only county with a varying amount of direct reuse water availability; all other counties' direct reuse water availability remains constant and is based on their permitted amount.

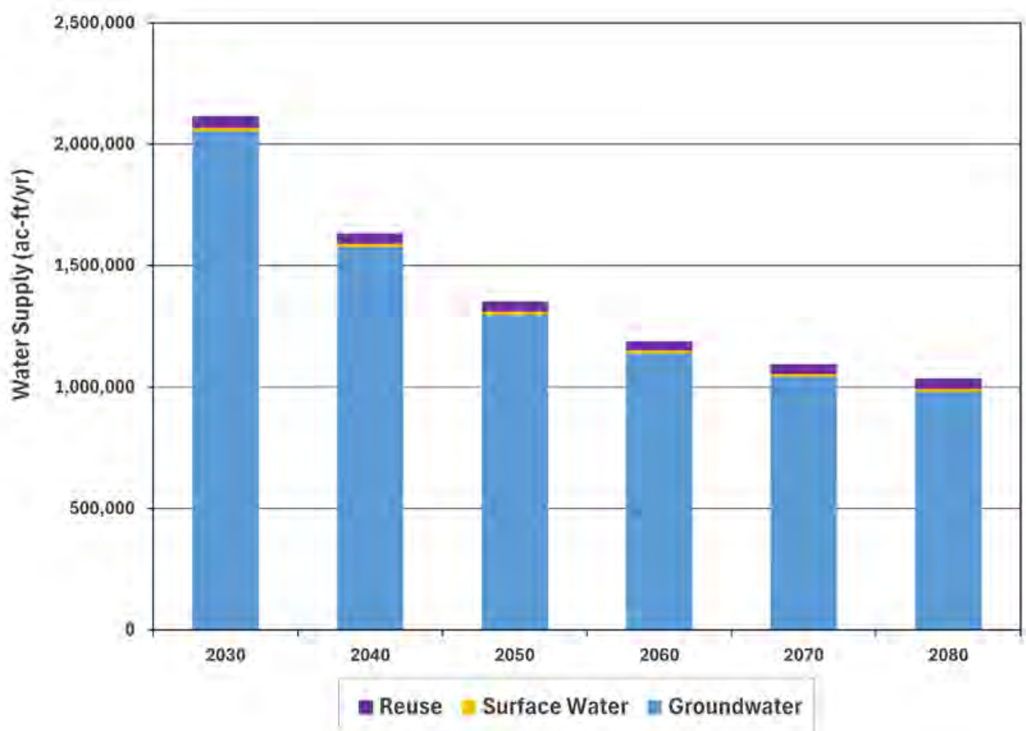

Figure ES-6. Total Available Supplies in the Llano Estacado Region

Water Supply Needs and Water Management Strategies

As part of the regional water planning process, water demands are compared to available water supplies. Shortages, or water needs, and surpluses are identified for each water user. In some decades, water supply may exist across the region but is not available or cannot be economically produced by a water user that has a need, as in the case of an irrigation need that cannot feasibly be met with distant supplies.

Projected water needs in 2030 are approximately 496,000 ac-ft/yr, decreasing to nearly 27,000 ac-ft/yr by 2080 (Table ES-4). Most of this need is for irrigation. The current TWDB planning process definition of future need does not acknowledge the conversion from irrigated to dryland cultivation or other land uses, as local groundwater supply is depleted, which can account for additional reduction in irrigation demands that are particularly important in the Llano Estacado Region.

Four counties (Dawson, Gaines, Lubbock, and Terry) are projected to have at least one WUG with a municipal need during the planning period. Fifteen counties (all counties, except Briscoe, Crosby, Cochran, Dickens, Garza, and Motley) are projected to have an irrigation need.

Major Water Providers

Projected water demands for each MWP are estimated on the basis of existing and/or future contracts with WUGs expected to continue receiving water or acquiring new water supplies from the MWP. CRMWA and the City of Lubbock have projected needs for additional water supply through the planning period. The MMWA and the WRMWD have existing supplies in excess or equal to projected demands through the planning period.

Table ES-4. Llano Estacado Region Projected Water Needs

Water User Group	Annual Water Need (acre-feet)					
	2030	2040	2050	2060	2070	2080
Municipal	37,235	27,428	15,034	1,099	(11,927)	(23,410)
Irrigation	(548,265)	(586,823)	(315,949)	(22,234)	(20,693)	(16,834)
Livestock	6,086	1,475	766	1,094	1,371	1,653
Manufacturing	1,559	1,270	970	658	336	2
Mining	581	469	405	280	5,632	5,567
Steam Electric	7,189	8,098	8,098	5,858	5,858	5,858
Total	(495,615)	(548,083)	(290,676)	(13,245)	(19,423)	(27,164)

The LERWPG identified water management strategies (WMSs) to meet specific water user needs. Conservation for all water users with needs was evaluated to meet the projected needs. Given the large irrigation water needs in the region, the LERWPG gave special consideration to agricultural conservation methods. In addition to conservation, strategies that include the development of new supplies and infrastructure were developed and evaluated. Potentially feasible WMSs were evaluated using the following metrics.

- Available supply or yield
- Infrastructure timing
- Environmental issues
- Engineering and cost
- Implementation factors, including permitting issues, water quality impacts, regulatory requirements, and timing

Strategies were identified for water users through review of previous water plans and studies and by maintaining ongoing communication with local interests through the regional water planning process. The first strategy considered for all water users was conservation. The LERWPG recognizes that many water users across all sectors are already implementing significant conservation and that this practice should continue and increase to at least delay the need for future water supply infrastructure implementation.

Most recommended WMSs in the Llano Estacado Region are new groundwater development or expansion of existing well fields. Although surface water supplies are limited in the region, expansion of surface water supply from LAH is evaluated. New reuse and brackish groundwater development were also evaluated. Strategies evaluated in the plan are shown in Table ES-6. Strategy evaluations show that conservation is projected to provide 115,256 ac-ft/yr of water savings by 2080. New groundwater development is projected to provide 32,000 ac-ft/yr by 2080. Alternate WMSs include those shown in Table ES-7.

TWDB Database Reports

The TWDB State Water Planning Database (DB27) includes data compiled and pertaining to the development of the regional water plan. Summary reports available from DB27 include the following.

Table ES-5. DB27 Summary Reports

Report ID	Report Name
71	2026 Regional Water Plan 1 - WUG Population
72	2026 Regional Water Plan 2 - WUG Demand
73	2026 Regional Water Plan 3 - Source Total Availability
74	2026 Regional Water Plan 4 - Water User Group Existing Water Supply
75	2026 Regional Water Plan 5 - Water User Group Needs or Surplus
80	2026 Regional Water Plan 7 - WUG Data Comparison to 2021 RWP
81	2026 Regional Water Plan 8 - Source Data Comparison to 2021 RWP
112	2026 Regional Water Plan 6 - WUG Second-Tier Identified Water Need
113	2026 Regional Water Plan 9 - WUG Unmet Needs
114	2026 Regional Water Plan 10 - Recommended WUG Water Management Strategies
115	2026 Regional Water Plan 11 - Recommended Projects Associated with Water Management Strategies
116	2026 Regional Water Plan 12 - Alternative WUG Water Management Strategies
117	2026 Regional Water Plan 13 - Alternative Projects Associated with Water Management Strategies
118	2026 Regional Water Plan 14 - WUG Management Supply Factor
119	2026 Regional Water Plan 15 - Recommended WMS Supply Associated with New/Amended IBT Permit
120	2026 Regional Water Plan 16 - Recommended WMS with New/Amended IBT Permit & Conservation
121	2026 Regional Water Plan 17 - Sponsored Recommended WMS Supplies Unallocated to WUGs
122	2026 Regional Water Plan 18 - Major Water Provider Existing Sales and Transfers
123	2026 Regional Water Plan 19 - Major Water Provider WMS Summary

Instructions for accessing the TWDB Database Reports:

1. Navigate to the TWDB Database Reports application at https://www3.twdb.texas.gov/apps/SARA/reports/list
2. Enter ‘2026 Regional Water Plan’ into the “Report Name” field to filter to all DB27 reports associated with the 2026 Regional Water Plans.
3. Click on the report name hyperlink to load the desired report.
4. Enter planning region letter parameter, click view report.

Table ES-6. Summary of Strategies Recommended for WUGs and/or WWPs

Recommended Strategies	Entity using Strategy	County	First Decade Average Annual Unit Cost ($/ac-ft)	Supply Developed (ac-ft/yr)						Total Project Cost ($)
				2030	2040	2050	2060	2070	2080	
Municipal Conservation	Municipal WUGs	Multiple	Varies	2,338	926	340	358	470	618	NA
Manufacturing Conservation	Manufacturing WUGs	Multiple	NA	78	263	439	439	439	439	NA
Mining Conservation	Mining WUGs	Multiple	NA	139	424	655	581	514	460	NA
Irrigation Conservation	Irrigation WUGs	Multiple	$450	96,036	160,059	191,281	171,893	161,510	155,527	NA
City of Plainview Aquifer Storage and Recovery (ASR)	Plainview	Hale	$1,430	-	987	987	987	987	987	$8,857,000
City of Plainview Reuse	Plainview	Hale	$2,511	-	-	560	560	560	560	$10,349,000
Lake 7 Reuse	Lubbock	Lubbock	$1,713	-	-	11,975	11,975	11,975	11,975	$251,043,000
Lake Alan Henry Phase 2	Lubbock	Lubbock	$2,206	5,100	5,100	5,100	5,100	5,100	5,100	$103,152,000
Bailey County Well Field Capacity Maintenance	Lubbock	Lubbock	$3,067	2,431	2,431	2,431	2,431	2,431	2,431	$94,704,000
Direct Potable Reuse to North Water Treatment Plant	Lubbock	Lubbock	$1,421	-	-	-	-	-	8,064	$125,890,000
CRMWA Supplies to ASR	Lubbock	Lubbock	$906	-	-	-	-	10,920	10,920	$103,917,000
CRMWA I & II Supply Replacement (New Wells Only)	CRMWA	Multiple	$159	-	-	904	2,568	5,634	7,166	NA
CRMWA II New Supply (Wells and Pipeline)	CRMWA	Multiple	$799	-	3,221	6,565	10,534	10,539	9,100	NA
CRMWA Aquifer Storage and Recovery (ASR)	CRMWA	Multiple	$355	-	6,000	7,000	7,000	7,000	7,000	NA
Additional Groundwater Development (Ogallala)	Muleshoe	Bailey	$204	-	240	240	240	240	240	$631,000
Additional Groundwater Development (Ogallala)	Littlefield	Lamb	$329	-	240	240	240	240	240	$902,000
Additional Groundwater Development (Ogallala)	Wolfforth	Lubbock	$1,481	-	-	3,300	3,300	3,300	3,300	$48,818,000
Additional Groundwater Development (Ogallala)	Seminole	Gaines	$2,891	1,225	1,225	1,725	1,725	1,725	1,725	$42,649,000
Additional Groundwater Development (Ogallala)	Brownfield	Terry	$331	-	-	-	160	160	160	$633,000
Additional Groundwater Development (Ogallala)	Slaton	Lubbock	$909	-	165	165	165	165	165	$1,875,000

Recommended Strategies	Entity using Strategy	County	First Decade Average Annual Unit Cost ($/ac-ft)	Supply Developed (ac-ft/yr)						Total Project Cost ($)
				2030	2040	2050	2060	2070	2080	
Additional Groundwater Development (Ogallala)	Ralls	Crosby	$450	160	160	160	160	160	160	$849,000

NA - costs and/or supply from strategy not determined; WUG = water user group; WWP = wholesale water providers; WTP = water treatment plant; ac-ft/yr = acre-feet per year

Table ES-7. Summary of Alternate Water Management Strategies

Recommended Strategies	Entity using Strategy	County	First Decade Average Annual Unit Cost ($/ac-ft)	Supply Developed (ac-ft/yr)						Total Project Cost ($)
				2030	2040	2050	2060	2070	2080	
Brackish Groundwater Development (Dockum Aquifer)	Seminole	Gaines	$8,192	-	-	500	500	500	500	$35,679,000
Additional CRMWA Supply from Levelland	Hockley County-Other (City of Smyer)	Hockley	$1,980	-	300	300	300	300	300	$5,577,000
Additional Groundwater Development	New Deal	Lubbock	$165	242	242	242	242	242	242	$398,000
Additional Groundwater Development	Lockney	Floyd		320	320	320	320	320	320	$1,750,000
Brackish Supplemental Water Supply for Bailey County Well Field	Lubbock	Lubbock	$2,736	-	2,240	2,240	2,240	2,240	2,240	$51,911,000
South Fork Discharge	Lubbock	Lubbock	$769	-	8,183	8,183	8,183	8,183	8,183	$52,536,000
North Fork Diversion at CR 7300	Lubbock	Lubbock	$3,093	-	-	8,030	8,030	8,030	8,030	$177,504,000
Post Reservoir	Lubbock	Lubbock	$1,063	-	-	-	-	8,962	8,962	$110,790,000
Direct Potable Reuse to South WTP	Lubbock	Lubbock	$1,777	-	-	-	-	-	8,064	$149,975,000
North Fork Diversion to Lake Alan Henry Pump Station	Lubbock	Lubbock	$830	-	-	7,510	7,510	7,510	7,510	$49,712,000
Direct Potable Reuse from Northwest Water Reclamation Plant to North Water Treatment Plant	Lubbock	Lubbock	$2,069	-	-	-	-	5,376	5,376	$119,906,000
Direct Potable Reuse from Northwest Water Reclamation Plant to Pump Station 9	Lubbock	Lubbock	$1,885	-	-	-	-	5,376	5,376	$103,992,000
Lubbock Land Application Groundwater Potable Reuse	Lubbock	Lubbock	$1,363	-	-	-	-	2,240	2,240	$33,569,000
Reclaimed Water Aquifer Storage and Recovery to North Water Treatment Plant	Lubbock	Lubbock	$3,100	-	-	-	-	5,600	5,600	$124,134,000
Reclaimed Water Aquifer Storage and Recovery to South Water Treatment Plant	Lubbock	Lubbock	$2,656	-	-	-	-	5,600	5,600	$146,233,000

NA - costs and/or supply from strategy not determined; ac-ft = acre-feet; WRMWD = White River Municipal Water District; CR = County Road; WTP = water treatment plant

In the 2022 State Water Plan, *Water for Texas*, the Llano Estacado Region had the highest unmet needs in Texas because of the irrigation needs in the region. In the 2026 LERWP, unmet needs again exist for irrigation and livestock water users (Table ES-8).

Table ES-8. Unmet Needs in the Llano Estacado Region

Water User Group	Annual Water Need (acre-feet per year)					
	2030	2040	2050	2060	2070	2080
Livestock	112	122	844	2,041	3,689	5,442
Irrigation	634,241	1,301,696	1,268,331	1,279,354	1,288,343	1,293,414

Implementation

Implementation of the 2026 LERWP provides for the development of new water supplies that will be reliable in the event of a repeat of the most severe drought on record. Implementation of all recommended WMSs often results in a cumulative amount of supplies that exceed projected needs with which the strategies are associated. The LERWPG explicitly recognizes the difference between additional supplies and projected needs as "System Management Supplies" and has recommended WMSs that, if developed all together, will intentionally provide a total supply in excess of some needs in the 2026 LERWP for the following reasons:

- So that water management strategies are identified to replace any planned strategies that may fail to develop, through legal, economic, or other reasons;
- To serve as additional supplies in the event that rules, regulations, or other restrictions limit use of any planned strategies;
- To meet additional demands should water demands be higher than TWDB projections;
- To facilitate development of specific projects being pursued by local entities for reasons that may not be captured in the supply and demand projections used to identify future supply shortages; and/or
- To provide adequate supplies in the event of a drought more severe than that which occurred historically.

Key Findings and Recommendations

- The Ogallala Aquifer is an important resource in the region. In addition to the supply used by all sectors in the region, supplies were allocated from the Ogallala Aquifer to meet municipal, mining, and manufacturing needs.
- Interregional strategies have been used in the development of the 2026 LERWP, including CRMWA strategies developed by the Panhandle Region that are recommended strategies to meet needs in the Llano Estacado Region.
- Fifteen counties (all counties, except Briscoe, Crosby, Cochran Dickens, Garza, and Motley) are projected to have an irrigation need. The recommended strategies are forms of conservation that unfortunately do not reduce use enough to meet the total need for the water users.
- Two WWPs (CRMWA and the City of Lubbock) are projected to have needs over the planning period. The recommended strategies for each provider will meet these needs.

- The LERWPG recognizes that many water users across all sectors are already implementing significant conservation and that this practice should continue and increase to delay the need for future water supply infrastructure implementation.

Other Aspects of the 2026 Llano Estacado Regional Water Plan

In addition to providing a roadmap for developing supplies to meet future water needs in the region, the 2026 LERWP includes other elements of value and interest to water supply managers and others in the Llano Estacado Region.

- The plan provides a concise summary of physiographic, hydrologic and natural resources in the Llano Estacado Region.
- The plan provides a comprehensive understanding of how water supplies have been developed and are managed in the Llano Estacado Region.
- The plan provides recommendations for drought management and emergency supply measures that may assist water managers with developing plans for their systems.
- The plan is in accordance with House Bill 807 (HB 807), passed by the 86th Texas Legislature in 2019, as the LERWPG has completed the following planning activities:
    - Assessed the potential for aquifer storage and recovery (ASR) projects to meet needs associated with significant identified water needs for several water users in the region;
    - Identified unnecessary or counterproductive variations in specific drought response strategies, including outdoor watering restrictions, among user groups in the RWPA that may confuse the public or otherwise impede drought response efforts;
    - Specified goals for gallons of water use per capita per day in each decade of the period covered by the plan for the municipal water user groups in the Llano Estacado Region;
    - Assessed the progress of the Llano Estacado Region in encouraging cooperation between water user groups for the purpose of achieving economies of scale and incentivizing strategies that benefit the entire region; and
    - Recommended legislative changes that the LERWPG believe would improve the water planning process.
- The plan includes recommendations to the TWDB and the Texas Legislature regarding key water policy issues and the direction of water supply management in Texas.

1

Planning Area Description

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Chapter 1: Planning Area Description

[31 TAC §357.30]

1.1 Background

Senate Bill 1 (SB1), which was passed into law in June 1997 and enacted by the 75th Texas Legislature, stemmed from increased awareness of Texas' vulnerability to drought and of the limitations of existing water supplies to meet the needs of the state's growing population. Senate Bill 2 (SB2), enacted in September 2001, expanded on the regional water planning process as created by SB1 and provided for further analysis and planning for water resources in the state. With rapidly growing populations, the need to adequately plan for existing and future water needs is vital to the economic health of the region and state.

The state water plan serves as a guide to state water policy and includes the Texas Water Development Board's (TWDB) legislative recommendations to facilitate voluntary water transfers. The state water plan addresses the needs of water user groups (WUGs) in Texas, including municipal, irrigation, manufacturing, livestock, mining, and steam-electric power. The state water plan also identifies river and stream segments of unique ecological value and sites of unique value for the construction of reservoirs that the TWDB recommends for protection.

1.1.1 Llano Estacado (Region O) Regional Water Planning Area

The TWDB divided the state into 16 planning regions designated by letters A through P (Figure 1-1). In the South Plains of Texas, the TWDB delineated 21 counties as Planning Region O, subsequently named the Llano Estacado Regional Water Planning Area (Llano Estacado Region) (Figure 1-2). The following counties are in the Llano Estacado Region (in alphabetical order)[4].

1. Bailey
2. Briscoe
3. Castro
4. Cochran
5. Crosby
6. Dawson
7. Deaf Smith
8. Dickens
9. Floyd
10. Gaines
11. Garza
12. Hale
13. Hockley
14. Lamb
15. Lubbock
16. Lynn
17. Motley
18. Parmer
19. Swisher
20. Terry
21. Yoakum

The 21-county Llano Estacado Region has an area of 20,294 square miles (12,988,160 acres), approximately 7.5 percent of the state's land area (Figure 1-2), and is located in the upstream parts of four major river basins (Brazos, Canadian, Colorado, and Red). Of the total area, 8,732 square miles are located in the Brazos Basin, 94 square miles are located in the Canadian Basin, 4,787 square miles are located in the Colorado Basin, and 6,681 square miles are located in the Red Basin. The boundaries of the region are on the west by the Texas-New Mexico border, on the north by TWDB Planning Region A (Panhandle), on the south by TWDB Planning Region F, and on the

[4] Texas Water Development Board (TWDB). 2024. http://www.twdb.texas.gov/waterplanning/rwp/regions/o/index.asp

east by TWDB Planning Regions B and G (Brazos). The region extends beyond the Caprock Escarpment and the eastern extent of the Ogallala Aquifer into the Rolling Plains. Although the region is located in the upstream parts of the Brazos, Canadian, Colorado, and Red River basins, limited amounts of surface water exist within the region.

The City of Lubbock is the largest city in the area, having a population of 266,878 within its city limits[5] (Figure 1-3). Agribusiness is the major industry in the region, with the City of Lubbock serving as the hub for health care, and Texas Tech University, Lubbock Christian University, Wayland Baptist University, and South Plains College serving as education centers.

The translation of “Llano Estacado” from Spanish to English is “Staked Plain.” The Llano Estacado is one of the largest mesas or tablelands on the North American continent. The elevation rises from 3,000 feet in the southeast to over 5,000 feet in the northwest, sloping almost uniformly at approximately 10 feet per mile (Figure 1-4).

[5] U.S. Census Bureau. 2024. QuickFacts: Lubbock City Texas. Population estimate July 1, 2023 https://www.census.gov/quickfacts/fact/table/lubbockcitytexas,US/PST045223

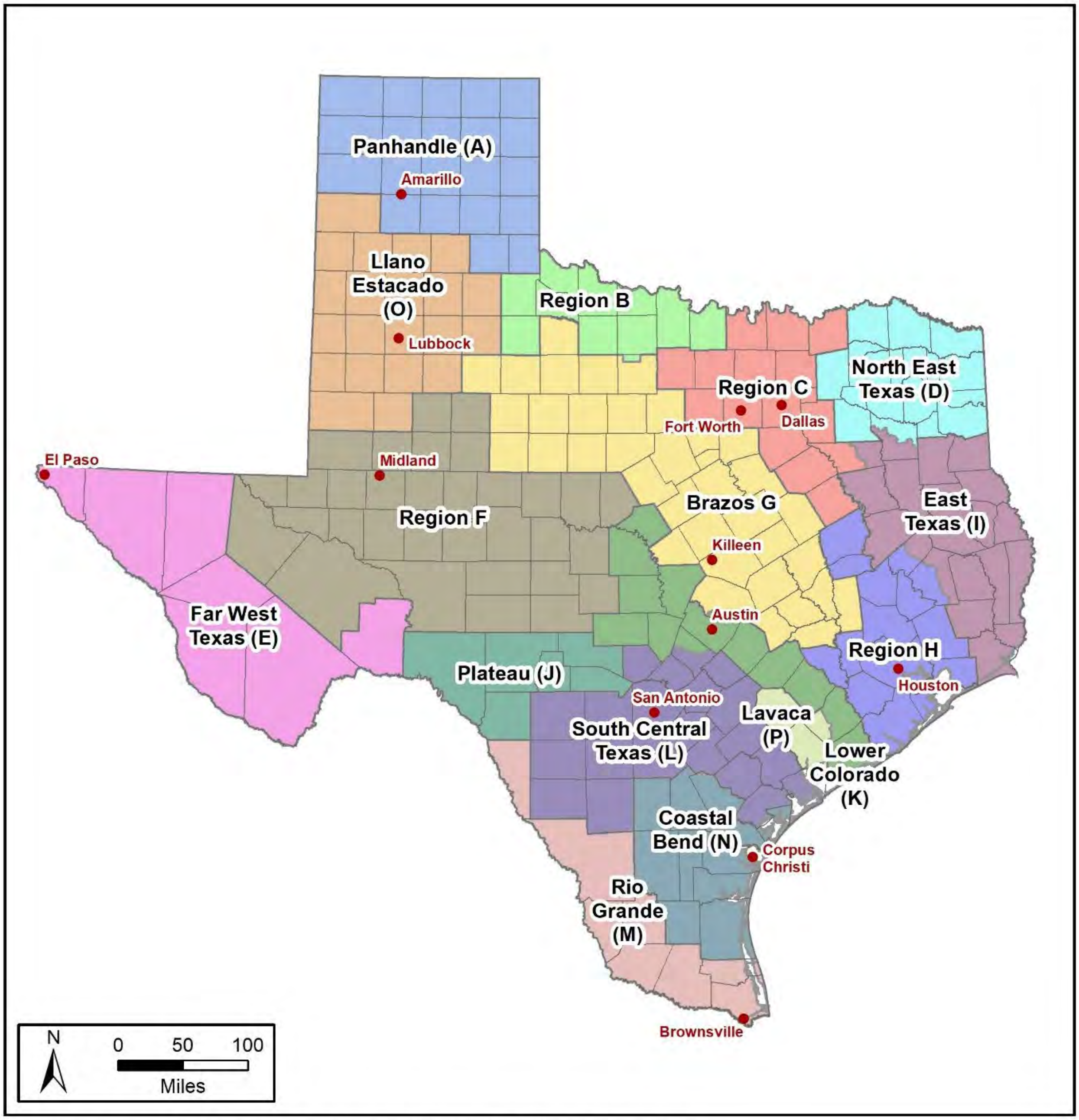

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Figure 1-1. Water Planning Regions of Texas

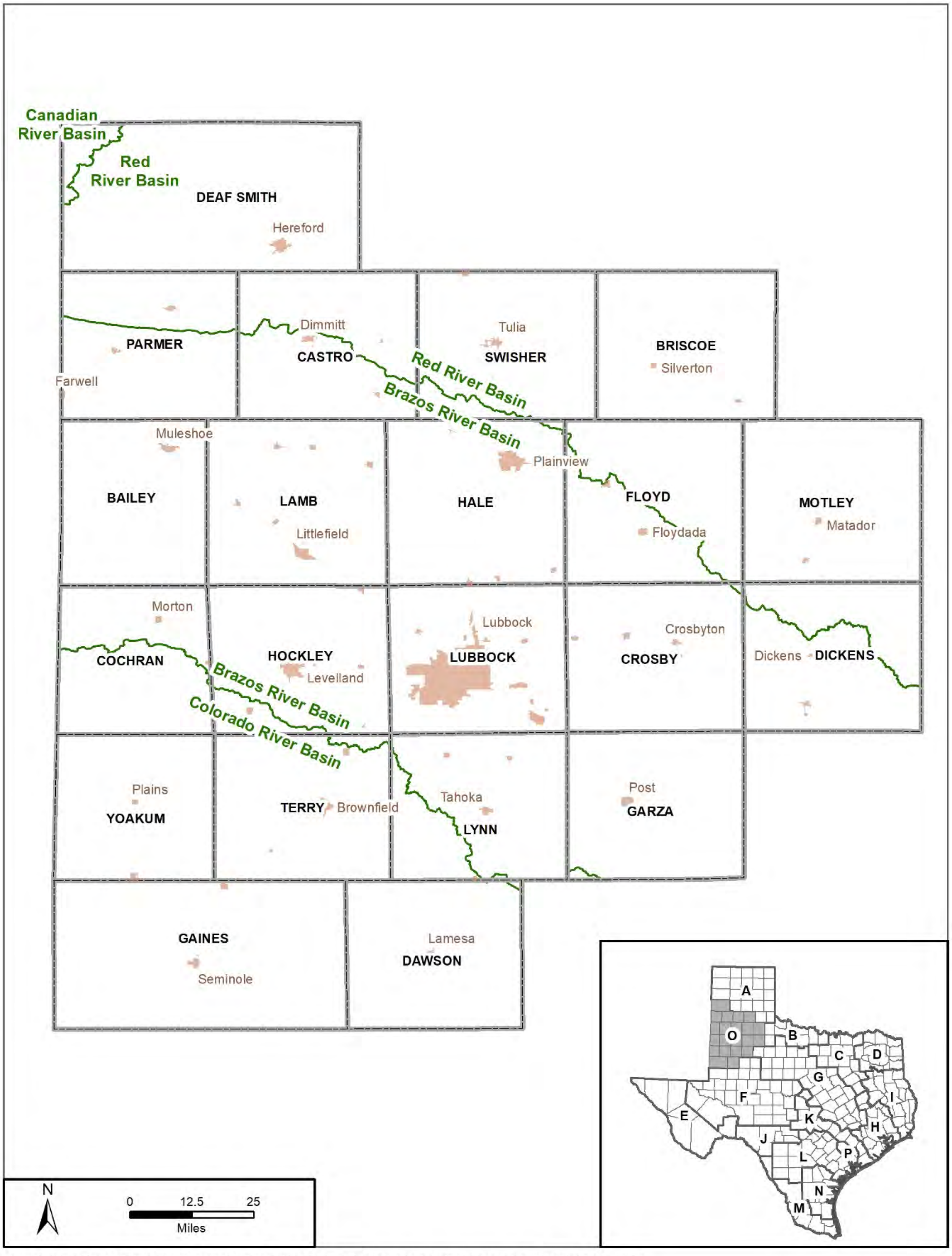

Figure 1-2. Llano Estacado Region

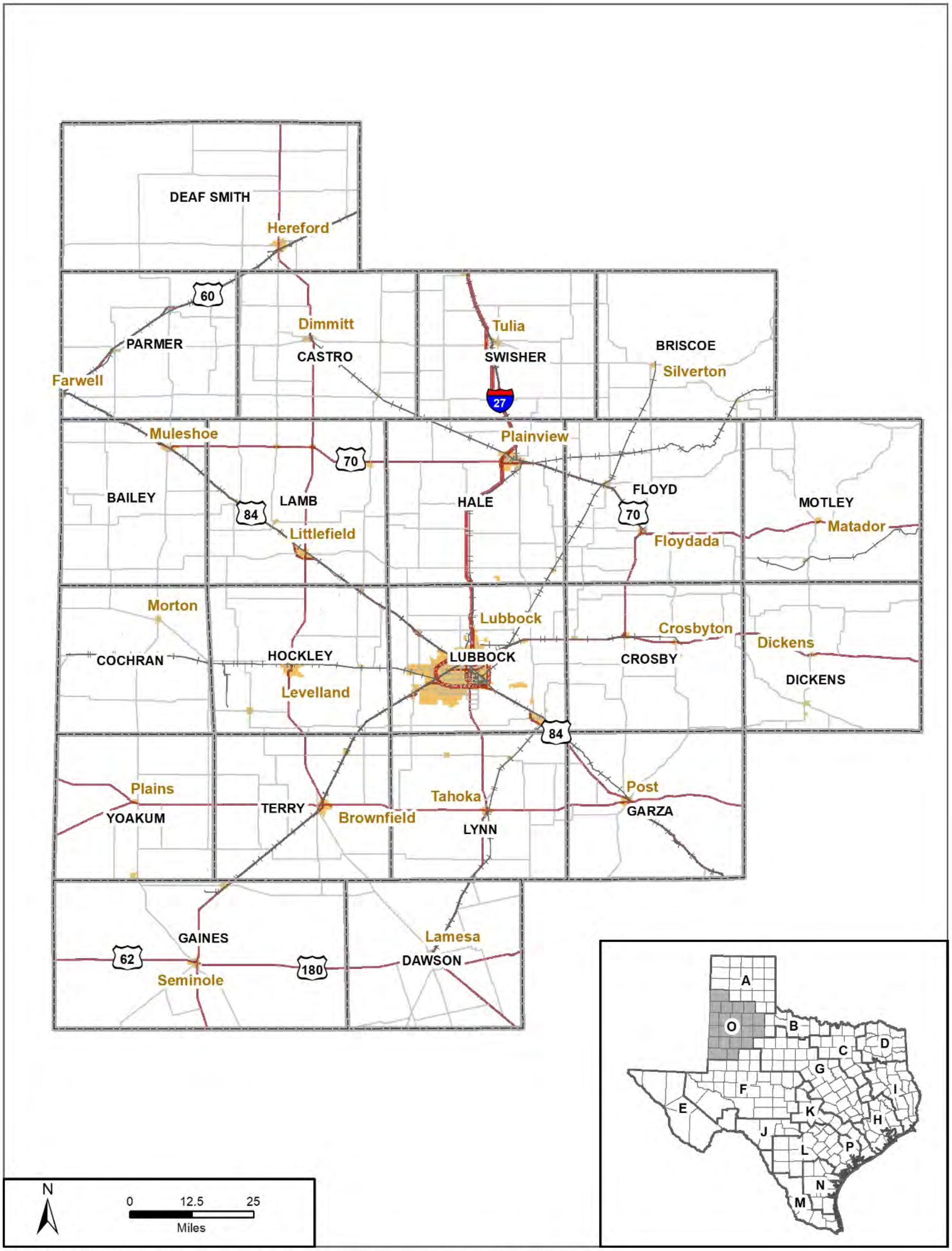

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Figure 1-3. Cities of the Llano Estacado Region

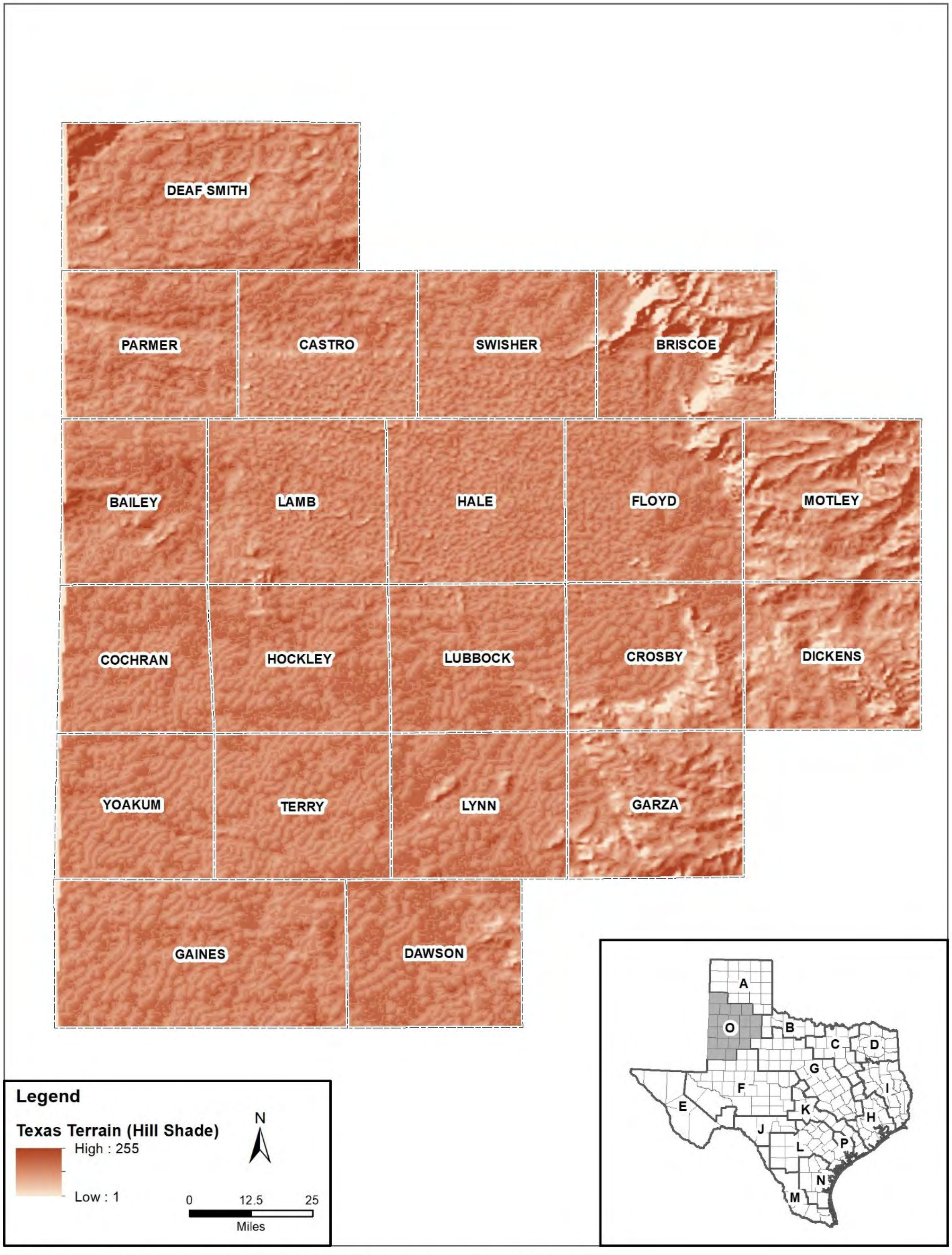

Figure 1-4. Topography Shaded Relief Map of the Llano Estacado Region

1.1.1.1 Llano Estacado Regional Water Planning Group

The TWDB appointed the Llano Estacado Regional Water Planning Group (LERWPG) to represent 12 stakeholder interests, as specified in 31 Texas Administrative Code (TAC) §357.11(d), and to act as the steering and decision-making body of the Llano Estacado Region planning effort. A list of LERWPG voting members is presented in Table 1-1 and non-voting member in Table 1-2, which include TWDB appointees and members appointed from nominations by local citizens[6]. Non-voting members include the TWDB project manager, representatives from Texas Parks and Wildlife Department (TPWD), Texas Department of Agriculture (TDA), Texas Commission on Environmental Quality (TCEQ), the Texas State Soil and Water Conservation Board, a designated liaison from adjacent regional water planning group (Brazos, Region G), and the regional water planning group's technical consultant. The LERWPG by-laws specify the terms of office of LERWPG members and methods of replacement.

Table 1-1. Current Llano Estacado Regional Water Planning Group Voting Membership[4]

Member	Term	Interest Category	City
Melanie Barnes, Ph. D.	2025	Public	Lubbock, TX
Jason Coleman, PE	2024	Water Districts	Lubbock, TX
Michael Lawrence	2024	Agriculture - Dairy	Muleshoe, TX
Carrie Dodson	2022	Groundwater Management Areas (#6)	Quanah, TX
Dr. Chris Grotegut, DVM	2021	Agricultural	Hereford, TX
Joey Hardin	2022	Industries	Lubbock, TX
Ronnie Hopper	2022	Groundwater Management Areas (#2)	Petersburg, TX
Shane Jones	2021	Water Utilities	Spur, TX
Mark Kirkpatrick	2022	Agricultural	Post, TX
Don McElroy	2022	Small Businesses	Muleshoe, TX
Alan Monroe	2025	Municipalities (small) less than 10,000	Friona, TX
Charlie Morris	2022	Counties	Spur, TX
Ken Rainwater, Ph. D.	2022	Public	Lubbock, TX
Jeff Sammon	2022	River Authorities	Waco, TX
Drew Satterwhite, PE	2022	Water Utilities	Sanford, TX
Neil Weems	2021	Municipalities (medium) 10-30,000	Plainview, TX
Wood Franklin, PE	2025	Municipalities (large) 30,000 or more	Lubbock, TX
Jim Steiert	2022	Environmental	Hereford, TX
Ben Weinheimer, Sr., PE	2022	Agricultural	Amarillo, TX
Bret Yeary, PE	2025	Electric Generating Utilities	Lubbock, TX
Lincoln Devault	2027	Agricultural	Farewell, TX

Table 1-2. Current Llano Estacado Regional Water Planning Group Non-Voting Membership[4]

Non-Voting Member	Term	Representing	City
John Maurer	n/a	Texas Water Development Board (TWDB) Project Manager	Austin, TX
Heather Johnson	n/a	Texas Parks and Wildlife Department	Lubbock, TX
Jason Lindeman	n/a	Texas Commission on Environmental Quality	Lubbock, TX
Briann Schenk	n/a	Texas Department of Agriculture	Amarillo, TX
Glenn Baker	n/a	Texas State Soil and Water Conservation Board	Temple, TX
Vacant	n/a	Region G Liaison to Region O	n/a

[6] LERWPG. 2024. Llano Estacado Regional Water Planning Group SPAG http://www.llanoplan.org/

1.1.2 Planning Guidelines

The TWDB planning guidelines require each regional water plan to address the following minimum reporting requirements[7]. The sections of the planning area description follow a twelve-point outline.

1. Describe the social and economic aspects of a region such as information on current population, economic activity, and economic sectors heavily dependent on water resources.
2. Describe the current water use and major water demand centers.
3. Describe current groundwater, surface water, and reuse supplies including major springs that are important for water supply or protection of natural resources.
4. Characterize the major water providers (MWPs).
5. Describe agricultural and natural resources.
6. Describe identified water quality problems.
7. Describe identified threats to agricultural and natural resources due to water quantity problems or water quality problems related to water supply.
8. Summarize existing local and regional water plans.
9. Describe the identified historic droughts of record within the water planning region.
10. Describe current preparations for drought within the regional water planning area (RWPA).
11. Characterize information provided by the TWDB from water loss audits performed by Retail Public Utilities pursuant to 31 TAC §358.6 (relating to water loss audits).
12. Identify each threat to agricultural and natural resources and discuss how that threat will be addressed or affected by the water management strategies evaluated in the plan.

1.2 Climate of the Llano Estacado Region

Climate is an important consideration in water supply planning because climate summarizes weather, or short-term atmospheric conditions, and provides the probability of drought and the availability of water for various uses. Two key indicators commonly measured are air temperature and precipitation, which provide a long-term record of conditions. Temperatures in the Llano Estacado Region range from an average low of 24 degrees Fahrenheit (˚F) in January to an average high of 93˚F in July. Average annual precipitation ranges from 16 to 22 inches across the region. Detailed climate information is presented in Chapter 7, *Drought Response Information, Activities, and Recommendations*.

[7] TWDB. 2024. Regional Water .Planning In Texas. https://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2026/projectdocs/RWP_RulePamphlet.pdf?d=53149.30000001192

1.3 Social and Economic Aspects of the Llano Estacado Region

Social and economic conditions drive the need for water. Water is at the core of sustainable development and is critical for socio-economic development, energy and food production, and healthy ecosystems. Increasing population and economic growth put greater demands on a limited water supply. Understanding these pressures is critical for water management.

1.3.1 Population

The regional population of 516,202 represents approximately 1.7 percent of the total state population of approximately 30.5 million persons in 2023[8, 9]. Eleven major cities with a population greater than 5,000 persons are located in the region, with these population centers relatively equally distributed within the 21 counties of the planning area. Lubbock County is the only county that contains more than one population center of 5,000 or more (cities of Lubbock, Wolfforth and Slaton). Twelve counties in the region (Briscoe, Castro, Cochran, Crosby, Dickens, Floyd, Garza, Lynn, Motley, Parmer, Swisher, and Yoakum) have no cities with more than 5,000 persons.

1.3.1.1 Historical and Recent Trends in Population

The area's population has grown from 11,418 in 1900 to 489,926 in 2010[10] and to 516,202 in 2023[11] (Table 1-3). From 1900 to 1920, the region experienced steady population growth as the large ranches that were predominant in the area, such as the XIT Ranch, and the railroads began to sell to farmers. Farmers converted ranchland to row crops and small grains and the economy of the region broadened to an economy of broad-based agribusiness, including the use of agricultural inputs from the non-farm manufacturing, trades, and service sectors, including marketing and processing agricultural commodities.

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[8] U.S. Census Bureau (USCB). 2024. Quick Facts Texas. Population estimate July 1, 2023. https://www.census.gov/quickfacts/TX

[9] U.S. Census Bureau, Population Division. 2024. Annual Estimates of the Resident Population for Counties in Texas: April 1, 2020 to July 1, 2023 (CO-EST2023-POP-48). https://www.census.gov/data/datasets/time-series/demo/popest/2020s-counties-total.html

[10] USCB. 2023. County Population by Characteristics: 2010-2019. https://www.census.gov/data/tables/time-series/demo/popest/2010s-counties-detail.html#par_textimage

[11] U.S. Census Bureau, Population Division. 2024. Annual Estimates of the Resident Population for Counties in Texas: April 1, 2020 to July 1, 2023 (CO-EST2023-POP-48). https://www.census.gov/data/datasets/time-series/demo/popest/2020s-counties-total.html

Table 1-3. Population Growth (1900 to 2023) Llano Estacado Region[12,13,14,15]

Year	Population
1900	11,418
1910	47,015
1920	80,722
1930	206,015
1940	229,280
1950	309,329
1960	402,533
1970	408,579
1980	449,533
1990	438,490
2000	453,997
2010	489,926
2020	509,782
2023	516,202

As settlers moved to the area between 1920 and 1930, the population increased 155 percent. During the late 1920s, the number of farms peaked at 25,595; however, due to farm consolidation, the number has declined slightly almost every year since[16]. In 2007, there were 12,287 farms in the region. By 2017, there were 9,821 farms in the region[17,18]. The 2022 Census of Agriculture reports that there were 11,185 farming operations at the time of reporting: either indicating an uptick in agricultural activities over the region, or a change in census methodology[19].

Eleven cities in the region have a population greater than 5,000 (Table 1-4). These larger urban areas constituted 70.0 percent of the region's 2023 population of 516,202, with most of this urban

[12] U.S. Census Bureau, Population Division. 2024. Annual Estimates of the Resident Population for Counties in Texas: April 1, 2020 to July 1, 2023 (CO-EST2023-POP-48). https://www.census.gov/data/datasets/time-series/demo/popest/2020s-counties-total.html

[13] USCB. 1996. Population of States and Counties of the United States: 1790-1990. March 1996. https://www2.census.gov/library/publications/decennial/1990/population-of-states-and-counties-us-1790-1990/population-of-states-and-counties-of-the-united-states-1790-1990.pdf

[14] Texas Health and Human Services. 2021. Texas Population, 2000. https://healthdata.dshs.texas.gov/dashboard/surveys-and-profiles/health-facts-profiles/population-profiles

[15] USCB. 2019. Quick Facts Texas. Population estimate July 1, 2019. https://www.census.gov/quickfacts/TX

[16] Inter-University Consortium for Political and Social Research (ICPSR). 2018. Study 00003: Historical Demographic, Economic and Social Data: U.S., 1790-1970.

[17] U.S. Department of Agriculture (USDA). 2017. Census of Agriculture, Volume 1 Geographic Area Series. Table 1. County Summary Highlights: 2017. https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Texas/st48_2_0001_0001.pdf

[18] USDA. 2017. Census of Agriculture. 2017 State and County Profiles – Texas. https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Texas/

[19] U.S. Department of Agriculture (USDA). 2022. Census of Agriculture, Volume 1 Geographic Area Series. Table 1. County Summary Highlights: 2022. https://www.nass.usda.gov/Publications/AgCensus/2022/Full_Report/Volume_1,_Chapter_2_County_Level/Texas/st48_2_001_001.pdf

population located in the City of Lubbock, which had a 2010 population of 229,573 persons[20] and a 2023 population of 266,878[21].

Table 1-4. Major Cities and U.S. Census Population (1990 to 2023) Llano Estacado Region[22 23 24 25]

City	County	1990		2000		2010		2023	
		Pop.	% of Region	Pop.	% of Region	Pop.	% of Region	Pop.	% of Region
Brownfield	Terry	9,560	2.2	9,488	2.1	9,657	2.0	8,652	1.7
Hereford	Deaf Smith	14,745	3.4	14,597	3.2	15,370	3.1	14,752	2.9
Lamesa	Dawson	10,809	2.5	9,952	2.2	9,422	1.9	8,266	1.6
Levelland	Hockley	13,986	3.2	12,866	2.8	13,542	2.8	12,530	2.4
Littlefield	Lamb	6,489	1.5	6,507	1.4	6,732	1.4	5,768	1.1
Lubbock	Lubbock	186,206	42.5	199,564	44.0	229,573	46.9	266,878	51.7
Muleshoe	Bailey	4,571	1.0	4,530	1.0	5,158	1.1	4,970	1.0
Plainview	Hale	21,700	4.9	22,336	4.9	22,194	4.5	19,420	3.8
Seminole	Gaines	6,342	1.4	5,910	1.3	6,430	1.3	7,231	1.4
Slaton	Lubbock	6,078	1.4	6,109	1.3	6,121	1.2	5,684	1.1
Wolfforth	Lubbock	1,941	0.4	2,554	0.5	3,670	0.7	7,258	1.4
	Total	282,427	64.4	294,413	64.7	327,869	66.9	361,409	70.1

1.3.1.2 Demographic and Socioeconomic Characteristics

In terms of population density, Motley County is the least populated, with 1,020 residents or 1.0 persons per square mile (Table 1-5). Lubbock County had the highest population density in the region, with 320,940 residents or 358.2 persons per square mile . The regional average population density is 25.5 persons per square mile[26].

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[20] USCB. 2012. 2010 U.S. Census of Population and Housing, U.S. Department of Commerce, Washington, D.C. https://www.census.gov/quickfacts/fact/table/

[21] U.S. Census Bureau. 2024. QuickFacts: Lubbock City Texas. Population estimate July 1, 2023 https://www.census.gov/quickfacts/fact/table/lubbockcitytexas,US/PST045223

[22] U.S. Census Bureau, Population Division. 2024. Annual Estimates of the Resident Population for Counties in Texas: April 1, 2020 to July 1, 2023 (CO-EST2023-POP-48). https://www.census.gov/data/datasets/time-series/demo/popest/2020s-counties-total.html

[23] Texas State Library and Archives Commission. 1990. 1990 Census: Population of Texas Cities, Arranged in Alphabetical Order. https://www.tsl.texas.gov/ref/abouttx/popcity1.html

[24] Texas State Library and Archives Commission. 2000. 2000 Census: Population of Texas Cities, Arranged in Alphabetical Order. https://www.tsl.texas.gov/ref/abouttx/popcity12000.html

[25] Texas State Library and Archives Commission. 2010. 2010 Census: Population of Texas Cities, Arranged in Alphabetical Order. https://www.tsl.texas.gov/ref/abouttx/popcity12010.html

[26] U.S. Census Bureau, Population Division. 2024. Annual Estimates of the Resident Population for Counties in Texas: April 1, 2020 to July 1, 2023 (CO-EST2023-POP-48). https://www.census.gov/data/datasets/time-series/demo/popest/2020s-counties-total.html

Table 1-5. County U.S. Census Population and Area for Llano Estacado Region[27,28]

County	Area (sq. mi.)	Population (2010)	Density (2010) (persons/sq. mi.)	Population (2023)	Density (2023) (persons/sq. mi.)
Bailey	827	7,165	8.7	6,672	8.1
Briscoe	900	1,637	1.8	1,445	1.6
Castro	894	8,062	9	7,227	8.1
Cochran	775	3,127	4	2,509	3.2
Crosby	900	6,059	6.7	4,917	5.5
Dawson	900	13,833	15.4	12,004	13.3
Deaf Smith	1,497	19,372	12.9	18,347	12.3
Dickens	902	2,444	2.7	1,711	1.9
Floyd	992	6,446	6.5	5,090	5.1
Gaines	1,502	17,526	11.7	22,523	15.0
Garza	893	6,461	7.2	4,517	5.1
Hale	1,005	36,273	36.1	31,761	31.6
Hockley	908	22,935	25.2	21,460	23.6
Lamb	1,016	13,977	13.8	12,711	12.5
Lubbock	896	278,831	311.3	320,940	358.2
Lynn	982	5,915	6.6	5,761	5.9
Motley	990	1,210	1.2	1,020	1.0
Parmer	881	10,269	11.7	9,617	10.9
Swisher	890	7,854	8.8	6,955	7.8
Terry	889	12,651	14.2	11,547	13.0
Yoakum	800	7,879	9.9	7,468	9.3
Total	20,239	489,926	24.2	516,202	25.5

In 2010, the age distribution across the region was relatively uniform from county to county[29] (Table 1-6). The two age groups that included the highest percentages of the population in 2010 across all counties were 60 years and above (18 percent) and 5 to 14 years (17 percent). In 2020, the two largest age groups were 5 to 17 years of age and 45 to 64 years of age, making up 18.6 and 22.0 percent of the population, respectively.

With respect to the level of education, of those residents in the Llano Estacado Region who are 25 years of age or older, 82 percent have at least a high school diploma (State of Texas average is 85 percent), while 25 percent have a college degree (State of Texas average is 32 percent) (Table 1-7)[30]. The region's unemployment rate was 3.6 percent in 2022[31]. The region's median household income was $58,848 in 2022.

[27] U.S. Census Bureau, Population Division. 2024. Annual Estimates of the Resident Population for Counties in Texas: April 1, 2020 to July 1, 2023 (CO-EST2023-POP-48). https://www.census.gov/data/datasets/time-series/demo/popest/2020s-counties-total.html

[28] USCB. 2023. County Population by Characteristics: 2010-2019. https://www.census.gov/data/tables/time-series/demo/popest/2010s-counties-detail.html#par_textimage

[29] USCB. 2012. 2010 U.S. Census of Population and Housing, U.S. Department of Commerce, Washington, D.C.

[30] USCB. 2022. U.S. Census Educational Attainment 2018-2022 American Community Survey 5-Year Estimates. U.S. Department of Commerce, Washington, D.C.

[31] Texas Association of Counties. 2024. Texas County Profiles: 2022. https://txcip.org/tac/census/CountyProfiles.php

Table 1-6. Age Distribution of the U.S. Census Population in 2020 for Llano Estacado Region[32]

County	Population (2020)	Age Distribution (values are percent of population)								
		0-4	5-17	18-24	25-34	35-44	45-64	65-84	85-99	100+
Bailey	6,904	7.6	22.3	8.8	13.4	12.3	21.1	12.5	1.9	0.0
Briscoe	1,435	5.3	17.1	5.1	8.6	11.2	25.0	23.8	3.8	0.0
Castro	7,371	6.8	21.7	8.5	11.8	11.7	22.2	14.9	2.6	0.0
Cochran	2,547	7.3	21.4	8.1	11.0	11.9	23.0	15.2	2.1	0.0
Crosby	5,133	5.3	20.4	7.1	10.1	10.9	25.7	17.9	2.3	0.1
Dawson	12,456	6.3	17.8	8.3	14.1	13.0	23.5	14.8	2.0	0.0
Deaf Smith	18,583	7.9	22.4	9.9	12.5	11.9	21.5	12.2	1.7	0.0
Dickens	1,770	5.1	17.6	5.5	7.5	11.5	27.5	22.8	2.5	0.1
Floyd	5,402	6.2	21.1	6.7	10.1	11.1	24.3	17.8	2.7	0.0
Gaines	21,598	9.6	25.0	10.7	13.8	11.8	19.8	8.2	1.1	0.0
Garza	5,816	4.2	13.5	7.2	15.3	17.5	27.7	13.4	1.2	0.1
Hale	32,522	6.1	19.6	10.0	12.9	12.0	24.1	13.4	1.8	0.0
Hockley	21,537	6.3	19.7	9.4	11.9	12.1	24.2	14.5	1.9	0.0
Lamb	13,045	6.2	20.9	7.9	11.1	11.3	24.6	15.5	2.5	0.0
Lubbock	310,639	6.2	17.3	14.8	14.4	12.3	21.2	12.2	1.6	0.0
Lynn	5,596	6.7	21.7	6.1	11.8	12.9	24.9	14.2	1.7	0.0
Motley	1,063	5.3	15.6	5.4	10.1	9.7	23.8	27.2	2.8	0.2
Parmer	9,869	7.5	21.3	9.9	12.6	10.7	23.5	12.7	1.8	0.0
Swisher	6,971	5.8	18.7	8.3	12.8	12.6	23.4	16.4	2.1	0.1
Terry	11,831	7.1	20.4	8.5	13.1	12.5	23.0	13.6	1.7	0.0
Yoakum	7,694	7.3	21.5	8.9	12.3	11.9	23.7	12.4	1.9	0.1
Total	509,782	6.5	18.6	12.5	13.7	12.2	22.0	12.8	1.7	0.0

[32] USCB. 2024. County Population by Characteristics: 2020-2023. https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-detail.html

Table 1-7. Summary of Selected Socioeconomic Indicators (2018-2022) for Llano Estacado Region[33] [34] [35]

County	High School Graduates (% of Population) (2018-2022)	College Graduates (% of Population) (2018-2022)	Civilian Labor Force (2018-2022)	Unemployment Rate (2022)	Median Household Income (2018-2022)
Bailey	73%	15%	58%	4.3%	$69,830
Briscoe	85%	16%	48%	3.6%	$35,446
Castro	75%	20%	67%	3.2%	$59,886
Cochran	69%	9%	60%	4.8%	$41,597
Crosby	78%	14%	62%	4.2%	$50,268
Dawson	70%	14%	49%	4.4%	$45,268
Deaf Smith	72%	12%	64%	3.0%	$51,942
Dickens	86%	20%	49%	4.8%	$46,638
Floyd	71%	16%	58%	4.2%	$49,321
Gaines	60%	10%	61%	3.0%	$73,299
Garza	70%	13%	37%	4.2%	$56,215
Hale	75%	15%	59%	5.0%	$50,721
Hockley	80%	17%	62%	3.7%	$53,283
Lamb	77%	13%	58%	4.0%	$54,519
Lubbock	88%	33%	65%	3.4%	$61,911
Lynn	81%	25%	61%	3.6%	$52,996
Motley	86%	20%	59%	4.1%	$66,528
Parmer	71%	19%	65%	2.4%	$65,575
Swisher	78%	19%	52%	4.1%	$40,290
Terry	76%	11%	59%	4.2%	$42,694
Yoakum	69%	10%	64%	4.1%	$80,317
Region Totals	82%	25%	63%	3.6%	$58,848
State Totals	85%	32%	65%	3.9%	$73,035

1.3.2 Economics

The economy of the region is intertwined with the region’s water resources. Understanding the multiple connections and feedback mechanisms between water resources and the economy is crucial for sustainable water management. This section describes the economic aspects of the region, such as economic activity and economic sections heavily dependent on water resources.

The region’s economic base is agriculture, with significant contributions from manufacturing, oil and gas, and trades and services, such as wholesale and retail trade, finance, insurance, legal, advertising, medical, personal, research, entertainment, repair services, and higher education. Agricultural processing, oilfield equipment, and electronics form the core of the region’s manufacturing base. Beef cattle and cotton are the predominant agricultural enterprises, although vegetables and oilseed crops are significant contributors to the region’s economy.

[33] USCB. 2022. U.S. Census Educational Attainment 2018-2022 American Community Survey 5-Year Estimates. U.S. Department of Commerce, Washington, D.C.

[34] U.S. Census Bureau. QuickFacts: https://www.census.gov/quickfacts/fact/table/

[35] Texas Association of Counties. 2024. Texas County Profiles: 2022. https://txcip.org/tac/census/CountyProfiles.php

1.3.2.1 Crop Production

Due to the semi-arid climate, limited water, and a relatively short growing season, the region can only grow certain crops. The major crops grown are cotton, grain sorghum, wheat, corn, soybeans, peanuts, and hay (Table 1-8) [36]. Reported production of these major crops is shown for each county of the region for 2022 (most recent census of agriculture).

All commodity farm sales in the Llano Estacado Region had a combined market value of over $8.3 billion in 2022. The major crops accounted for a combined market value of over $1.1 billion. Cotton, a somewhat drought-tolerant plant, was the leading crop of the region, with a market value of over $1.2 billion. The major crops from the Llano Estacado Region provided both a significant portion of the production (e.g., 78 percent of peanuts and 36 percent of cotton) and market value (17 percent) for the state.

Table 1-8. Crop Production in 2022 for Llano Estacado Region [37]

County	Selected Crops Harvested						
	Cotton (bales)	Wheat (bushels)	Corn (bushels)	Grain Sorghum (bushels)	Peanuts (lbs.)	Soybeans (bushels)	Hay and Haylage (tons)
Bailey	27,894	273,870	418,527	444,442	1,273,900	7,035	116,217
Briscoe	16,114	199,233	-	71,934	-	-	603
Castro	36,059	690,901	1,774,078	913,257	-	-	134,923
Cochran	58,426	317,021	578,165	919,030	21,547,871	-	-
Crosby	100,669	212,841	203,103	168,553	-	-	-
Dawson	61,535	172,511	-	315,924	15,857,199	-	87
Deaf Smith	14,542	1,442,109	2,335,942	1,984,377	-	-	69,945
Dickens	6,105	7,633	-	-	-	-	5,100
Floyd	107,914	409,975	570,051	469,882	-	-	1,261
Gaines	115,018	744,310	1,624,846	582,399	127,958,561	-	95,133
Garza	14,793	11,081	-	20,583	-	-	63
Hale	129,516	677,176	1,751,504	717,299	-	-	81,679
Hockley	103,516	165,220	787,905	983,873	-	-	6,648
Lamb	71,477	293,993	1,028,352	759,166	-	-	57,334
Lubbock	66,751	120,955	398,217	166,487	1,910,000	-	789
Lynn	86,673	41,267	219,764	144,110	-	-	-
Motley	23,546	-	-	-	-	-	1,292
Parmer	39,773	796,267	517,295	673,632	-	-	245,195
Swisher	46,473	932,787	853,132	653,156	-	-	9,750
Terry	32,546	442,013	80,425	287,788	27,057,384	-	50,293
Yoakum	44,786	181,340	330,295	406,108	35,508,500	-	-
Region Total	1,204,126	8,132,503	13,471,601	10,682,000	231,113,415	7,035	876,312
State Total	3,390,501	50,999,411	163,247,152	55,171,394	297,433,439	1,273,916	7,974,739
Region % State	35.5%	15.9%	8.3%	19.4%	77.7%	0.6%	11.0%

[36] USDA. 2024. National Agricultural Statistics Service 2022 Census of Agriculture https://www.nass.usda.gov/Publications/AgCensus/2022/index.php#full_report

[37] USDA. 2024. National Agricultural Statistics Service 2022 Census of Agriculture https://www.nass.usda.gov/Publications/AgCensus/2022/index.php#full_report

1.3.2.2 Irrigated Crops

In the semi-arid Llano Estacado Region, farmers supplement precipitation with irrigation from groundwater to increase crop yields, with the level of irrigation being determined by the quantities of precipitation received during the growing season and the quantities of irrigation water available to individual producers. During wetter years, farmers need to pump less irrigation water from the aquifer than during drought years, and during periods of severe drought, such as 1998, only irrigated crops produced "harvestable" yields. The 2017 Census of Agriculture[38] indicates that irrigated lands were approximately 2.012 million acres (26 percent) of the cropland in the region. The 2022 Census of Agriculture[39] reports much less land in the region being irrigated with 1.4 million acres.

Table 1-9. Irrigated land by acre in 2022 and 2017 for the USDA Census of Agriculture[40] [41]

County	Year	
	2022	2017
Bailey	39,702	54,222
Briscoe	10,881	22,057
Castro	121,782	121,837
Cochran	66,668	113,184
Crosby	48,858	86,465
Dawson	35,436	54,834
Deaf Smith	115,252	122,396
Dickens	5,168	8,876
Floyd	61,317	120,101
Gaines	140,156	197,021
Garza	3,700	8,877
Hale	125,825	189,342
Hockley	66,248	106,373
Lamb	109,314	173,865
Lubbock	62,819	166,725
Lynn	48,877	83,101
Motley	3,602	4,405
Parmer	144,077	110,098
Swisher	42,612	71,462
Terry	102,527	104,419
Yoakum	45,813	92,765
Region	1,400,634	2,012,425
Texas	3,765,438	4,363,345

When farmers began extensive irrigation in the 1940s, and for more than two decades thereafter, they gave little thought to irrigation water efficiency. However, now, the Llano Estacado Region is a

[38] USDA. 2017. National Agricultural Statistics Service 2017 Census of Agriculture https://www.nass.usda.gov/Publications/AgCensus/2017/index.php#full_report

[39] USDA. 2024. National Agricultural Statistics Service 2022 Census of Agriculture https://www.nass.usda.gov/Publications/AgCensus/2022/index.php#full_report

[40] USDA. 2017. National Agricultural Statistics Service 2017 Census of Agriculture https://www.nass.usda.gov/Publications/AgCensus/2017/index.php#full_report

[41] USDA. 2024. National Agricultural Statistics Service 2022 Census of Agriculture https://www.nass.usda.gov/Publications/AgCensus/2022/index.php#full_report

leader in adoption and use of highly efficient water use technology, and as new technology becomes available, farmers adopt it as rapidly as economics allow. In fact, the region has developed better and better water conservation methods and equipment, and in some cases, individual farmers have built prototypes of equipment that specialized manufacturers have produced and sold.

In the Llano Estacado Region, drought planning is a way of life as opposed to being a contingency plan. Farmers are always aware of how precious water is, and they work hard to make efficient use of precipitation, while saving the groundwater supply for use when precipitation is not adequate to grow crops.

1.3.2.3 Dryland Crops

Dryland, also known as rain-fed[42], farming produces crops without irrigation using only the precipitation provided by nature. Approximately 75 percent of the average annual precipitation occurs during the growing season, which is from May through September. Maximum conservation of this precipitation is the key to producing acceptable crop yields. Farmers accomplish this by holding the rainfall, which often falls in high-intensity, short-duration precipitation events, in place until it has time to soak into the soil. Methods that are effective at holding rainfall on the soil include bench leveling, parallel terraces, contour farming, furrow dikes, deep chiseling, and crop residue management. Minimum tillage using chemicals to control weeds instead of plowing also conserves moisture, since plowing provides an opportunity for moisture to evaporate when turned to the surface.

Crops produced by the dryland farming method include cotton, wheat, rye, and grain sorghum.

1.3.2.4 Livestock Production

Total livestock water use in 2022 accounted for 1 to 2 percent of the water demand in the Llano Estacado Region over the planning period from 2030 to 2080. Major types of livestock produced include feedlot cattle, range cattle, dairy cattle, swine, and sheep. The largest classification of livestock is cattle and calves, which includes feedlot livestock, followed by beef cows, sheep, and lambs. The most recent information available regarding fed cattle in the Llano Estacado Region originated from Ben Weinheimer, LERWPG member and Texas Cattle Feeders Association representative[43]. U.S. Department of Agriculture (USDA) information indicates that the one-time feedlot capacity in 2020 was 1.61 million head, an increase from 1.53 million head in 2017 (Table 1-10).

[42] D. Molden, D. Peden, in Treatise on Water Science, 2011. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/rainfed-agriculture

[43] Weinheimer, B. 2025. Personal communication, Texas Cattle Feeders Association, January 17, 2025.

Table 1-10. Livestock Numbers in 2022 for Llano Estacado Region

County	2022 Livestock and Poultry						
	Feedlot Capacity (number[44])	Cattle & Calves (number)	Beef Cows (numbers)	Milk Cows (number)	Swine (Hogs & Pigs) (number)	Sheep & Lambs (number)	Poultry Layers (number)
Bailey	(D)	128,705	5,722	26,730	247	654	226
Briscoe	(D)	45,616	11,536	-	24	-	(D)
Castro	316,700	582,951	13,927	68,107	1167	2,970	155
Cochran	(D)	2,743	1,596	-	(D)	-	34
Crosby	(D)	9,286	6,125	-	36	(D)	452
Dawson	(D)	3,358	2,295	-	490	224	260
Deaf Smith	364,275	700,069	30,595	52,135	(D)	(D)	438
Dickens	(D)	22,739	13,110	-	44	245	421
Floyd	(D)	53,490	5,770	-	(D)	1,317	432
Gaines	(D)	7,672	(D)	(D)	126	1,560	714
Garza	(D)	8,286	5,953	-	(D)	12	378
Hale	(D)	121,898	6,311	27,601	521	1,248	294
Hockley	(D)	7,559	4,177	-	96	434	600
Lamb	(D)	156,623	8,383	25,190	79	377	790
Lubbock	(D)	38,032	(D)	(D)	2,005	1,856	(D)
Lynn	(D)	8,592	5,862	-	96	814	126
Motley	(D)	14,678	9,824	-	(D)	94	82
Parmer	215,959	362,742	8,633	56,420	7	31	(D)
Swisher	163,323	196,293	13,356	-	30	(D)	345
Terry	(D)	13,296	(D)	(D)	122	212	316
Yoakum	(D)	10,656	3,043	-	56	312	165
Total	1,060,257	2,495,284	156,218	256,183	5,146	12,360	6,228

(D) data withheld

1.3.2.5 Beef Cows

Beef cows, which include any cow kept primarily for calf production, make up 6 percent of the total livestock in the Llano Estacado Region. In 2022, there were approximately 156,000 beef cows in the region (beef cows versus cattle and calves in Table 1-10), which is just under 4 percent of the state's total beef cow population of 4,360,026. The leading counties in beef cow numbers are Deaf Smith, Castro, Swisher, and Dickens.

1.3.2.6 Feedlot Livestock

During the last 25 to 30 years, the South Plains of Texas observed the development and growth of the confined cattle feeding industry to finish weights before slaughter. In the early years of development, individual ranchers built and operated feedlots to add value to their own cattle. During the 1960s, feedlot operators expanded the size and numbers of feedlots and began feeding cattle for others (custom feeding). This procedure opened a new market for ranchers across the region and the state; they could now have their own cattle custom-fed in a custom cattle feedlot. Farmers saw immediate grain marketing benefits from the establishment of feedlots in the Llano Estacado Region.

[44] 2022 Census of Agriculture - County Data, USDA, National Agricultural Statistics Service.

Fed cattle marketing in Texas increased from 477,000 head in 1960 to 2.7 million in 1969, a 467 percent growth rate as new capital flowed into the industry. During the 1970s, fed cattle marketing grew to 4.9 million head. The more modest 82 percent growth rate reflected the "market crash" of 1973 to 1974 that led to fewer new feedlots and slowed expansion of existing feedlots. During the 1980s, fed cattle marketing peaked at 5.3 million head in 1986, reflecting an 8.2 percent growth for the decade, with expansion during the 1980s being predominantly from expansion of existing feedlots. During the 1990s, the Texas feedlot industry matured with a 12 percent growth rate and marketing of 6.06 million head in 1998—resulting primarily from expansion of existing feedlots. Of the 142 feedlots in Texas in 1998, almost 50 percent were located in the Llano Estacado Region. In 1998, the cattle feedlots in the Llano Estacado Region marketed over 3.39 million head of fed cattle from 69 feedlots located in the 21 counties in the region. The most recent information available regarding fed cattle in the Llano Estacado Region originated from Ben Weinheimer, LERWPG member and Texas Cattle Feeders Association representative[45]. U.S. Department of Agriculture (USDA) information indicates that the one-time feedlot capacity in 2020 was 1.61 million head, an increase from 1.53 million head in 2017

1.3.2.7 Dairies

In the Llano Estacado Region, the dairy industry included a total of 70 dairies. Table 1-11 shows estimates of milk cow numbers for the Llano Estacado Region based on information from Harry DeWit, LERWPG member and CEO of Blue Sky Farms, based on December 2019 Texas Milk Market Administration information and dry cow estimates.[46]

Table 1-11. Dairy and Milk Cow Production in the Llano Estacado Region

County	Dairies	Total Dairy Cows	Sales $1,000
Bailey	7	26,730	162,375
Castro	11	68,107	382,881
Deaf Smith	7	52,135	291,165
Hale	6	27,601	124,470
Lamb	6	25,190	165,599
Lubbock	1	(D)	1,803
Parmer	15	56,420	(D)
Total	53	256,183	1,128,293

lbs - pounds

1.3.2.8 Other Livestock

Ranchers in the Llano Estacado Region also produce swine, sheep, and poultry, although in relatively low numbers. Production has been cyclical with some periods of declines in the numbers.

1.3.2.9 Oil and Gas

In the Llano Estacado Region, most of the oil and gas production activity is concentrated in the southern counties. Gaines and Yoakum counties are the leading oil and gas-producers in the

[45] Weinheimer, B. 2025. Personal communication, Texas Cattle Feeders Association, January 17, 2025.

[46] DeWit, H. 2020. Personal communication, Blue Sky Farms, January 20, 2020.

region[47] (Table 1-12). In 2023, oil production in the Llano Estacado Region was 71.7 million barrels or 4 percent Texas' total production. The 2023 natural gas production (casing head gas plus gas well gas) was 85,525,152 thousand cubic feet (mcf) or approximately 1 percent of Texas' total production. The wellhead value of oil and gas production of the region in 2023 is estimated at approximately $6 billion.

Table 1-12. Oil and Gas Production in 2023 for Llano Estacado Region[48]

County	Oil (bbl)	Condensate (bbl)	Casing head Gas (mcf)	Gas Well Gas (mcf)
Bailey	0	0	0	0
Briscoe	0	0	0	0
Castro	0	0	0	0
Cochran	2,245,703	98	1,401,224	29,333
Crosby	581,236	0	0	0
Dawson	6,943,452	0	5,021,976	0
Deaf Smith	0	0	0	0
Dickens	319,165	0	17,712	0
Floyd	0	0	0	0
Gaines	18,567,950	3,026	16,462,918	962,957
Garza	1,656,594	0	817,771	0
Hale	852,860	0	1,178,927	0
Hockley	9,669,100	1,186	6,225,247	7,849
Lamb	172,110	0	177,276	0
Lubbock	859,022	0	60,519	0
Lynn	128,664	0	32,317	0
Motley	18,225	0	1,387	0
Parmer	0	0	0	0
Swisher	0	0	0	0
Terry	2,203,528	0	298,662	0
Yoakum	27,447,086	0	52,801,096	27,981
Region Total 2017	**75,633,987**	**11,669**	**65,745,520**	**4,739,817**
Region Total 2023	**71,664,695**	**4,310**	**84,497,032**	**1,028,120**
Region Change 2017/2023	**-5%**	**-63%**	**29%**	**-78%**
Texas Total 2017	**1,083,758,987**	**176,265,505**	**2,637,886,440**	**4,811,630,451**
Texas Total 2023	**1,645,224,799**	**4,817,284,259**	**7,400,296,142**	**318,193,139**
Texas Change 2017/2023	**52%**	**2633%**	**181%**	**-93%**

bbl = barrel; mcf = thousand cubic feet

1.3.2.10 Manufacturing

The leading types of manufacturing plants in the region are food and kindred products, agricultural and industrial machinery and equipment, printing and publishing, and fabricated metal products, and ethanol plants. Information from 2022 for manufacturing (North American Industry Classification

[47] The Railroad Commission of Texas. 2023. General Production Query. http://webapps2.rrc.texas.gov/EWA/productionQueryAction.do

[48] The Railroad Commission of Texas. 2023. General Production Query. http://webapps2.rrc.texas.gov/EWA/productionQueryAction.do

System [NAICS] codes 31-33) , the region's 379 manufacturing establishments contributed and provided 12,568 jobs with an annual payroll of $686.68 million (Table 1-13).

Table 1-13. Manufacturing Activity in 2022 for Llano Estacado Region[49]

County	Total Number of Establishments	Total Number of Employees	Annual Payroll (million-dollars)
Bailey	10	200	6.41
Briscoe	0	0	0.00
Castro	8	42	2.68
Cochran	0	0	0.00
Crosby	0	0	0.00
Dawson	9	92	4.33
Deaf Smith	18	2,615	163.77
Dickens	0	0	0.00
Floyd	8	46	1.91
Gaines	18	239	16.86
Garza	0	0	0.00
Hale	16	661	32.71
Hockley	14	210	11.36
Lamb	11	288	13.37
Lubbock	228	5,502	276.30
Lynn	5	87	3.80
Motley	0	0	0.00
Parmer	9	2333	139.60
Swisher	8	65	4.77
Terry	9	105	3.77
Yoakum	8	83	5.04
Total	379	12,568	686.68

1.3.2.11 Wholesale Trade

The wholesale trade classification (NAICS code 42) includes durable goods such as motor vehicles, furniture and home furnishings, lumber and construction materials, electrical goods, and non-durable goods, such as farm products, chemicals and allied products, and petroleum and petroleum products, with the leading type of wholesale trade within the Llano Estacado Region being non-durable goods. The region's 733 wholesale trade establishments provide over 9,147 jobs with an annual payroll of over $625.55 million in 2022 (Table 1-14).

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[49] USCB. 2024. 2022 Economic Census, Washington D.C. https://www.census.gov/data/datasets/2022/econ/cbp/2022-cbp.html

Table 1-14. Wholesale Trade 2022 Llano Estacado Region[50]

County	Total Number of Establishments	Total Number of Employees	Annual Payroll (million-dollars)
Bailey	18	229	11.19
Briscoe	0	0	0.00
Castro	11	114	7.79
Cochran	3	40	2.76
Crosby	9	92	8.16
Dawson	16	85	5.26
Deaf Smith	26	384	26.13
Dickens	0	0	0.00
Floyd	12	88	4.52
Gaines	43	417	32.28
Garza	6	25	1.67
Hale	47	532	32.28
Hockley	26	175	10.41
Lamb	19	141	8.36
Lubbock	422	6,237	432.22
Lynn	9	33	1.71
Motley	0	0	0.00
Parmer	20	172	19.10
Swisher	11	67	2.53
Terry	21	237	13.26
Yoakum	14	79	5.94
Total	733	9,147	625.55

1.3.2.12 Retail Trade

The retail trade classification (NAICS codes 44-45) includes building materials and garden supplies, general merchandise stores, food stores, automotive dealers and service stations, apparel and accessory stores, furniture and home furnishing stores, household appliance stores, restaurants, and retail stores. The leading areas of retail trade within the Llano Estacado Region are restaurants, food stores, automotive dealers and service stations, and general merchandise stores. In 2022, the region's reported 1,656 retail trade establishments contributed and provided over 27,278 jobs with an annual payroll of over $895.90 million (Table 1-15).

[50] USCB. 2024. Annual Report for Wholesale Trade: 2022. https://www.census.gov/data/datasets/2022/econ/cbp/2022-cbp.htm

Table 1-15. Retail Trade in 2022 for Llano Estacado Region[51]

County	Total Number of Establishments	Total Number of Employees	Annual Payroll (million-dollars)
Bailey	23	273	6.214
Briscoe	9	61	1.53
Castro	23	139	3.40
Cochran	5	40	0.84
Crosby	18	160	3.94
Dawson	40	520	25.43
Deaf Smith	53	892	29.64
Dickens	10	48	1.29
Floyd	15	110	2.37
Gaines	64	671	22.65
Garza	19	185	4.67
Hale	94	1279	34.58
Hockley	66	1097	24.97
Lamb	34	359	9.73
Lubbock	1060	20,272	692.20
Lynn	12	81	2.23
Motley	4	37	0.63
Parmer	25	200	4.20
Swisher	14	133	4.00
Terry	39	424	13.63
Yoakum	29	297	7.78
Total	1,656	27,278	895.90

1.3.2.13 Services

The services group of businesses (NAICS codes 54, 56, 61, 72, and 81) includes accounting services, amusement services, business services, computer services, educational services, engineering services, funeral services, health services, legal services, management services, personal services, research services, and social services. The services group also includes automobile repair, automobile parking, barber shops, beauty shops, commercial sports, credit reporting, hotels and motels, motion pictures, personnel supply services, photographic studios, shoe repair and services to buildings. Additionally, membership organizations and services provided by local, state, and federal agencies are part of the services group of businesses. The leading types of services within the Llano Estacado Region are health services, business services, social services, and membership organizations. The 2022 Economic Census reported 3,919 services establishments in the Llano Estacado Region, with a value of $1,467 million in payroll (Table 1-16).

[51] USCB. 2024. Annual Retail Trade Survey: 2022. https://www.census.gov/data/datasets/2022/econ/cbp/2022-cbp.html

Table 1-16. Services 2022 Llano Estacado Region[52]

County	Total Number of Establishments	Total Number of Employees	Annual Payroll (million-dollars)
Bailey	46	332	7.03
Briscoe	7	27	0.44
Castro	52	399	9.83
Cochran	10	25	0.42
Crosby	16	47	1.02
Dawson	87	550	13.46
Deaf Smith	106	903	31.76
Dickens	11	30	0.81
Floyd	37	157	3.78
Gaines	154	1404	49.53
Garza	35	366	16.02
Hale	206	2295	61.75
Hockley	131	1108	27.62
Lamb	69	492	14.43
Lubbock	2700	38,004	1180.97
Lynn	20	109	5.15
Motley	7	10	0.12
Parmer	68	474	14.51
Swisher	39	215	4.77
Terry	67	456	12.09
Yoakum	51	291	11.73
Total	3,919	47,694	1,467.24

1.3.2.14 Finance, Insurance, and Real Estate

The finance, insurance, and real estate classification (NAICS codes 52 and 53) includes banks, savings and loans, non-depository institutions, security and commodity brokers, insurance carriers, insurance agents, brokers and services, real estate holdings and other investment offices. In 2022, the region's 1,508 finance, insurance, and real estate establishments provided 9,366 jobs with an annual payroll of over $615.70 million (Table 1-17).

[52] USCB. 2022. Economic Data. https://www.census.gov/data/datasets/2022/econ/cbp/2022-cbp.html

Table 1-17. Finance, Insurance, and Real Estate 2022 Llano Estacado Region[53]

County	Total Number of Establishments	Total Number of Employees	Annual Payroll (million-dollars)
Bailey	11	40	2.392
Briscoe	4	36	2.38
Castro	15	44	2.42
Cochran	5	10	0.86
Crosby	7	23	0.81
Dawson	29	108	7.26
Deaf Smith	45	222	12.34
Dickens	0	0	0.00
Floyd	12	57	2.86
Gaines	33	320	21.92
Garza	10	32	1.62
Hale	87	291	16.45
Hockley	59	248	16.94
Lamb	31	124	5.83
Lubbock	1077	7,451	498.73
Lynn	10	36	3.07
Motley	0	0	0.00
Parmer	21	99	6.90
Swisher	10	35	2.92
Terry	24	106	5.75
Yoakum	18	84	4.26
Total	1,508	9,366	615.70

1.3.2.15 Recreation

Most of the region's revenue derived from recreation comes from Lubbock County and is almost certainly due to Texas Tech University and other education institutions in the area. In rural areas of the Llano Estacado Region, spending on hunting and fishing comprise most recreation-based revenue. Based on 2020 data from the U.S. Census Bureau[54], annual payroll in the economic area of recreation was over $53 million. This figure includes the $51 million generated in Lubbock County.

While hunting and fishing will probably remain a substantial part of the outdoor recreation picture, the activity of ecotourism has been growing rapidly in the region since 1980. The definition of ecotourism is discretionary travel to natural areas that conserve the environmental, social, and cultural values, while generating an economic benefit to the local community. Ecotourists engage in activities, including bird watching, wildlife viewing, hiking, rock climbing, backpacking, camping, and outdoor photography. Forecasts are for this activity to increase within the Llano Estacado Region in the future, especially where water is available to attract wildlife. In addition, landowners can increase opportunities to attract hunters and ecotourists at low cost and little effort.

1.4 Current Water Use and Major Water Demand Centers

Residents of the Llano Estacado Region use water to grow crops and livestock, manufacture goods, and to meet energy needs. There are six major types of water use classifications in the Llano

[53] USCB. 2022. Economic Data. https://www.census.gov/data/datasets/2022/econ/cbp/2022-cbp.html

[54] USCB. 2022. Economic Data. https://www.census.gov/data/datasets/2022/econ/cbp/2022-cbp.html

Estacado Region: (1) agriculture irrigation; (2) agriculture livestock; (3) industrial manufacturing; (4) industrial mining; (5) industrial power generation; and (6) municipal.

1.4.1 Agriculture Irrigation Water Use

In the Llano Estacado Region, some agricultural producers pump water from aquifers to supplement precipitation for crop production. This choice means that irrigating producers pump more water during periods of drought than during years when precipitation is higher.

In 2017, the High Plains Underground Water Conservation District No. 1 (HPWD), which covers the majority of the Llano Estacado Region, reported 2,172,911 irrigated acres within the district. This total included 1,741,133 acres irrigated with center pivot systems, and 431,778 acres irrigated with subsurface drip irrigation[55]. In 2023, the HPWD reported 2,250,058 irrigated acres within the district. This total included 1,791,640 acres irrigated with center pivots and 458,418 acres irrigated with subsurface drip irrigation[56].

1.4.2 Agriculture Livestock Water Use

Cattle feeding and dairy operations constitute approximately 1 percent to 2.5 percent of the total demand in the Llano Estacado Region. Water classified as livestock water use is used for consumption by cattle, sanitation, and dust control.

1.4.3 Industrial Manufacturing Water Use

Water is used in a variety of ways for manufacturing purposes, including process uses (water used in the manufacture of products), cooling of portions of the manufacturing process, wash-down water for cleaning, water for employee drinking purposes, sanitary uses in restrooms, and landscape irrigation. The amount of water used for each purpose is usually particular to the type of industry. In the Llano Estacado Region, the major manufacturing uses of water are for food processing, industrial machinery and equipment, and fabricated metal products.

In response to the high costs to treat and dispose of wastewater, rising energy costs, and environmental considerations, industries use water more efficiently now than they did in the past. Some specific areas where savings are taking place are process modification or substitution, cooling water recycling and reuse, and steam and hot water conservation. Methods used in manufacturing to conserve cooling water may include use of saline water or treated wastewater, air cooling, and using recirculating cooling systems. Methods used to conserve water used for steam and hot water manufacturing processes include energy conservation and waste heat recovery.

1.4.4 Industrial Mining Water Use

Different types of mining or extractive industries use water in different ways. The primary water use in the mining industry in the Llano Estacado Region is for enhanced recovery of petroleum, such as with water injection and hydraulic fracturing. Sand and gravel mining operations also use water for

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[55] HPWD. 2017. Annual Report. https://static1.squarespace.com/static/53286fe5e4b0bbf6a4535d75/t/5a56223053450a0fe1c03fd7/1515594293311/2017+Annual+Report.pdf

[56] HPWD. 2023. Annual Report. https://www.hpwd.org/files/8cada94b1/2023+Annual+Report.pdf

their processes and dust suppression. Methods used to conserve freshwater may include the use of brackish or saline water, treated wastewater, or the capture and recirculation of used water.

1.4.5 Industrial Power Generation Water Use

In the Llano Estacado Region, steam-electric power is generated in Hale, Lamb, Lubbock, and Yoakum counties. A steam-electric plant works by heating water in a boiler to generate steam. The steam turns the turbine-generator, which produces electricity, after which the steam goes to a condenser to cool back into water. Most of the water used in steam-electric power generation is to cool the steam back into water. The condensed water returns to the steam generator to become steam again, and the cooling water discharges as wastewater or recycles through cooling ponds or towers. Within a steam-electric plant, make-up water replaces the water lost as steam, blowdown (purging) of boilers, washing of stacks, and power plant and employee sanitation.

Steam-electric power generation closely resembles manufacturing uses of water where steam is required; therefore, conservation practices in the two industries closely resemble each other. Water used for cooling purposes constitutes most water use in a steam-electric plant and is perhaps where the greatest water saving can be achieved. Methods used to conserve freshwater may include use of saline water or treated wastewater, air-cooling, and using recirculating cooling systems.

1.4.6 Municipal Water Use

Municipal water use, as defined by the TWDB, includes water used for residential and commercial purposes. Residential water use includes water for drinking, cooking, bathing, flushing toilets, general cleaning and sanitation, swimming pools, car washing, gardening, and lawn watering. Outside household use ranges from near zero in humid areas to 60 percent of total domestic use in arid areas.[57]

The TWDB municipal water use definition also includes water used by commercial facilities such as hotels, restaurants, laundries, car washes, office buildings, educational institutions, prisons, government and military facilities, retail establishments, public swimming pools, fire protection, and irrigation of public parks and open spaces. In the Llano Estacado Region, per capita municipal water use in 2011 was approximately 176 gallons per day (gpd), and the 2020 estimate was 165 gpd.

Although most counties in the Llano Estacado Region have small towns and communities, several major municipal demand centers exist within the region. The City of Lubbock is the largest demand center in the region for municipal and manufacturing water use. The major water demand centers for water used in oil and gas extraction are in counties located in the southern portion of the region, while large cattle feedlots, most of which are located in the northern half of the region, are the major demand centers for livestock water. Unlike water demand for municipal, manufacturing, electric power generation, and mining purposes, water demand for irrigation is throughout the region.

1.5 Current Water Supplies

Water sources used to supply water use demands within the Llano Estacado Region include groundwater, surface water, springs, and reuse. Groundwater is the primary water source in the

[57] U.S. Environmental Protection Agency (EPA). 2024. How We Use Water. https://www.epa.gov/watersense/how-we-use-water

Llano Estacado Region. Protecting water sources is critical for long-term management and use of the resource.

1.5.1 Groundwater

Groundwater is the primary source of water in the Llano Estacado Region. The principal aquifer in the Llano Estacado Region is the High Plains Aquifer[58], which consists of the Ogallala Aquifer, Dockum Aquifer, Edwards-Trinity (High Plains) Aquifer, and Rita Blanca Aquifer. The Llano Estacado Region overlies the southern part of the Ogallala Aquifer, small areas of the Seymour Aquifer and Blaine Aquifer, and two minor aquifers (Dockum and ETHP) (Figure 1-5 and Figure 1-6).

The Ogallala Aquifer, the most productive source of groundwater supply for the Llano Estacado Region, consists of the saturated section of the Ogallala Formation, as well as those underlying and overlying geologic units that are in hydraulic continuity. The Ogallala Formation consists chiefly of sediments deposited by headwater streams in the mountainous areas to the west and northwest. The Ogallala Formation was deposited on the eroded surfaces of underlying Triassic and Cretaceous aged sediments. In general, the Ogallala Formation is thicker in the northern part of the area, with the thickness ranging from 400 to 500 feet in central Parmer County, west central Castro County, and southwestern Floyd County to an edge where the formation pinches out against outcrops of older rocks.

The original layer of sediments that formed the Ogallala Formation extended from the Rocky Mountains eastward through north central Texas. The Ogallala Formation has subsequently eroded such that the segment in southeastern New Mexico and the Southern High Plains of Texas is isolated from underground connection with other water-bearing beds, except through underlying older sediments, which may contain highly mineralized water unlike the fresh water in the Ogallala Aquifer. In Texas and New Mexico, the source of the recharge to the Ogallala Aquifer is precipitation falling on the unconsolidated lacustrine, fluvial, and eolian deposits sediments that overlie the Ogallala Formation. Thus, these Quaternary-aged materials serve as important conduits for recharge to the Ogallala Aquifer. The amount of recharge depends on many factors, including the amount, distribution, and intensity of precipitation and the type of soil and vegetative cover. Research has estimated that recharge to the Ogallala Aquifer in Groundwater Management Area (GMA) 2 can vary from 0.25 inch to 2.25 inches per year[59].

Generally, the water in the Ogallala Aquifer occurs under water-table conditions, although locally it may be under slight artesian pressure. The water in the Ogallala Aquifer occupies the pore spaces or voids in the unconsolidated sediments. The thickness of the zone of saturation in the Ogallala Aquifer varies throughout the Llano Estacado Region, ranging from less than 1 foot to more than 300 feet. Transmissivities range from less than 500 gallons per day per foot (gpd/ft) to greater than 200,000 gpd/ft. Transmissivities tend to be greater than 5,000 gpd/ft, and average over 30,000 gpd/ft.[60] In general, the movement of water in the Ogallala Aquifer is from the northwest to the

[58] McGuire, V.L., M.R. Johnson, R.L., Schieffer, J.S. Stanton, S.K. Sebree, and I.M. Verstraeten. 2003. Water in storage and approaches to ground-water management, High Plains Aquifer, 2000: U.S. Geological Survey Circular 1243, U.S. Department of the Interior, Reston, Virginia, 51p.

[59] Texas Groundwater Management Area 2. https://gma2.hpwd.org/

[60] Brackish Groundwater Manual for Texas Regional Water Planning Groups. 2003. http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/2001483395.pdf

southeast. The water-table slopes roughly parallel to the slopes of both the bedrock and land surface. Estimates of the rate of water movement in the formation are approximately 150 feet per year.[61]

The water in the Ogallala Aquifer in the Llano Estacado Region is generally of good chemical quality, except that it is "hard," due to high levels of calcium and magnesium. Most of the water is suitable for irrigation and meets the U.S. Public Health Service primary standards for public supplies, although the waters from some wells have excessive fluoride and arsenic contents.

The long-term trend throughout much of the region has been a steady decline in the water table, due primarily to large quantities of water withdrawn for irrigation. The topography of the land surface, the proximity to areas of recharge or natural discharge, the proximity of pumping wells, and the configuration of the bedrock surface affect the depth to water below land surface. The depth to water in the aquifer within the region ranges from less than 50 feet to more than 300 feet.

The TWDB has identified and characterized nine major and 21 minor aquifers in the state based on the quantity of water supplied by each[62]. The Blaine Aquifer is located in the upper northwest corner of Motley County but does not provide a significant source of water for the Llano Estacado Region and therefore is not discussed in any further detail.

The stratigraphy of the region's aquifers and the formations that comprise them is depicted in Table 1-18. Throughout the area, recent aged fluvial deposits occur along major stream valleys. The Quaternary-aged Blackwater Draw Formation overlies the Ogallala Formation. The Ogallala Aquifer is composed of Tertiary-age sediments and is the most consistently productive aquifer in the area. Wells have been flow-tested to 800 gallons per minute (gpm) in Lubbock County, as recently as 2011[63]. However, thin saturated thicknesses limit productivity in some areas.

Table 1-18. Stratigraphy of the Llano Estacado Region

System	Formation	Aquifer
Quaternary	Ogallala	Ogallala
Tertiary		
Cretaceous	Duck Creek	Edwards-Trinity High Plains
	Kiamichi	
	Edwards	
	Comanche Peak	
	Walnut	
	Antlers	
Triassic	Cooper Canyon	Upper Dockum
	Trujillo	
	Tecovas	Lower Dockum
	Santa Rosa	
Permian	Dewey Lake	-
	Rustler	

[61] High Plains Underground Water Conservation District. http://www.hpwd.org/aquifers

[62] TWDB. 1995. Report 345, Aquifers of Texas. Austin, TX.

[63] Deeds, N.E., J.J. Harding, T.L. Jones, A. Singh, S. Hamlin, and R.R. Reedy. 2014. Conceptual Model for the High Plains Aquifer System Groundwater Availability Model. GAM report prepared for the Texas Water Development Board.

Cretaceous-aged sediments of the Edwards-Trinity High Plains (ETHP) Aquifer directly underlie the Ogallala Formation in much of the central portion of the Southern High Plains, extending from New Mexico on the west to Garza County on the east and into the southern portions of Bailey and Lamb counties to the north and the northern portions of Gaines and Dawson counties to the south. These sediments are comprised of the Trinity, Fredericksburg, and Washita groups, consisting primarily of sandstone, shale, and limestone, with the sandstone and limestone being the principal water-bearing units. The most consistently productive formation of the ETHP Aquifer is the Antlers sandstone. The Edwards and Comanche Peak formations also occasionally yield high-producing wells in areas where the limestone contains fractures and solution cavities of high permeability. In places where the ETHP Aquifer is in hydraulic continuity with the overlying Ogallala Formation, wells provide moderate quantities of water, particularly from the limestone. Locally, the ETHP Aquifer may be an important aquifer where other water is not available; however, the Cretaceous-aged sediments generally do not constitute a large source of water for irrigation or municipal use.

Upper Triassic-aged rocks underlie the Cretaceous formations or directly underlie the Ogallala Formation in the Llano Estacado Region. The Dockum sediments are comprised of the Cooper Canyon, Tecovas, Trujillo, and Santa Rosa formations. The Cooper Canyon, Trujillo, and Tecovas formations consist chiefly of interbedded siltstone, mudstone, sandstone, and shale, while the Santa Rosa Formation consists mainly of medium to coarse conglomeratic sandstone. The formations of the Dockum Group are capable of yielding small to moderate quantities of water in many parts of the region, particularly in the coarser-grained Santa Rosa Formation. However, in most places, the water quality can be saline to briny and probably unsuitable for most purposes. There are some areas, particularly in Deaf Smith County, where the Dockum Aquifer produces good supplies of fresh water.

Below the Triassic, rocks of Permian Age underlie the entire area and consist chiefly of red sandstone and shale containing numerous beds of gypsum and dolomite. The Permian Blaine Aquifer is considered a minor aquifer in Texas and is located at the east end of the High Plains in the northeast corner of Motley County. The Permian rocks are not a significant source of water in the Llano Estacado Region. Water in these rocks contains gypsum and salts, making it generally unsuitable for domestic use. However, livestock use this water in the Rolling Plains area.

1.5.2 Surface Water

Although the Llano Estacado Region lies within four river basins, there is little surface water. Dams have been built to take advantage of what surface water exists. In other segments of rivers, surface water amounts to a trickle. Little, if any, water leaves the region via streamflow. Following are descriptions of the region’s surface water resources by basin.

The Llano Estacado Region includes the upstream parts of four major river basins (Brazos, Canadian, Colorado, and Red) (Figure 1-5 and Figure 1-7). Within the Llano Estacado Region, most streams and rivers are intermittent. Almost no water flows out of the region via rivers.

1.5.2.1 Canadian River Basin

Beginning in northeastern New Mexico, the Canadian River flows eastward across the Texas Panhandle into Oklahoma and merges with the Arkansas River in eastern Oklahoma. Total drainage area of the basin is 12,700 square miles, of which 94 square miles are located in the Llano Estacado Region. Most of its course across the Panhandle is in a deep gorge. A tributary dips into Texas’ northern Panhandle and then flows to a confluence with the main channel in Oklahoma. Lake Meredith, formed by the Sanford Dam on the Canadian River provides water for 11 Panhandle cities, including Brownfield, Lamesa, Levelland, Lubbock, O'Donnell, Plainview, Slaton, and Tahoka within the Llano Estacado Region.

1.5.2.2 Red River Basin

In the Llano Estacado Region, the Red River Basin is bounded on the north by the Canadian River Basin and on the south by the Brazos River Basin. The Red River Basin extends from the headwaters in eastern Curry County, New Mexico, across the Texas High Plains to the southwestern corner of Oklahoma, near Childress, Texas, where the river becomes the Texas-Oklahoma border. The Red River Basin encompasses 6,681 square miles in the region.

The uppermost tributary of the Red River in Texas is Tierra Blanca Creek, which rises in Curry County, New Mexico, and drains into the Prairie Dog Town Fork a few miles east of Canyon. However, these tributaries do not supply significant quantities of water to users of the Llano Estacado Region. Major population centers located in the basin include the cities of Hereford (Deaf Smith County) and Tulia (Swisher County).

1.5.2.3 Brazos River Basin

In the Llano Estacado Region, the Brazos River Basin is bounded on the north by the Red River Basin and on the south by the Colorado River Basin and includes 8,732 square miles in the Llano Estacado Region. In the region, the Brazos River rises in three upper forks, the Double Mountain, Salt, and Clear Forks of the Brazos. However, the Brazos River proper is considered to begin where the Double Mountain and Salt Forks flow together in Stonewall County, east of the Llano Estacado Region. Major population centers located in the basin include the cities of Muleshoe (Bailey County), Littlefield (Lamb County), Plainview (Hale County), Levelland (Hockley County), Lubbock and Slaton (Lubbock County), and Post (Garza County). Lake Alan Henry (LAH) on the Double Mountain Fork in southeastern Garza County was built in 1993 to supply municipal water and industrial water to Lubbock.

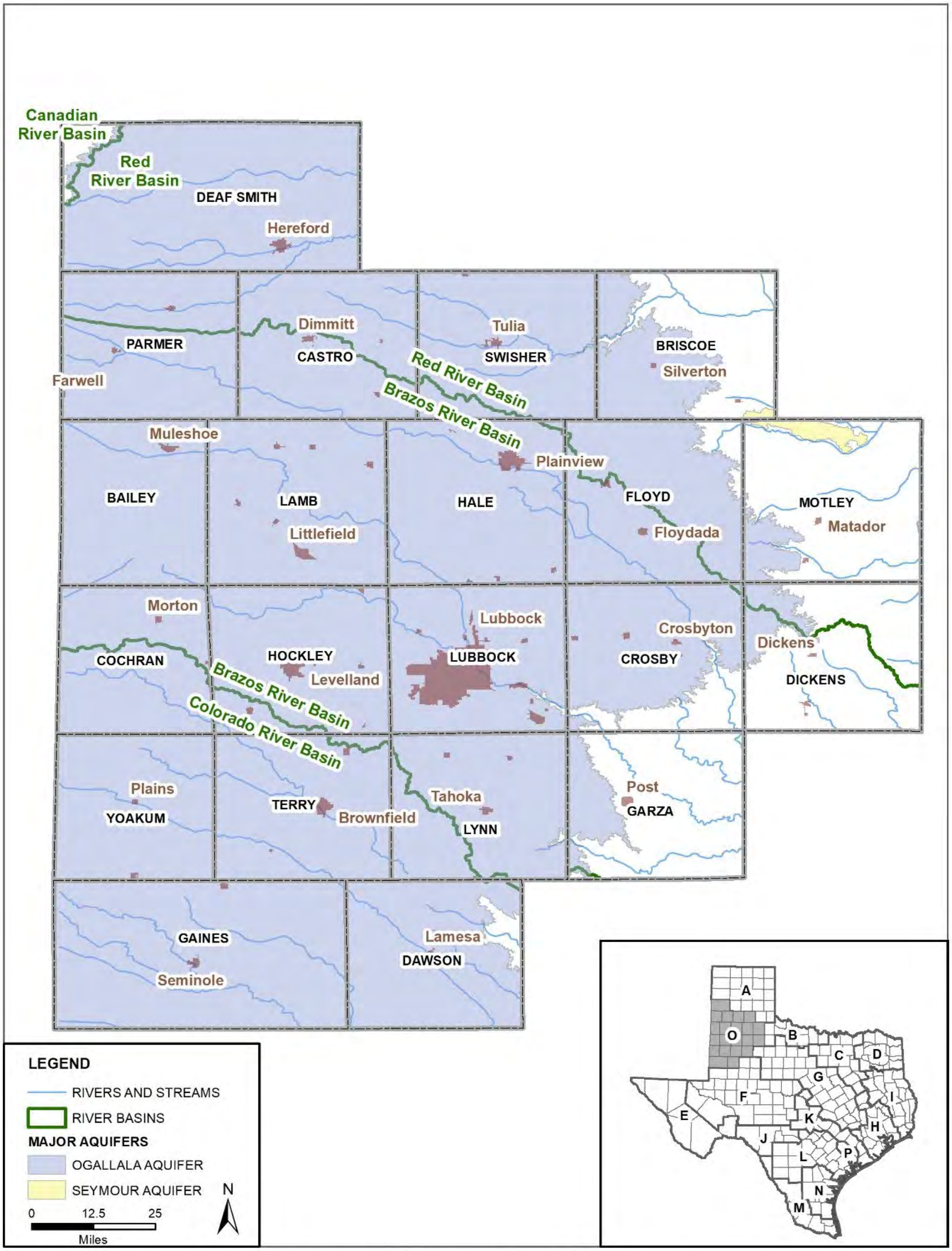

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Figure 1-5. Major Aquifers and River Basin Boundaries of the Llano Estacado Region

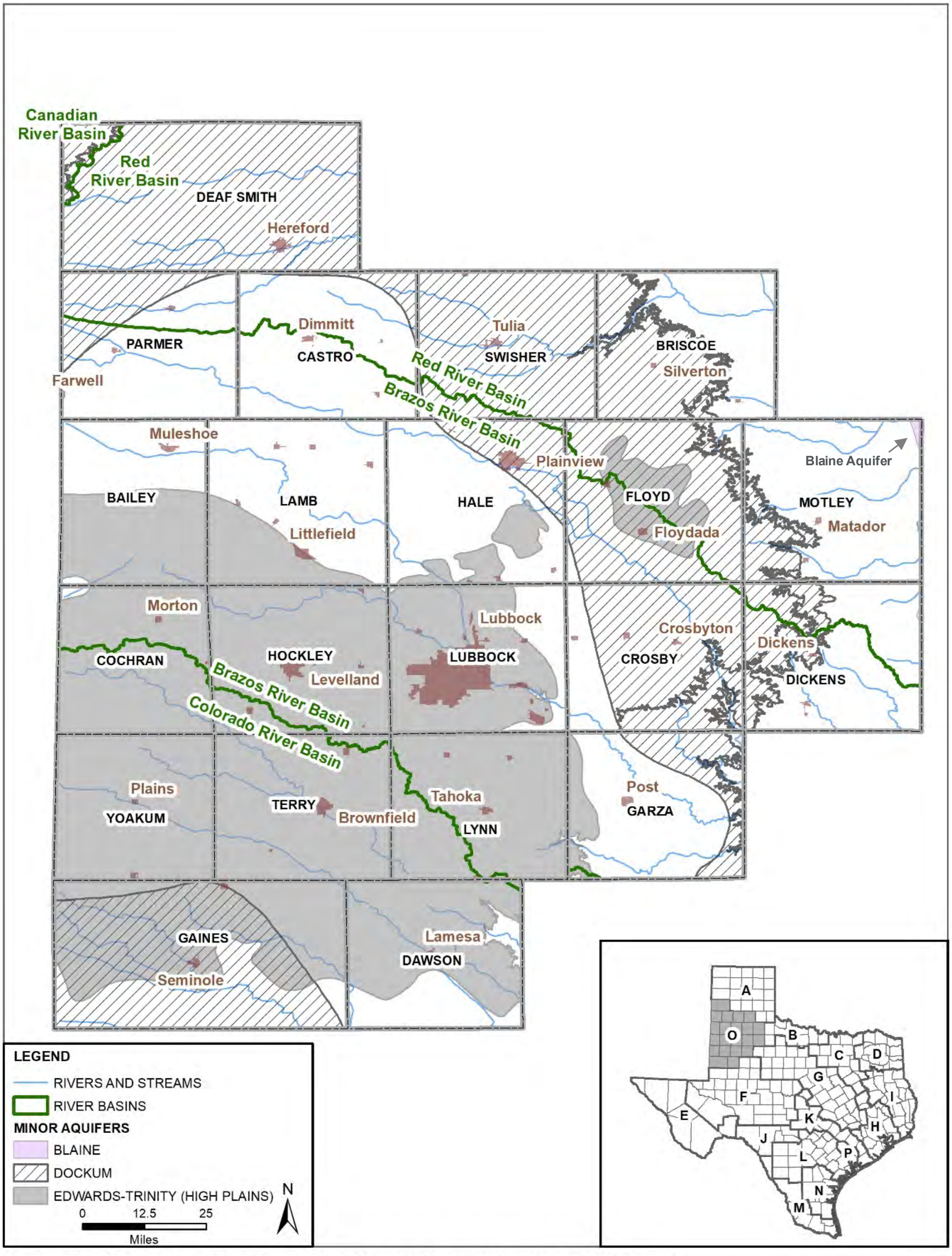

Figure 1-6. Minor Aquifers and River Basin Boundaries of the Llano Estacado Region

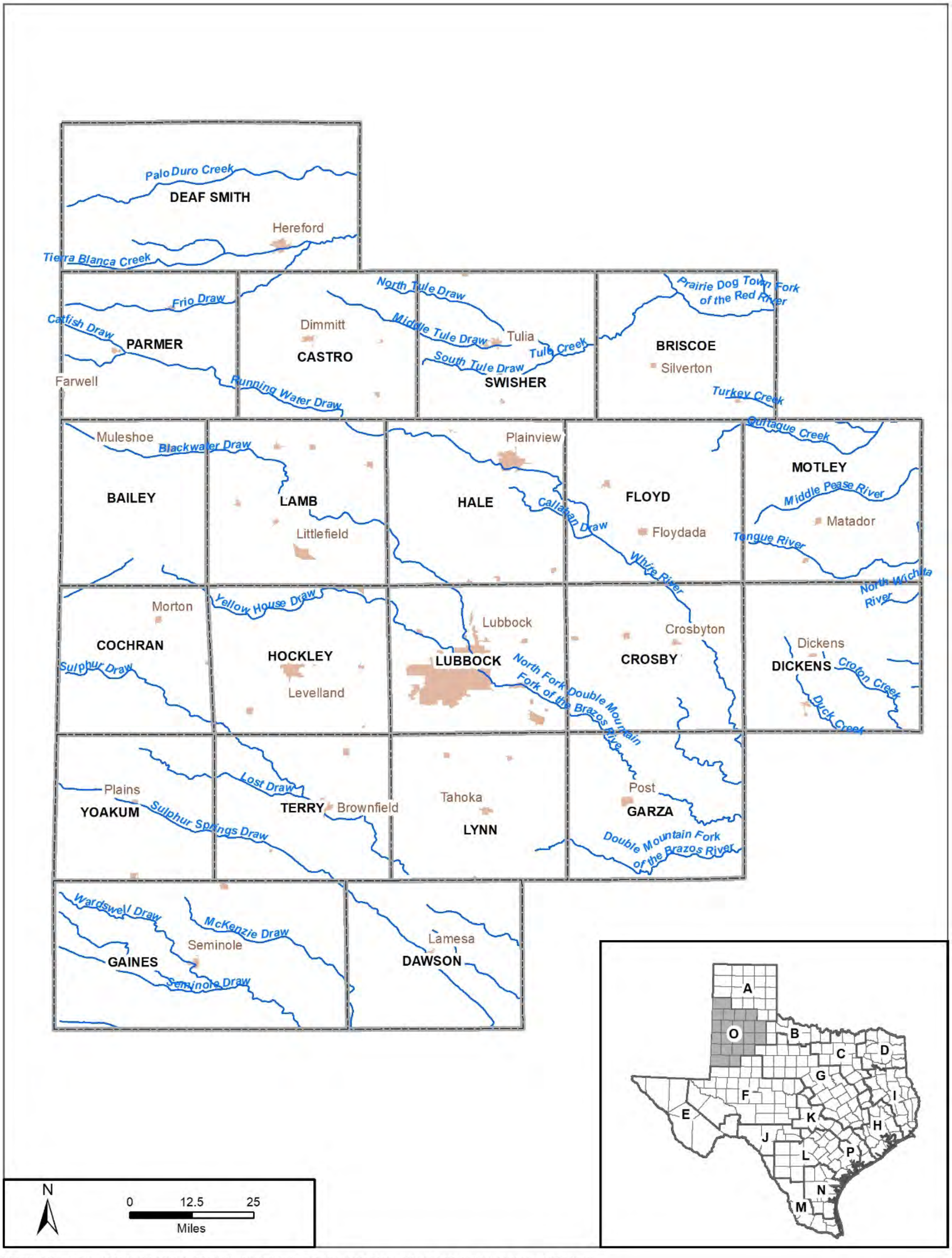

Figure 1-7. Rivers of the Llano Estacado Region

1.5.2.4 Colorado River Basin

In the Llano Estacado Region, the Colorado River Basin is bounded on the north by the Brazos River Basin and on the south by the Rio Grande Basin. The Colorado River Basin contains 4,787 square miles in the Llano Estacado Region. The headwaters of the Colorado River occur in eastern New Mexico, and the river course is to the southeast across Texas approximately 600 miles, discharging into Matagorda Bay and the Gulf of America. However, there is little flow within the Llano Estacado Region. Major population centers of the region located in the basin include the cities of Brownfield (Terry County), Denver City (Yoakum County), Lamesa (Dawson County), and Seminole (Gaines County). However, neither the Colorado River nor its tributaries supply water to any of these cities.

1.5.2.5 Developed Surface Water Resources

Development of surface water supply sources has been limited in the Llano Estacado Region simply because the area does not have flowing streams of any significance. However, four water storage projects are located nearby and supply water for municipal and industrial uses within the region. These four water storage projects are Lake Meredith, Mackenzie Reservoir, White River Lake, and LAH. Those cities that do not receive water from these reservoirs rely on groundwater to supply their water needs for both municipal and non-municipal purposes.

Lake Meredith

Lake Meredith, located in the Panhandle Region (Region A) in the Canadian River Basin in Potter, Moore, and Hutchinson counties, has a total storage capacity of 864,400 acre-feet (ac-ft) and can supply approximately 81,100 ac-ft of water per year when at conservation pool elevation[64]. Results from the 1995 TWDB hydrographic survey[65] indicate Lake Meredith encompasses around 16,411 surface acres and contains a volume of 817,970 ac-ft at the normal pool elevation of 2936.5 feet. The storage volume calculated by the 1995 TWDB survey is approximately 2.5 percent less than the 1980 sediment re-survey information for the lake. The lowest gated outlet invert elevation is at elevation 2850.0 feet resulting in a dead pool storage volume of 38,414 ac-ft. The conservation storage capacity of the lake is limited to 500,000 ac-ft in accordance with the interstate Canadian River Compact. Associated, supplemental projects to supply groundwater from Roberts County in the Panhandle Region have been implemented increase reliability and improve the quantity and quality of currently contracted supplies.

Mackenzie Reservoir

Mackenzie Reservoir is located in the Red River Basin in Swisher and Briscoe counties, and supplies water to Silverton, Tulia, Floydada, and Lockney. The reservoir has a total storage capacity of 45,500 ac-ft and can supply approximately 5,200 ac-ft of water per year when at conservation pool elevation. During recent dry conditions, Lake Mackenzie was unable to meet its contracted demands.

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[64] CRMWA. 2019. Lake Meredith. https://www.crmwa.com/lake-meredith

[65] TWDB. 2003. Volumetric Survey of Lake Meredith http://www.twdb.texas.gov/surfacewater/surveys/completed/files/meredith/1995-06/Meredith1995_FinalReport.pdf?d=3066.6349999955855

White River Lake

White River Lake is located in the Brazos River Basin in the southeast corner of Crosby County. It is owned and operated by the White River Municipal Water District (WRMWD), which supplies water to Ralls, Spur, Post, and Crosbyton. The lake has a surface area of 1,808 acres at conservation pool elevation, a drainage area of 173 square miles, and a total storage capacity of 44,897 ac-ft, and a water right of 6,000 ac-ft/yr. WRMWD purchased groundwater rights and drilled wells to supply its customers should the water levels in the reservoir drop below the level at which water can be removed.

Lake Alan Henry

LAH is located on the Double Mountain Fork of the Brazos River in Garza and Kent counties and is owned by the City of Lubbock. It is a critical, strategic water resource for the City of Lubbock, supplying drinking water to approximately 300,000 people and to industries in the South Plains. In 2017, LAH provided 19 percent of the water supply for the city. In the future, LAH may comprise up to 40 percent of the city's water supply.

The lake has a total storage capacity of 96,206 ac-ft and a firm yield of approximately 21,400 ac-ft per year based on the current (2017) area-capacity curves and sediment accumulation rates published in the September 2018 TWDB survey report[66].

1.5.2.6 Playa Lakes

Runoff in the region is collected in approximately 15,500 playa lakes located within the Llano Estacado Region[67, 68] (Figure 1-8). Playa lakes are naturally occurring depressions in the landscape of the Southern High Plains that provide the internal drainage for much of the region. Playa watersheds are closed systems, with playa floors representing the deepest parts of the watershed. Some playa floors are defined as wetlands by the presence of hydric, vertisol clay soil, usually Randall Clay, and despite being surrounded by intensive agricultural activities, the playa lakes perform many functions beneficial to humans and biota of the region.

Playa lakes comprise approximately 2 percent of the total land surface within the region. Most playa lakes are ephemeral, holding water only during and for a short period after rains, unless augmented by irrigation tailwater or urban runoff. Values for annual net lake surface evaporation range from a high of 54 inches per year for the southern portion of the region to a low of 45 inches per year in the north. TPWD describes playa lakes with the following excerpts of their description of "Panhandle Playa Lakes."[69]

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[66] TWDB. 2017. Volumetric Survey of Alan Henry Reservoir. https://www.waterdatafortexas.org/reservoirs/individual/alan-henry/rating-curve/TWDB/2017-08-01

[67] Guthery, F.S., F.C. Bryant, B. Kramer, A. Stoecker, and M. Dvoracek. 1981. "Playa Assessment Study", U.S. Water and Power Resources Service, Southwest Region, Amarillo, Texas.

[68] Playa Lakes Joint Venture, 2020. http://pljv.org/

[69] Texas Parks and Wildlife. Panhandle Playa Lakes https://tpwd.texas.gov/landwater/land/habitats/high_plains/wetlands/playa.phtml

Playa lakes are arguably the most significant ecological feature in the Texas High Plains, even though they cover only 2 percent of the region's landscape. Playa lakes are shallow, circular-shaped wetlands that are primarily filled by rainfall, although some playa lakes found in cropland settings may also receive water from irrigation runoff. Playa lakes average slightly more than 15 acres in size. Although larger playa lakes may exceed 800 acres, most (around 87 percent) are smaller than 30 acres.

Once the subject of much debate, mounting evidence points to playa lakes as a critical recharge source for the Ogallala aquifer. Playa lakes filter and recharge as much as 95 percent of the water collected in the southern portion of the aquifer. Recharge occurs both through playa lakes and along the perimeter (or annual rings) of playa lakes. Recharge occurring through playa lakes flows downward through large cracks in the clay lining. These cracks eventually swell shut and become impermeable as the clay absorbs water following a rain. Recharge occurring along playa perimeters takes place after rainfall events leave flood-water standing outside the clay-lined basins.

In times of abundant rainfall, they collect water and form lakes. Playa lakes have little elevation change as one proceeds across them in a horizontal gradient; playa floors are flat.

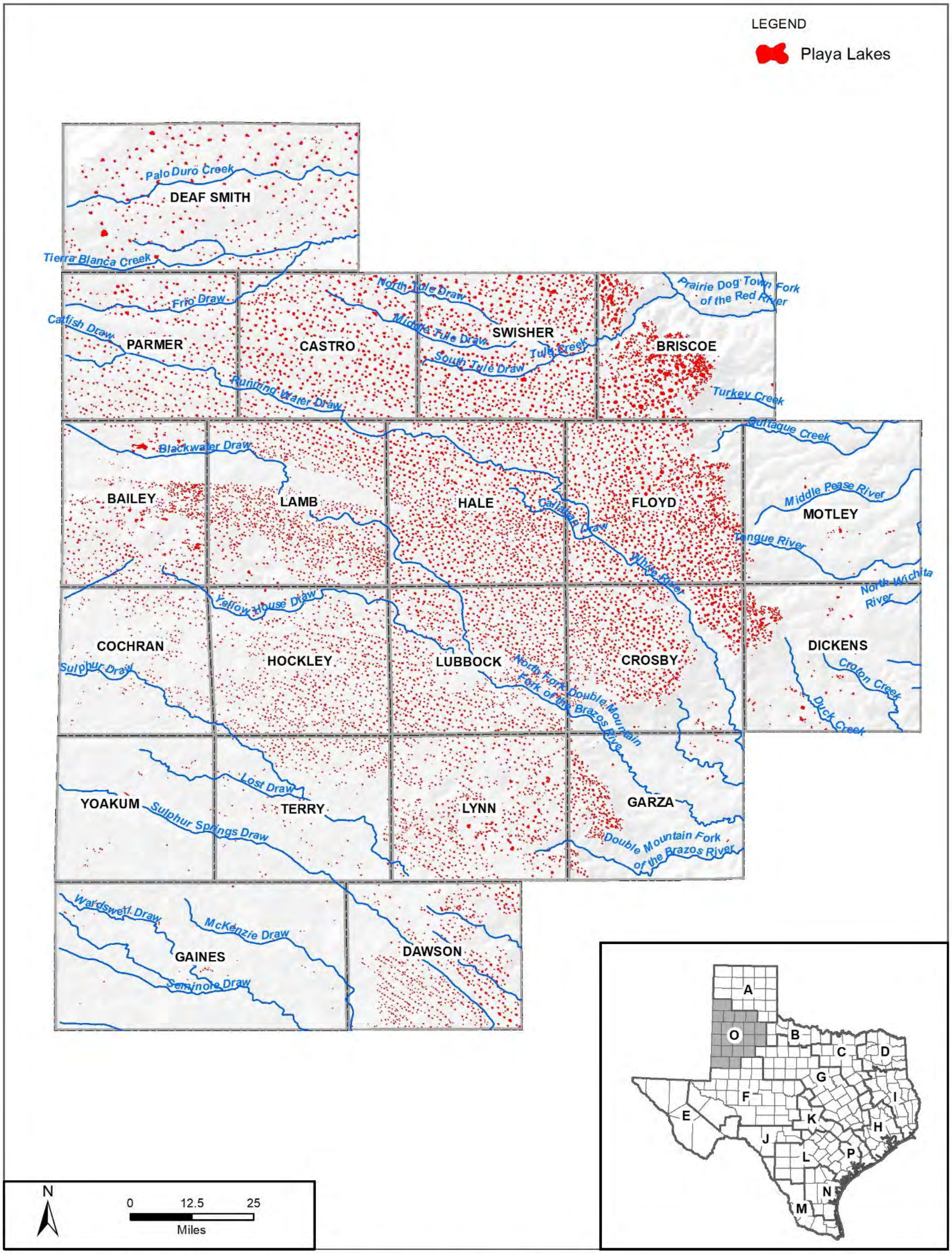

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Figure 1-8. Playa Lakes of the Llano Estacado Region

1.5.3 Springs

According to the TWDB's "Major and Historical Springs of Texas," there are four active springs located within the Llano Estacado Region (Hylsey, Roaring, Buffalo, and Couch Springs).[70] Hylsey Springs is located approximately 9 miles north of Vigo Park within Palo Duro Canyon in Briscoe County. Hylsey Springs produces water from the Santa Rosa Sandstone, which is the primary water-bearing unit of the Dockum Aquifer. Roaring Springs is located approximately 4 miles south of the Town of Roaring Springs in Motley County. Roaring Springs produces water from the Santa Rosa Sandstone (Dockum Aquifer) and the Ogallala Aquifer. Buffalo Springs is located approximately 9 miles southeast of the City of Lubbock. Buffalo Springs produces water from the ETHP Aquifer. Couch Springs, located approximately 8 miles east of Crosbyton in Crosby County, produces water from the Ogallala Aquifer. In addition, groundwater discharge to the Jim Bertram Lake System in the City of Lubbock has been confirmed, and additional seeps are often noted further downstream on the North Fork of the Double Mountain Fork of the Brazos River (North Fork)[71].

1.5.4 Reuse

Currently limited reuse occurs within the Llano Estacado Region. According to data provided by the TCEQ[72], four reuse authorizations exist in the region: one facility each in Dawson and Lubbock counties and two facilities in Hockley County. Additional reuse options are recommended to meet future water needs, as described in Chapter 5.

1.6 Major Water Providers

In response to the TWDB's new fifth cycle of planning requirements in 31 TAC § 357.30(4), the LERWPG designated five MWPs.

The Texas Water Code (TWC), Chapter 357.10(19) defines an MWP as follows:

> *"Major Water Provider (MWP)—A Water User Group or a Wholesale Water Provider of particular significance to the region's water supply as determined by the Regional Water Planning Group. This may include public or private entities that provide water for any water use category."*

The five MWPs designated by the LERWPG are the City of Lubbock, Canadian River Municipal Water Authority (CRMWA), Mackenzie Municipal Water Authority (MMWA), WRMWD, and the Red River Authority (RRA).

1.6.1 City of Lubbock

The City of Lubbock has four wholesale customers.

- Area in County-Other, Garza,
- Area in County-Other, Lubbock,
- Town of Ransom Canyon, and

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[70] TWDB. 1975. "Major and Historical Springs of Texas (Report No. 189)," March 1975.

[71] Ken Rainwater, Texas Tech University, 2020. Personal communication, February 18, 2020.

[72] Paul Brochi, Water Quality Division, TCEQ. 2019. Personal communication, April 18, 2019.

- City of Shallowater.

1.6.2 Canadian River Municipal Water Authority

In 1953, the Texas Legislature authorized CRMWA to organize as a legal entity and independent political subdivision of Texas for the purpose of implementing the Canadian River Project, which had been authorized by Congress in 1950. Eleven cities formed the authority: Amarillo, Borger, Pampa, Plainview, Lubbock, Slaton, Brownfield, Levelland, Lamesa, Tahoka, and O'Donnell. Under a tri-state compact, Texas was entitled to impound up to 500,000 ac-ft of water[73] in conservation storage in the (South) Canadian River Basin. CRMWA obtained a permit from the State of Texas to impound the water as allowed by the compact.[74] A dam was constructed on the Canadian River 9 miles west of Borger, Texas, and an aqueduct was constructed to deliver water from the reservoir to the member cities. The dam crossing the Canadian River 9 miles west of Borger is 226 feet high and 6,380 feet long. The aqueduct system, with 322 miles of pipeline, ten pumping plants, and three regulating reservoirs, has furnished municipal and industrial water to the cities of the authority since 1968. CRMWA acquired groundwater rights from property located in the Panhandle Region (Region A) and developed the John C. Williams Aqueduct & Wellfield to improve the quality and increase the quantity of water delivered via its aqueduct to its member cities. Since the end of 2001, a blend of surface water and groundwater has been supplied to the CRMWA member cities.

1.6.3 Mackenzie Municipal Water Authority

The MMWA was created in 1965 to manage and operate Lake Mackenzie. It consists of Floydada, Lockney, Silverton, and Tulia, each with allocated contracts.

- Floydada: 155 ac-ft/yr
- Lockney: 75 ac-ft/yr
- Silverton: 128 ac-ft/yr
- Tulia: 210 ac-ft/yr

Sometimes due to low lake levels, the MMWA is unable to deliver the full contracted allocation to its member cities as happened in 2014. Tulia and Floydada have existing city wells that are able to supply these cities with water if there is not surface water available. Silverton is working on developing new city wells. Lockney has developed wells in the ETHP Aquifer. Currently, Tulia is working on the infrastructure to run water from Tulia to Silverton.

[73] Canadian River Compact. 1950. https://www.tceq.texas.gov/assets/public/permitting/watersupply/water_rights/canadian_river_compact_1950.pdf

[74] Canadian River Compact. 1950. https://www.tceq.texas.gov/assets/public/permitting/watersupply/water_rights/canadian_river_compact_1950.pdf Entered into by New Mexico, Oklahoma, and Texas, the compact guarantees that Oklahoma shall have free and unrestricted use of all waters of the Canadian River in Oklahoma and that Texas shall have free and unrestricted use of all water of the Canadian River in Texas subject to limitations upon storage of water (500,000 ac-ft of storage until such time as Oklahoma has acquired 300,000 ac-ft of conservation storage, at which time Texas's limitation shall be 200,000 ac-ft plus the amount stored in Oklahoma reservoirs). New Mexico shall have free and unrestricted use of all waters originating in the drainage basin of the Canadian River above Conchas Dam and free and unrestricted use of all waters originating in the drainage basin of the Canadian River.

1.6.4 White River Municipal Water District

The WRMWD was created in 1957 to manage and operate the White River Lake. In addition to providing water from the White River Lake, WRMWD owns a well field capable of supplying groundwater to supplement surface water supplies during periods of shortages at the lake. WRMWD is comprised of the following members: Crosbyton, Post, Ralls, Spur, and rural county members. Each city is allocated the following amounts.

- Crosbyton: 179 ac-ft/yr
- Post: 414 ac-ft/yr
- Ralls: 202 ac-ft/yr
- Spur: 224 ac-ft/yr
- Rural County: 51 ac-ft/yr

1.6.5 Red River Authority

The RRA supplies water to 33 independent community water systems (within a 15-county service area), most of which are located in the Panhandle Region (Region A) and Region B RWPAs. In the Llano Estacado Region, the RRA supplies water to parts of Dickens and Motley counties.

1.7 Agricultural and Natural Resources

Agricultural and natural resources of the Llano Estacado Region heavily dominate the region's economy. Most of the Llano Estacado Region is cultivated cropland. The main crops are cotton, wheat, corn, grain, sorghum, peanuts, soybeans, and hay. The main livestock raised are feedlot animals, cattle, calves, beef cows, milk cows, swine, sheep, lambs, and poultry. The economic impact of these resources is further described in Section 1.3.2.

1.7.1 Physiography, Soils, and Vegetation

The Southern High Plains of Texas, spanning much of the Llano Estacado Region, is the most southerly extent of the Southern Great Plains of the United States. The relatively level plateau of the Southern High Plains contains many shallow depressions, or playa lakes. Land uses from the National Land Cover Database (NLCD)[75] are depicted in Figure 1-9. Broken terrain exists in the northwest corner of the planning region and on the eastern side of the planning region, which is part of the Rolling Plains physiographic region, below the Caprock Escarpment.

According to State Soil Geographic (STATSGO) dataset[76], there are 51 different soil types in the region, most of which are suitable for irrigation (Figure 1-10 and Figure 1-11). Classification of the original High Plains vegetation was mixed prairie, shortgrass prairie, and, in some locations on deep sandy soils, tallgrass prairie. Blue grama (*Bouteloua gracilis*), buffalograss (*Bouteloua dactyloides*), and galleta (*Pleuraphis* sp.) were the principal natural vegetation on the clay and clay loam soils. Characteristic grasses on sandy loam soils were little bluestem (*Schizachyrium scoparium*), western wheatgrass (*Pascopyrum smithii*), sideoats grama (*Bouteloua curtipendula*), and sand dropseed (*Sporobolus cryptandrus*).

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[75] https://www.mrlc.gov/data/nlcd-2016-land-cover-conus

[76] http://www.fsl.orst.edu/pnwerc/wrb/metadata/soils/statsgo.pdf

The High Plains area is characteristically free from brush, but sand sagebrush (*Artemisia filifolia*), along with pricklypear (*Opuntia* sp.) and yucca (*Yucca* sp.), have invaded the ranchland that have sandy and sandy loam soils. Honey mesquite (*Prosopis glandulosa*) has invaded the ranchland on most soils in the region, and saltcedar (*Tamarix spp.*) is considered a prevalent invasive species along several waterways, including the Double Mountain Fork of the Brazos River upstream of LAH, where the City of Lubbock has been spraying to eliminate the invasive species since 2013. Several grass species of dropseeds are abundant on land containing coarse sandy soils. The playa depressions, which can contain several feet of water after heavy rains, support unique patterns of vegetation within their confines. Aquatic species, such as curlytop smartweed (*Persicaria lapathifolia*), are associated with the playa lakes.

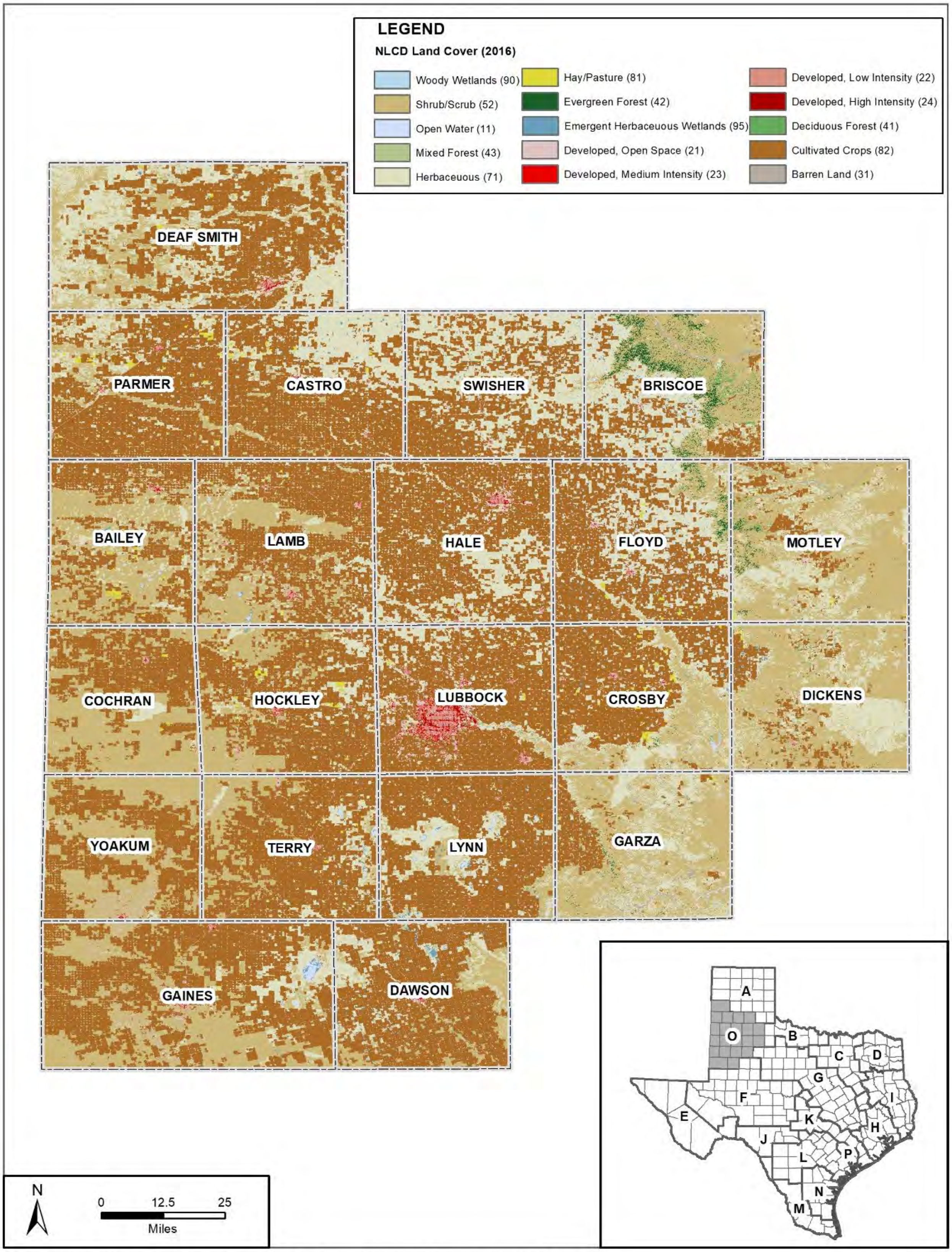

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Figure 1-9. Land Use Covers (NLCD 2016)

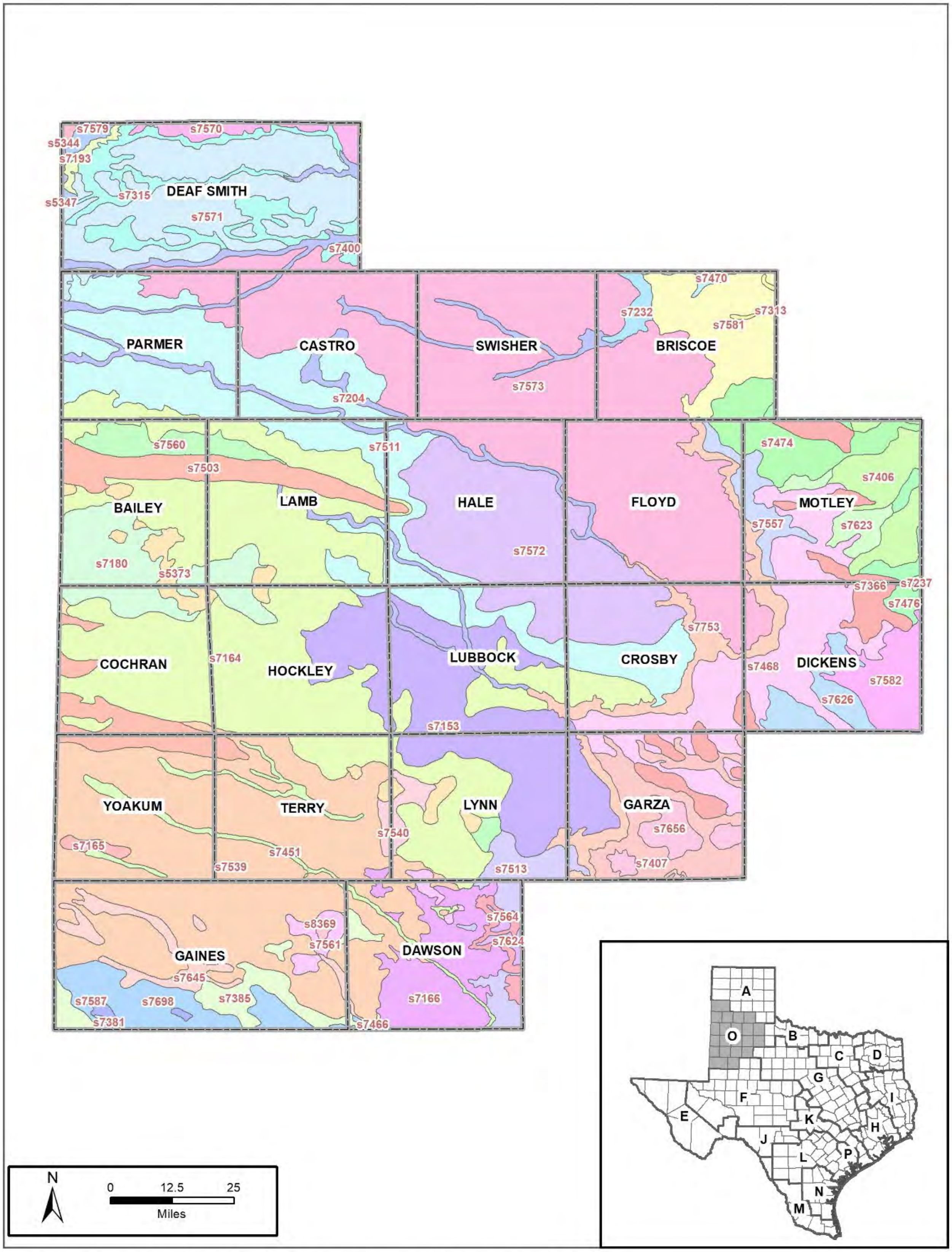

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Figure 1-10. Soils of the Llano Estacado Region (Region O)

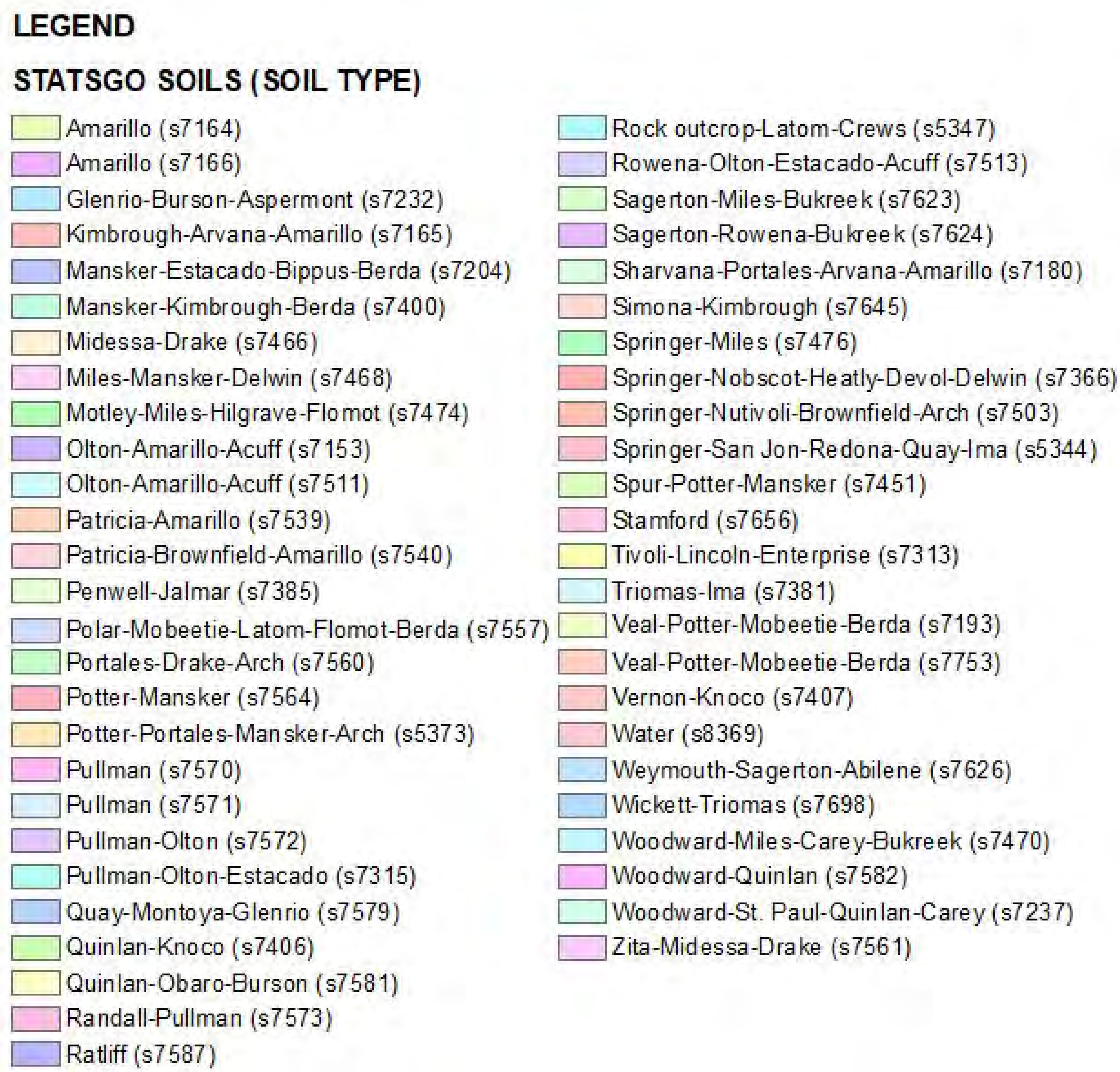

Figure 1-11. Soil Data of the Llano Estacado Region

1.7.2 Wildlife Resources

In the Region O planning region, U.S. Fish and Wildlife (USFWS) has 13 federally-listed species[77] and TPWD has nine species state-listed species and many others identified as rare or species of concern but with no official listing.[78] Table 1-19 shows the species that are listed as endangered, threatened or rare for the 21 counties in the Region O planning area.

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[77] USFWS. 2024. Information for Planning and Consultation. Accessed online on August 9, 2024 [IPaC: Explore Location resources (fws.gov)](https://ipac.ecosphere.fws.gov).

[78] TPWD. 2024. Rare, Threatened, and Endangered Species of Texas – Baily, Briscoe, Castro, Cochran, Crosby, Dawson, Deaf Smith, Dickens, Floyd, Gaines, Garza, Hale, Hockley, Lamb, Lubbock, Lynn, Motley, Parmer, Swisher, Terry, and Yoakum counties. Accessed online August 9, 2024 at http://tpwd.texas.gov/gis/rtest/

Table 1-19. Species Listed as Endangered, Threatened, Candidate, and Species of Greatest Conservation Need for the 21 counties in the Llano Estacado Region[79]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status[61]	TPWD Status[62]	Potential Occurrence in Counties
Amphibians					
Woodhouse's toad	*Anaxyrus woodhousii*	A wide variety of terrestrial habitats are used, including forests, grasslands, and barrier island sand dunes. Aquatic habitats are equally varied.	--	--	Resident
Birds					
Bald eagle	*Haliaeetus leucocephalus*	Found primarily near rivers and large lakes	--	--	Resident
Black rail	*Laterallus jamaicensis*	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps. Nests in or along marsh edges	T	T	Possible migrant
Chestnut-collared longspur	*Calcarius ornatus*	Occurs in open shortgrass settings especially in patches with some bare ground.	--	--	Resident
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries and along sandy beaches.	--	--	Possible migrant
Golden eagle	*Aquila chrysaetos*	Habitat description is not available at this time	--	--	Resident
Lark bunting	*Calamospiza melanocorys*	Overall, a generalist in most shortgrass settings including ones with some brushy components.	--	--	Resident
Lesser prairie chicken	*Tympanuchus pallidicinctus*	Arid grasslands, generally interspersed with shrubs	LE	--	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Northern Aplomado falcon	*Falco femoralis septentrionalis*	Open country, especially savanna and open woodland and sometimes in very barren areas. Grassy plains and valleys.	LE	--	Resident
Piping plover	*Charadrius melodus*	Beaches, sandflats and dunes along the Gulf Coast.	LT	--	Possible migrant
Rufa red knot	*Calidris canutus rufa*	Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and tidal flats/shore.	LT	--	Possible migrant
Sprague's pipit	*Anthus spragueii*	Habitat during migration and in winter consists of pastures and weedy fields.	--=	--	Possible migrant
Western burrowing owl	*Athene cunicularia hypugaea*	Open grassland, especially prairie, plains, and savanna	--	--	Resident

[79] TPWD. 2024. Rare, Threatened, and Endangered Species of Texas – Baily, Briscoe, Castro, Cochran, Crosby, Dawson, Deaf Smith, Dickens, Floyd, Gaines, Garza, Hale, Hockley, Lamb, Lubbock, Lynn, Motley, Parmer, Swisher, Terry, and Yoakum counties. Accessed online August 9, 2024 at http://tpwd.texas.gov/gis/rtest/

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status[61]	TPWD Status[62]	Potential Occurrence in Counties
White-faced ibis	*Plegadis chihi*	Prefers freshwater marshes, sloughs, and irrigated rice fields. Currently confined to near-coastal rookeries, nests in marshes.	--	T	Possible migrant
Crustaceans					
Salt playa fairy shrimp	*Phallocryptus sublettei*	Saline playa lakes ranging from a few meters to a kilometer in diameter; usually very shallow.	--	--	Resident
Fish					
Arkansas River shiner	*Notropis Girardi*	Canadian River. Typically found in turbid water over mostly silt and shifting sand substrates.	LT	--	Resident
Chub shiner	*Notropis potteri*	Brazos, Colorado, San Jacinto, and Trinity river basins. Found in flowing water with silt or sand substrate.	--	T	Resident
Peppered Chub	*Macrhybopsis tetranema*	Historically found throughout Arkansas River basin but is now only found in portions of the upper Canadian River upstream of Lake Meredith. Flowing water over coarse sand and fine gravel substrates in streams.	LE	--	Resident
Red River pupfish	*Cyprinodon rubrofluviatilis*	Native to Red River and Brazos River basins where typically found in saline waters of main channels and in saline springs.	--	T	Resident
Red River shiner	*Notropis bairdi*	Red River basin, typically found in turbid waters of broad, shallow channels of main stream, over bottom of silt and shifting sand.	--	--	Resident
Sharpnose shiner	*Notropis oxyrhynchus*	Range now restricted to upper Brazos River system upstream from Possum Kingdom Lake. May be native to Red and Colorado River basins. Typically found in turbid water over mostly silt and shifting sand substrates.	LE	E	Resident
Smalleye shiner	*Notropis buccula*	Appears to now be restricted to upper Brazos River system upstream of Possum Kingdom Lake. Typically in turbid waters of broad, sandy channels of main stream.	LE	E	Resident
Texas shiner	*Notropis amabilis*	Typical habitat includes rocky or sandy runs as well as pools.	--	--	Resident

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status[61]	TPWD Status[62]	Potential Occurrence in Counties
Insects					
No accepted common name	*Cicindela fulgoris albilata*	Habitat description is not available at this time.	--	--	Resident
American bumblebee	*Bombus pensylvanicus*	Habitat description is not available at this time.	--	--	Resident
No common name	*Bombus variabilis*	Habitat description is not available at this time.	--	--	Resident
No common name	*Eupseudomorpha brillians*	Habitat description is not available at this time.	--	--	Resident
Comanche harvester ant	*Pogonomyrmex comanche*	Habitat description is not available at this time.	--	--	Resident
Monarch butterfly	*Danaus Plexippus*	Native milkweed plants and other flowering plants.	C	--	Migrant
Mammals					
Big brown bat	*Eptesicus fuscus*	Any wooded areas or woodlands except south Texas. Riparian areas in west Texas.	--	--	Resident
Big free-tailed bat	*Nyctinomops macrotis*	Prefers to roost in crevices and cracks in high canyon walls	--	--	Resident
Black-tailed prairie dog	*Cynomys ludovicianus*	Dry, flat, short grassland with low, sparse vegetation	--	--	Resident
Cave myotis bat	*Myotis velifer*	Colonial and cave dwelling, also roosts in rock crevices, old buildings, under bridges, and old Cliff Swallow nests.	--	--	Resident
Eastern red bat	*Lasiurus borealis*	Found in a variety of habitats in Texas. Usually associated with wooded areas. Highly migratory.	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, etc.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Commonly found in unforested parts of the state and lowland deserts. Highly migratory.	--	--	Resident
Kit fox	*Vulpes macrotis*	Open desert grassland; avoids rugged, rocky terrain and wooded areas.	--	--	Resident
Long-tailed weasel	*Mustela frenata*	Includes brushlands, fence rows, upland woods and bottomland hardwoods, forest edges and rocky desert scrub. Usually close to water.	--	--	Resident
Mountain lion	*Puma concolor*	Rugged mountains and riparian zones.	--	--	Resident
Palo Duro mouse	*Peromyscus truei comanche*	Rocky, juniper-mesquite covered slopes of steep-walled canyons.	--	T	Resident
Pronghorn	*Antilocapra americana*	Prefers hilly, plateau areas of open grassland. Desert grassland and desert-scrub.	--	--	Resident
Swift fox	*Vulpes velox*	Restricted to current and historic shortgrass prairie	--	--	Resident

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status[61]	TPWD Status[62]	Potential Occurrence in Counties
Texas kangaroo rat	*Dipodomys elator*	Sandy loam surface soils with some clay to support short grasses.	PE	T	Resident
Townsend's big-eared bat	*Corynorhinus townsendii*	Variety of habitats, including from desert scrub to pinyon-juniper woodland, consistently in areas with canyons or cliffs.	--	--	Resident
Tricolored bat	*Perimyotis subflavus*	Forest, woodland and riparian areas. Caves are important to this species.	PE	--	Resident
Western hog-nosed skunk	*Conepatus leuconotus*	Woodlands, grasslands, and deserts up to 7,200 feet. Most common in rugged, rocky canyon country.	--	--	Resident
Western small-footed myotis bat	*Myotis ciliolabrum*	Usually in wooded areas, also found in grassland and desert scrub habitats.	--	--	Resident
Western spotted skunk	*Spilogale gracilis*	Brushy canyons, rocky outcrops (rimrock) on hillsides and walls of canyons.	--	--	Resident
Mollusks					
Edwards Plateau liptooth	*Daedalochila gracilis*	Habitat description is not available at this time.	--	--	Resident
Reptiles					
Dunes sagebrush lizard	*Sceloporus arenicolus*	Active and semi-stabilized sand dunes, dwarf shin-oak sandhills with sagebrush and yucca with open blowouts.	LE	--	Resident
Eastern box turtle	*Terrapene carolina*	Inhabits forests, fields, forest-brush, and forest-field ecotones.	--	--	Resident
Gray-checkered whiptail	*Aspidoscelis dixoni*	The habitat comprises rocky plains, dry washes, canyon bottoms, and desert scrub.	--	--	Resident
Roundtail horned lizard	*Phrynosoma modestum*	Seems to prefer rocky or gravelly substrates in open areas that are sparsely vegetated.	--	--	Resident
Slender glass lizard	*Ophisaurus attenuatus*	Variety of grassland, woodland and scrub habitats and areas near streams and ponds. Often in areas with sandy soils.	--	--	Resident
Texas garter snake	*Thamnophis sirtalis annectens*	Habitats used include the grasslands and modified open areas in the vicinity of aquatic features, such as, ponds, streams or marshes.	--	--	Resident
Texas horned lizard	*Phrynosoma cornutum*	Open, arid, and semi-arid regions with sparse vegetation	--	T	Resident

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status[61]	TPWD Status[62]	Potential Occurrence in Counties
Texas map turtle	*Graptemys versa*	Primarily a river turtle but can be found in reservoirs. Found in deep and shallow water with sufficient basking sites.	--	--	Resident
Western box turtle	*Terrapene ornata*	Prairie grassland, pasture, fields, sandhills, and open woodland.	--	--	Resident
Western massasauga	*Sistrurus tergeminus*	Shortgrass or mixed grass prairie, with gravel or sandy soils. Often found associated with more mesic habitats within the arid landscape.	--	--	Resident
Western rattlesnake	*Crotalus viridis*	Dry desert and prairie grasslands, shrub desert rocky hillsides, edges of arid and semi-arid river breaks.	--	--	Resident
Plants					
Cienega false clappia-bush	*Pseudoclappia arenaria*	Mostly in alkali sacaton grasslands on alkaline, gypseous or saline soils of alluvial flats around desert wetlands.	--	--	Resident
Correll's wild-buckwheat	*Eriogonum correllii*	Occurs on clay mounds, caprock, and rocky ledges on caliche substrates.	--	--	Resident
Cory's ephedra	*Ephedra coryi*	Dune areas and dry grasslands in southern Plains Country.	--	--	Resident
Cory's evening-primrose	*Oenothera coryi*	Calcareous prairies in the Plains Country.	--	--	Resident
Jones' selenia	*Selenia jonesii*	Wet clayey soils of stream margins, playa lakes, and roadsides.	--	--	Resident
Mexican mud-plantain	*Heteranthera mexicana*	Wet clayey soils along margins of playas in the Panhandle	--	--	Resident
Prairie butterfly-weed	*Gaura triangulate*	Open sandy areas.	--	--	Resident
Sticky tansy aster	*Xanthisma viscidum*	Occurs on calcareous or sandy soils in Chihuahuan Desert shrublands or mesquite grasslands.	--	--	Resident
Tall plains spurge	*Euphorbia strictior*	Occurs in shortgrass grasslands on dry rocky or, more commonly, deep sandy sites.	--	--	Resident

Notes:
Acronyms: USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department;
Statuses: E = State-listed Endangered; T = State-listed Threatened; PE = Proposed Endangered; PT = Proposed Threatened; C = Candidate for Listing; LE = Federally-listed Endangered; LT Federally-listed Threatened.

Additionally, the Llano Estacado Region planning area overlaps USFWS designated critical habitat for the sharpnose shiner and the smalleye shiner.

1.8 Identified Water Quality Concerns

1.8.1 Groundwater Quality

1.8.1.1 Ogallala Aquifer

The chemical quality of water in the Ogallala Aquifer is generally fresh; however, both dissolved solids and chloride concentrations increase from north to south.

1.8.1.2 Seymour Aquifer

Water quality in these alluvial remnants generally ranges from fresh to slightly saline. In Motley and Dickens counties, where the Seymour Aquifer is located within the Llano Estacado Region, high total dissolved solids (TDS) and nitrate concentrations can occur.

1.8.1.3 Edwards-Trinity (High Plains) Aquifer

Water quality in the aquifer is typically fresh to slightly saline and is generally poorer in quality than water in the overlying Ogallala Aquifer. Water quality deteriorates near the saline lakes in Dawson, Gaines, Lynn, and Terry counties.

1.8.1.4 Dockum Aquifer

Concentrations of dissolved solids in the groundwater range from less than 1,000 milligrams per liter (mg/L) near the eastern outcrop to more than 35,000 mg/L in the deeper parts of the aquifer in Gaines, Garza, Hockley, Lubbock, Lynn, and Terry counties. Relatively high sodium concentrations make the water undesirable for irrigation use in some areas, although this aquifer is used for irrigation in other areas. Within the aquifer, high concentrations of uranium, nitrates, radium-226, and radium-228 have exceeded the Texas primary drinking water standards. Irrigation and public supply use is limited to the areas of the Dockum Aquifer where water quality is acceptable. The cities of Dickens, Happy, Hereford, and Tulia use or have used water from the aquifer. In addition, some livestock feedlots use water from the aquifer as their primary water supply.

1.8.2 Surface Water Quality

The TCEQ's *Texas Integrated Report of Surface Water Quality* evaluates the quality of surface waters in the state, provides resource managers with a tool for making informed decisions when directing agency programs, and describes the status of Texas' natural waters based on historical data and the extent to which they attain the Texas Surface Water Quality Standards. The Texas integrated report satisfies the requirements of the federal Clean Water Act Sections 305(b) and 303(d). Surface water stream segments and impairments identified by TCEQ[80] are shown in Table 1-20.

[80] TCEQ Surface Water Quality Viewer. https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778

Table 1-20. Surface Water Stream Segments Identified by TCEQ[81]

Stream Segment[1]	Stream Name	County	Segment Class[2]	Impairment	Category	Year First Listed
0229B	Tierra Blanca Creek	Deaf Smith	Unclassified	No	n/a	n/a
0207	Lower Prairie Dog Town Fork Red River	Briscoe	Classified	Bacteria in water (recreational use)	5b	2006
1240A	White River above White River Reservoir	Floyd Crosby	Unclassified	No	n/a	n/a
0220	Upper Pease/North Fork Pease River	Floyd Motley	Classified	No	n/a	n/a
0221	Middle Fork Pease River	Motley	Classified	Chloride in water Sulfate in water Total Dissolved Solids in water	5c	2020 2020 2020
0227	South Fork Pease River	Motley	Classified	No	n/a	n/a
1241A	North Fork Double Mountain Fork Brazos River	Lubbock Crosby Garza	Unclassified	Bacteria in water (recreational use)	5c	2004
1241C	Buffalo Springs Lake	Lubbock	Unclassified	No	n/a	n/a
1238	Salt Fork Brazos River	Crosby Garza	Classified	Bacteria in water (recreational use) Chloride in water	5c	2020 2002
1240	White River Lake	Crosby	Classified	Chloride in water Total dissolved solids in water	5b	2002 2006
1239	White River	Crosby Garza	Classified	No	n/a	n/a
0218	Wichita/North Fork Wichita River	Dickens	Classified	Bacteria in water (recreational use)	5c	2022
0226	South Fork Wichita River	Dickens	Classified	Excessive algal growth in water Chloride in water	5c	2020 2006
1238A	Croton Creek	Dickens	Unclassified	No	n/a	n/a
1238B	Duck Creek	Dickens	Unclassified	Bacteria in water (recreational use)	5b	2022
1241D	South Fork Double Mountain Fork Brazos River upstream of confluence with North Fork Double Mountain Fork	Lynn Garza	Unclassified	No	n/a	n/a
1241B	Lake Alan Henry	Garza	Unclassified	Mercury in edible tissue	5c	2010

Order of stream segments is based on reviewing the TCEQ Surface Water Quality Viewer and reviewing county by county from north to south and west to east.

[1]Stream segments are individually defined by the TCEQ and assigned unique identification numbers. Stream segments are intended to have relatively homogeneous chemical, physical, and hydrological characteristics and provide a basic unit for assigning site-specific standards and for applying water quality management programs of the agency.

[2]Classified segments, also referred to as designated segments, refer to water bodies that are protected by site- specific criteria. Unclassified waters are those smaller water bodies that do not have site-specific water quality standards assigned to them, but instead are protected by general standards that apply to all surface waters in the state.

[81] TCEQ. 2024. Draft 2024 Texas Integrated Report – Texas 303(d) List (Category 5). https://www.tceq.texas.gov/downloads/water-quality/assessment/integrated-report-2024/2024-303d

1.8.2.1 Canadian River Basin

The principal water quality problems in the Canadian River Basin are elevated TDS and chloride levels. The Canadian River at the New Mexico-Texas state line is moderately saline during low flow due to natural conditions. The high chloride levels affect water quality in Lake Meredith. CRMWA, owner of the lake, has implemented a chloride control project to alleviate this problem. Work to further reduce chlorides in the Canadian River Basin is ongoing.

1.8.2.2 Red River Basin

High concentrations of TDS, sulfate, and chloride are a general problem in most streams of the Red River Basin under low flow conditions. These high salt concentrations are caused, in large part, by natural conditions due to the presence of saltwater springs, seeps, and gypsum outcrops. Saltwater springs are located in the western portion of the basin in the upper reaches of the Wichita River, the North and South Forks of the Pease River and the Little Red, which is a tributary to the Prairie Dog Town Fork of the Red River. Gypsum outcrops are found in the area ranging westward from Wichita County to the High Plains Caprock Escarpment. The water in these areas usually contains extremely high levels of dissolved solids. At times, TDS are comparable to those found in seawater. However, the streams supply practically no water to the Llano Estacado Region.

1.8.2.3 Brazos River Basin

Water quality in most reaches of the upper Brazos River Basin is considered to be fresh, although in some areas of the upper basin, high concentrations of natural salt contribute salt loads to area streams and rivers. Primary sources of salt include the watersheds of the Double Mountain and Salt Forks of the river. The Brazos River segment from the confluence with the Salt Fork of the Brazos River in Kent County to White River Dam in Crosby County contains above average concentrations of chloride, sulfate, and TDS. As White River Lake is a source of water for some cities in the region, this quality condition is important to this regional water supply planning effort.

1.8.2.4 Colorado River Basin

The Colorado Basin flows from Dawson County to Matagorda Bay and the Gulf of America. Due to a lack of perennially flowing streams in the upper Colorado River Basin, there are no regularly monitored water quality gauging stations along these streams (i.e., no water, no water quality concerns). There are no Llano Estacado Region reservoirs in this basin, and the one nearest to the Llano Estacado Region is J.B. Thomas, which has good water quality, but has had issues with TDS, chloride, and sulfates. Downstream of the reservoir, there are some issues with chlorides, low dissolved oxygen, and fecal coliform bacteria[82].

1.8.3 Natural Chlorides

Chloride contamination of groundwater in the Ogallala Aquifer occurs in several of the southern counties in the Llano Estacado Region. Stormwater runoff collects in lake basins, as does water discharged from springs from the Ogallala Aquifer. When the water evaporates from the basins, the minerals remain. When these minerals dry, they can be dissolved in rainwater and enter the aquifer.

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[82] LCRA, 2024. 2014 Basin Highlights Report. lcra.org/download/2024-lcra-basin-highlights-report/?wpdmdl=33817

1.8.4 Saltwater Disposal

Oilfields developed throughout the Llano Estacado Region contribute brine to area aquifers, lakes, streams, and rivers. Collective efforts of several state and local agencies have led the oil industry to eliminate the evaporation pit method of brine disposal. By the 1980s, most of the produced oilfield brine, not used in secondary recovery operations, was being properly disposed of by injection into deep formations. Both injection and disposal operations are performed under permits issued by the Railroad Commission of Texas. However, residual salts contained in and on soils near disposal sites that were in existence prior to the 1980s continue to seep into groundwater aquifers in the general proximity of each active or inactive oilfield. Other contributing sources are identified as originating from failures of abandoned wells that were improperly plugged, commingling between saltwater injection zones and freshwater formations, and accidental spills.

1.8.5 Urban Stormwater Runoff

Stormwater runoff from city streets generated during a storm event is perceived as a source of possible contamination of surrounding playa lake basins. Water in urban playa lakes in Lubbock is regularly monitored.

1.8.6 Nutrients Associated with Agricultural Production

The semi-arid climate, uniform topography, low-permeability soils, large depth to groundwater, and gradually sloping terrain of the Llano Estacado Region restrict the movement of agricultural nutrients. The geographic features of the region, in combination with farm and livestock management practices, reduce the threat to surface water and groundwater quality.

1.9 Identified Threats to Agriculture and Natural Resources

The Llano Estacado Region's agricultural business relies on groundwater for irrigation and water for livestock. The most important threat to agricultural and natural resources is the continuing groundwater depletion in the region. The Llano Estacado Region also recognizes the following additional potential threats to agricultural and natural resources:

- Shortage of freshwater and economically accessible groundwater attributable to increased irrigation demands;
- Sedimentation of surface water resources;
- Spread of invasive species, including salt cedar, juniper, zebra mussels, and golden algae, into surface water resources;
- Drought impact on reservoir levels;
- Improper land management practices of playa lakes;
- Water quality changes due to pesticide and fertilizer runoff, livestock operations, and modification of native wetland vegetation;
- Potential impacts to threatened, endangered, and other species of concern; and

- Water quality changes due to leaking abandoned wells (oil, gas, and water) and related industry infrastructure (pipelines, tank batteries).

1.10 Existing Local and Regional Water Plans

1.10.1 Regional Water Planning

1.10.1.1 City of Lubbock's 2018 Strategic Water Supply Plan

The City of Lubbock developed the 2018 Strategic Water Supply Plan (SWSP) to actively plan for future water supplies. The SWSP provides a "road map" to guide the development and implementation of cost-effective and sustainable water supplies over the next 100 years[83]. This 2018 SWSP includes multiple strategies to diversify the City of Lubbock's water supply portfolio to minimize risk associated with variable climatic conditions while emphasizing conservation efforts to delay expensive water supply projects. This 2018 SWSP is a comprehensive update of the 2013 SWSP and is being updated as additional information about specific strategies becomes available or as conditions change.

1.10.2 State Water Planning

SB1 was enacted by the 75th Session of the Texas Legislature in 1997. It specified that water plans be developed for regions of Texas and that future regulatory and financing decisions of the TCEQ and the TWDB be consistent with approved regional water plans. Furthermore, SB1 specified that regional water planning groups submit a regional water plan by January 2001, and at least as frequently as every 5 years thereafter, for TWDB approval and inclusion in the state water plan.

1.10.2.1 2021 Llano Estacado Region Water Plan

Regional water plans form the basis of the state water plan. The LERWPG approved the final 2021 Llano Estacado Region plan and it was submitted to the TWDB in September 2021. The strategies recommended by the 2021 and previous 2016 regional water plans for the Llano Estacado Region are shown in Table 1-21.

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[83] City of Lubbock 2018. Strategic Water Supply Plan. https://ci.lubbock.tx.us/storage/images/4G1pIUEKJzRJftCGkkPQyFewa9PVdySLl4ekNLWV.pdf

Table 1-21 Recommended Projects from 2016 and 2021 LERWPs[84]

Water Management Strategies	2016 Regional Water Plan	2021 Regional Water Plan
Municipal conservation	√	√
Agricultural conservation	√	√
Manufacturing conservation	-	√
Local groundwater development	√	√
Water reuse	√	√
Water Loss Reduction	√	-
Brackish groundwater desalination	√	√
Bailey County Well Field Capacity Maintenance	√	√
Brackish Well Field at the South Water Treatment Plant	√	-
CRMWA Aquifer Storage and Recovery	√	√
Direct Potable Reuse to North Water Treatment Plant	-	√
Jim Bertram Lake 7	√	√
Lake Alan Henry Phase 2	√	√
North Fork Scalping Operation	√	-
South Lubbock Well Field	√	-
Plainview Aquifer Storage and Recovery	-	√
South Garza Water Supply	√	-
Seminole Groundwater Desalination (Alternative)	-	√
Brackish Supplemental Water Supply for Bailey County Well Field (Alternative)	-	√
Direct Potable Resue to South Water Treatment Plant (Alternative)	-	√
North Fork Diversion at CR 7300 (Alternative)	-	√
North Fork Diversion to Lake Alan Henry Pump Station (Alternative)	-	√
Post Reservoir (Alternative)	-	√
South Fork Discharge (Alternative)	-	√
WMS = water management strategy; CRMWA = Canadian River Municipal Water Authority		

1.10.2.2 2022 State Water Plan

In *Water for Texas 2022 State Water Plan* (2022 State Water Plan)[85], the TWDB used information and recommendations from the 16 individual 2021 regional water plans developed by the regional water planning groups (RWPGs) established under SB1. In the State Water Plan, the TWDB acknowledges that each RWPG identified many of the same basic recommendations to meet future water demands. These recommendations include continuing regional planning funding, supporting groundwater conservation districts, controlling brush, reusing water, continuing support of

[84] TWDB. 2021. Llano Estacado Regional Water Plan. https://www.twdb.texas.gov/waterplanning/rwp/plans/2021/index.asp

[85] TWDB. 2022. State Water Plan: WATER FOR TEXAS. https://www.twdb.texas.gov/waterplanning/swp/2022/index.asp

groundwater availability modeling, providing conservation education, ongoing funding for groundwater supply projects, and supporting alternative water management strategies.

The 2022 State Water Plan projected a Llano Estacado Region water shortage of 1,500,000 ac-ft/yr in 2070[86]. The Llano Estacado Region had the highest unmet needs of any region in Texas, with most of this shortage occurring as irrigation needs. The 2022 State Water Plan recommended potential new water supply mostly in the form of existing supply made available through conservation and other water management strategies.

1.11 Historic Droughts of Record

In terms of severity and duration, the devastating drought of the 1950s is considered the drought of record (DOR) for most of Texas. In 1956, 244 of the 254 counties in the state were considered disaster areas. At that time, the 1950s drought included the second, third, and eighth driest years on record (1956, 1954, and 1951, respectively). This drought lasted almost a decade in many places and affected numerous states across the nation.

The Llano Estacado Region has experienced two recent droughts in 1996 and 2011 that were significant enough to necessitate considering them as DORs for the planning region. In 2011, severely decreased precipitation resulted in substantial declines in streamflow throughout Texas. Record high temperatures also occurred June through August leading to increased evaporation rates. The evaporation was so great that by August 4, 2011, state climatologist John Nielson-Gammon declared 2011 to be the worst 1-year drought on record in Texas[87]. The 2011 water year statewide annual precipitation was 11.27 inches, more than 2 inches less than the previous record low of 13.91 inches in 1956. In 2011, measured precipitation in the City of Lubbock equaled 5.86 inches, almost 3 inches less than the previous record of 8.73 inches in 1917[88].

1.12 Drought Preparations

Llano Estacado Region WUGs can prepare for drought by participating in the regional planning process, which attempts to meet projected water demands during a drought of severity equivalent to the DOR. In addition, WWPs and most municipalities develop individual drought contingency plans or emergency action plans to be implemented at each drought stage.

1.12.1 Overall Assessment of Local Drought Contingency Plans

Predicting the timing, severity and length of a drought is an inexact science; however, it is an inevitable component of the Texas climate. For this reason, it is critical to plan for these occurrences with policy outlining adjustments to the use, allocation, and conservation of water in response to drought conditions. Drought and other circumstances that interrupt the reliable supply or water quality of a source often lead to water shortages. During a drought period, there generally is a

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[86] TWDB. 2022. State Water Plan: WATER FOR TEXAS. Table https://www.twdb.texas.gov/waterplanning/swp/2022/index.asp

[87] Winters, K.E., 2013, A historical perspective on precipitation, drought severity, and streamflow in Texas during 1951-56 and 2011: U.S. Geological Survey Scientific Investigations Report 2013-5113, p. 1 http://pubs.usgs.gov/sir/2013/5113

[88] Nation Weather Service. 2011. NWS Lubbock 2011 Year End Summary. https://www.weather.gov/lub/events-2011-20111231-summary

greater demand on the already decreased supply as individuals attempt to maintain landscape vegetation through irrigation because less rainfall is available. This added demand can further exacerbate a water supply shortage situation.

TCEQ requires wholesale public water suppliers, retail public water suppliers serving 3,300 connections or more, and irrigation districts to submit drought contingency plans. In accordance with the requirements of TAC §288(b), drought contingency plans (DCPs) must be updated every 5 years and adopted by retail public water providers. TCEQ defines a DCP as “A strategy or combination of strategies for temporary supply and demand management responses to temporary and potentially recurring water supply shortages and other water supply emergencies.” [89] According to a TCEQ handbook[90], the underlying philosophy of drought contingency planning is that

- While often unpreventable, short-term water shortages and other water supply emergencies can be anticipated,
- The potential risks and impacts of drought or other emergency conditions can be considered and evaluated in advance of an actual event; and, most importantly,
- Response measures and best management practices (BMPs) can be determined with implementation procedures defined, again in advance, to avoid, minimize, or mitigate the risks and impacts of drought-related shortages and other emergencies.

Model DCPs are available on TCEQ’s website; however, it is not possible to create a single DCP that will adequately address local concerns for entities throughout the State of Texas. The conditions that define a water shortage can be location specific and depend on the water supply source. For example, some communities rely on LAH, yet others rely on groundwater aquifer systems that are considered at risk under location-specific conditions. While the approach to planning may be different between entities, DCPs should include the following.

- Specific, quantified targets for water use reductions,
- Drought response stages,
- Triggers to begin and end each stage,
- Supply management measures,
- Demand management measures,
- Descriptions of drought indicators,
- Notification procedures,
- Enforcement procedures,
- Procedures for granting exceptions,
- Public input to the plan,
- Ongoing public education,
- Adoption of plan, and
- Coordination with regional water planning groups.

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[89] TCEQ. Retail and Wholesale Requirements for Water Conservation & Drought Contingency Plans http://www.twdb.texas.gov/conservation/training/archives/more-than-a-drop-workshop/doc/5_%20TCEQ%20Rules.pdf

[90] TCEQ. 2005. Handbook for Drought Contingency Planning for Retail Public Water Suppliers, Austin, Texas. April 2005.

For water suppliers such as those in Llano Estacado Region, the primary goal of DCP development is to have a plan that can ensure an uninterrupted supply of water in an amount that can satisfy essential human needs. A secondary but also important goal is to minimize negative impacts on quality of life, the economy, and the local environment. In order to meet these goals, action needs to be taken in an expedient, pre-determined procedure, requiring that an approved DCP be in place before drought conditions occur.

In accordance with TAC, most Llano Estacado Region entities have submitted DCPs to implement when local shortages occur. The Llano Estacado Region was able to obtain DCPs for multiple WUGs and wholesale water providers (WWPs). These plans identify multiple triggers for initiation and termination of drought stages, responses to be implemented and reduction targets based on each stage. The plans also include information regarding public notification procedures and enforcement measures.

1.12.2 Summary of Existing Triggers and Responses

Through timely implementation of drought response measures, it is possible to meet DCP goals by avoiding, minimizing, or mitigating risks and impacts of water shortages and drought. Therefore, DCPs are built around a collection of drought responses and triggers based on each drought stage. Stages are generally similar in DCPs but can vary from entity to entity. Stage I will normally represent mild water shortage conditions, and the severity of the situation will increase through the stages until emergency water conditions are reached and, in some cases, a water allocation stage is determined.

The LERWPG compiled stage, trigger, and response information from DCPs in the region and summarized in Chapter 6, including those from WUGs, WWPs, and other entities. Compliance in most of the DCPs in the region is voluntary under Stage I and mandatory under Stage II and Stage III. Most entities included a Stage IV and a few plans specify Stage V and/or Stage VI scenarios. Target reductions, triggers, and responses are included for most stages in DCPs for Llano Estacado Region entities.

1.13 TWDB Water Loss Audits

In accordance with 31 TAC§357.7(a)(1)(M), the 2026 LERWP includes information compiled by the TWDB from water loss audits performed by retail public utilities of the Llano Estacado Region pursuant to 31 TAC§358.6.

In addition, in accordance with 31 TAC 357.7 (a)(7)(A)(iv), the LERWPG shall consider strategies to address any issues identified in the information compiled by the TWDB from the water loss audits performed by retail public utilities pursuant to 31 TAC§358.6.

House Bill 3338 (HB 3338) required the TWDB to compile the information included in the water audits by type of retail public utility and by RWPA, and to provide that information to the regional planning groups for use in identifying appropriate water management strategies (WMSs) in the development of their regional water plan. Retail public water suppliers are required to submit to the TWDB a water loss audit once every 5 years. The water supplies that have an active financial obligation with the TWDB or have 3,300 connections must submit an audit annually. The TWDB reported these data in the 2014, 2018, and 2022 water loss audits. The methodology used for the water loss audit forms relies upon self-reporting data provided by public utilities, and the selfreported data may then be unreliable and in need of further refinement. This water loss audit provides utilities with understanding of water loss in the distribution system and water loss over time.

The 2026 regional water planning development is based on utility-based planning for municipal WUGs, as delineated by water provider service areas, rather than political boundaries. The municipal WUGs include the following.

- Retail public utilities owned by a political subdivision providing more than 100 ac-ft/yr of water for municipal use;
- Privately-owned utilities that request inclusion as an individual WUG, provide more than 100 ac-ft/yr for municipal use for each owned water system, and are approved for inclusion as an individual WUG by the RWPG;
- State or federal-owned water systems that request inclusion as an individual WUG, provide more than 100 ac-ft/yr for municipal use, and approved for inclusion as an individual WUG by the RWPG; and
- Collective reporting units (CRU), or groups of retail public utilities that have a common association and are requested by the RWPG.

The TWDB provided the water loss data for 19 public utilities of the Llano Estacado Region that filed a water loss audit report for 2022 (Table 1-22). The City of Lubbock's 2023 data has been appended to the table because 2022 data was not reported. Twenty five percent of the 20 total entities report total losses exceeding 15 percent. The total losses for these reporting WUGs range from 1.5 percent to 26 percent. In accordance with 31 TAC§357.30, the LERWPG has considered strategies to reduce water losses as further described in Chapter 5.

Table 1-22. Summary of Water Loss Percentages Based on 2022 TWDB Water Loss Report

Water User Group	County Name	Total Apparent Losses (gallons)	Total Real Losses (gallons)	Total Loss (%)
City of Quitaque	Briscoe	2,945,042	5,695,969	16.7
Silverton Municipal Water System	Briscoe	922,441	6,307,625	26.1
City of Lorenzo	Crosby	499,681	5,827,589	14.2
City of Dickens	Dickens	1,129,292	1,709,701	18.8
Valley WSC	Dickens	75,893	2,141,008	14.5
City of Lockney	Floyd	5,190,631	6,859,081	12.0
City of Seminole	Gaines	15,612,010	141,456,234	23.8
Plainview Municipal Water System	Hale	73,201,131	48,624,098	4.1
City of Anton	Hockley	4,230,481	13,746,891	24.2
City of Smyer	Hockley	357,493	2,412,332	14.3
City of Levelland	Hockley	15,335,327	99,313,102	13.8
City of Idalou	Lubbock	13,649,450	5,139,481	3.7
City of Shallowater	Lubbock	5,321,693	2,124,114	1.5
City of Wolfforth	Lubbock	4,458,966	5,493,974	1.8
City of New Deal	Lubbock	1,481,708	700,010	2.5
Lubbock Public Water System[1]	Lubbock	359,155,436	573,047,977	4.5
City of Wilson	Lynn	665,493	2,477,906	14.0
City of New Home	Lynn	640,123	1,885,326	11.1
City of Tahoka	Lynn	2,041,125	4,654,080	3.7
City of Wellman	Terry	194,677	1,365,361	15.5

[1]Data from the 2023 Water Loss Report from TWDB
MWD = municipal water district; WSC = water supply corporation

1.14 Identification of Threats to Agricultural and Natural Resources and Water Management Strategy Evaluation

Regional water plan guidelines require identifying threats to agricultural and natural resources and discussions about how they will be addressed or affected by WMSs evaluated in the regional water plan. These environmental impacts include possible effects to agriculture, natural resources, wildlife habitat, cultural resources, and environmental water needs. Each WMS evaluation (presented in Chapter 5) includes a discussion of these environmental considerations and potential impacts associated with project implementation. The summary at the end of each WMS summary in Chapter 5 also includes water quality concerns and a table of wildlife species that could potentially be impacted by the proposed WMS.

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Population and Water Demand Projections

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Chapter 2: Population and Water Demand Projections

[31 TAC §357.31]

In order to develop water plans to meet future water needs, it is necessary to make projections of future population and water demands for the region. For the Llano Estacado Region, the Texas Water Development Board (TWDB) publishes both population and water demand projections for cities, rural areas, and water-using purposes for each of the region's counties (21 full counties). These counties are located in four major river basins (Brazos, Canadian, Colorado, and Red; see Table 1-1 in Chapter 1). The TWDB also developed projections for a county-other category to account for people living outside the cities or service areas of defined water user groups (WUGs) for municipal water use in each of the 21 counties in the region. In accordance with the TWDB Rules, Section 357.31(e)(1), the regional water planning groups (RWPGs) use population and water demand projections developed by the executive administrator that will be contained in the next state water plan and adopted by the TWDB after consultation with the RWPGs, Texas Commission on Environmental Quality (TCEQ), Texas Department of Agriculture (TDA), and the Texas Parks and Wildlife Department (TPWD). The TWDB-approved population and water demand projections are presented in this chapter.

2.1 Population Projections

The TWDB projects that the population of the Llano Estacado Region will increase from 564,047 in 2030 to 817,498 by 2080, an increase of 44.9 percent (Table 2-1 and Figure 2-1). Approximately 85.8 percent of the population of the region is projected to reside in the Brazos Basin in the year 2080, with 10.3 percent in the Colorado River Basin (Table 2-2).

Table 2-1. Population Projections, Llano Estacado Region, Individual Counties with River Basin Summaries

County/ River Basin	Population Projections					
	2030	2040	2050	2060	2070	2080
Counties						
Bailey	6,996	7,153	7,155	7,179	7,204	7,230
Briscoe	1,301	1,203	1,134	1,054	971	885
Castro	7,198	7,024	6,799	6,625	6,444	6,255
Cochran	2,384	2,233	2,082	1,942	1,796	1,644
Crosby	4,762	4,433	4,037	3,663	3,273	2,867
Dawson	12,342	12,302	12,210	12,024	11,830	11,628
Deaf Smith	19,367	19,492	19,289	18,823	18,337	17,831
Dickens	1,592	1,483	1,328	1,181	1,028	869
Floyd	5,043	4,758	4,470	4,212	3,943	3,663
Gaines	25,154	30,014	34,831	39,552	44,611	50,032
Garza	5,660	5,501	5,250	4,905	4,546	4,172
Hale	33,015	32,465	31,253	29,960	29,000	28,102
Hockley	21,758	21,831	21,558	21,281	20,992	20,691
Lamb	12,846	12,761	12,522	12,265	11,997	11,718
Lubbock	361,834	401,911	442,502	494,185	549,570	608,921
Lynn	5,500	5,387	5,278	5,114	4,943	4,765
Motley	985	911	856	850	844	838
Parmer	9,809	9,721	9,471	9,210	8,938	8,655
Swisher	6,687	6,458	6,172	5,924	5,666	5,397
Terry	11,908	12,074	12,061	12,013	11,963	11,911
Yoakum	7,906	8,271	8,596	8,861	9,137	9,424
Total	564,047	607,386	648,854	700,823	757,033	817,498
River Basin Summaries						
Brazos	470,364	508,603	545,719	593,788	645,770	701,652
Canadian	7	7	6	5	3	1
Colorado	58,848	64,153	69,102	73,769	78,769	84,121
Red	34,828	34,623	34,027	33,261	32,491	31,724
Total	564,047	607,386	648,854	700,823	757,033	817,498

Source: Texas Water Development Board (TWDB), Consensus Projections adopted by the TWDB, November 2023.

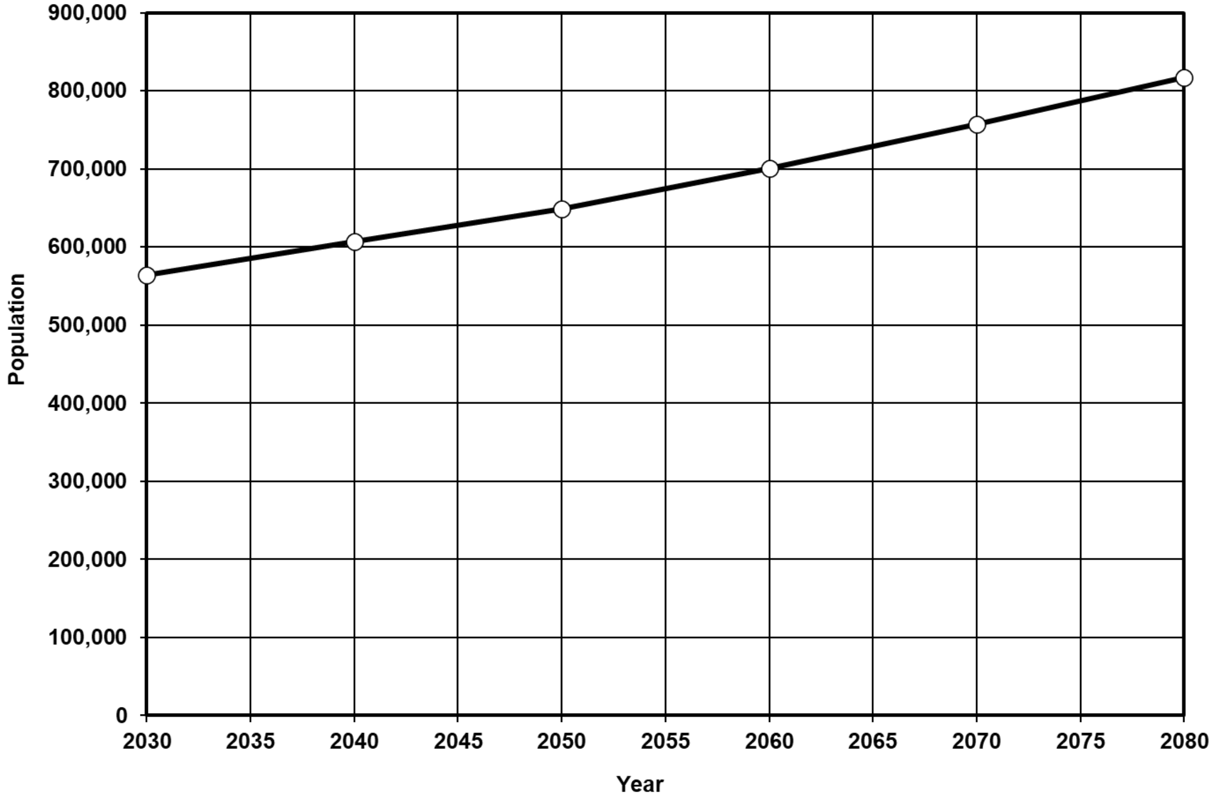

Figure 2-1. Summary of Llano Estacado Region Projected Population

Table 2-2. Municipal Water Demand Projections, Llano Estacado Region, Individual Counties with River Basin Summaries

County/ River Basin	Water Demand Projections (acre-feet/year)					
	2030	2040	2050	2060	2070	2080
Counties						
Bailey	1,240	1,264	1,274	1,290	1,312	1,342
Briscoe	307	283	267	249	229	208
Castro	1,383	1,352	1,314	1,289	1,263	1,238
Cochran	616	574	535	498	458	419
Crosby	705	655	596	540	484	423
Dawson	2,294	2,275	2,253	2,213	2,172	2,127
Deaf Smith	3,830	3,877	3,886	3,860	3,846	3,852
Dickens	236	218	196	175	152	128
Floyd	745	702	664	629	593	556
Gaines	4,516	5,158	5,803	6,401	7,051	7,754
Garza	712	688	657	614	569	522
Hale	5,678	5,607	5,479	5,340	5,194	5,067
Hockley	3,278	3,270	3,225	3,180	3,131	3,082
Lamb	2,046	2,020	1,986	1,950	1,915	1,882
Lubbock	61,251	68,027	75,006	83,690	92,971	102,884
Lynn	744	726	712	690	666	642
Motley	252	233	219	217	216	214
Parmer	1,890	1,873	1,837	1,797	1,760	1,721
Swisher	1,032	992	944	904	863	818
Terry	1,746	1,764	1,767	1,768	1,770	1,773
Yoakum	1,910	1,995	2,073	2,133	2,191	2,253
Total	**96,411**	**103,553**	**110,693**	**119,427**	**128,806**	**138,905**
River Basin Summaries						
Brazos	78,958	85,414	91,938	100,152	108,950	118,394
Canadian	1	1	1	1	0	0
Colorado	10,875	11,587	12,265	12,860	13,503	14,198
Red	6,577	6,551	6,489	6,414	6,353	6,313
Total	**96,411**	**103,553**	**110,693**	**119,427**	**128,806**	**138,905**

Source: Texas Water Development Board (TWDB); Consensus Projections adopted by the TWDB, November 2023.

The TWDB developed county population projections based on projections developed by the Texas State Data Center (TSDC) and the Office of the State Demographer. The TSDC and the Office of the State Demographer used a model called the Cohort-Component Model to develop the county projections. Using this model, the population projection is equal to the base population plus natural changes (births minus deaths) plus net migration. The migration rate applied for a given county is based on a percentage of the historical migration rate observed for that county between 2010 and 2020.

Projections for the individual WUGs were developed by allocating growth from the county projections to the cities and rural areas not served by a water utility in a given county, known as county-other in the TWDB planning process (i.e., the sum of all WUG populations within a county equals the total county projection). In previous plans, county populations were not allowed to decline; however, in this plan, the county population projections have been allowed to follow the trends projected by the Texas Demographic Center, including declines.

The TWDB population projections for 51 municipal WUGs (individual cities and water supply districts and/or authorities), 34 rural areas of each county, and county or part of county located within each river basin area of the Llano Estacado Region are shown in Appendix A.

2.2 Municipal Water Demand Projections

Municipal water demand is primarily for drinking, bathing, dish and clothes washing, cleaning, sanitation, air conditioning, and landscape watering for residential and commercial establishments and public offices and institutions. Residential and commercial uses are categorized together because they are similar types of uses and they are usually served treated water of drinking quality from a common system (e.g., a public water system). The projected quantity of water needed for municipal purposes depends upon the size of the population of the service area, climatic conditions, and water conservation measures. In addition to these factors, per capita water use (gallons per person per day [gpcd]) is a key municipal water planning parameter. Population and per capita water use are used to make projections of municipal water demand for each of the 85 municipal WUGs of the Llano Estacado Region (Appendix A).

Municipal water demand is calculated by multiplying population by per capita water use (gpcd), which is a measure of daily water consumption per person. The TWDB calculates a unique gpcd for each WUG based on the following equation:

$$\text{GPCD} = \text{Total annual water used} / \text{Total population} / 365 \text{ days}$$

To ensure that water demand projections are based on dry-year conditions, the TWDB uses a “Dry Year Designation.” That is, the TWDB requires that the base year for GPCD calculations be the driest year on record from 2006 onward. For all counties in the Llano Estacado Region, the base year is 2011.

Unlike previous plans, future savings from additional faucet and dishwasher replacements were not considered in the plumbing code savings for this current planning cycle. Based on the effective year of the relevant plumbing code standards (the State Water-Efficient Plumbing Act, passed in 1991, and House Bill 2667, passed in 2009) and the useful life of these items, the expected water efficiency savings by replacements and new growth are shown to be fully realized by the first projected decade (2030). Therefore, per capita water use in the Llano Estacado Region is projected to remain steady over the planning period at 152 gpcd (Figure 2-2). However, due to projected population growth between 2030 and 2080 for some WUGs, municipal water demand in the Llano Estacado Region is projected to increase from 96,411 acre-feet per year (ac-ft/yr) in 2030 to 138,905 ac-ft/yr in 2080 (Figure 2-2 and Table 2-2).[91]

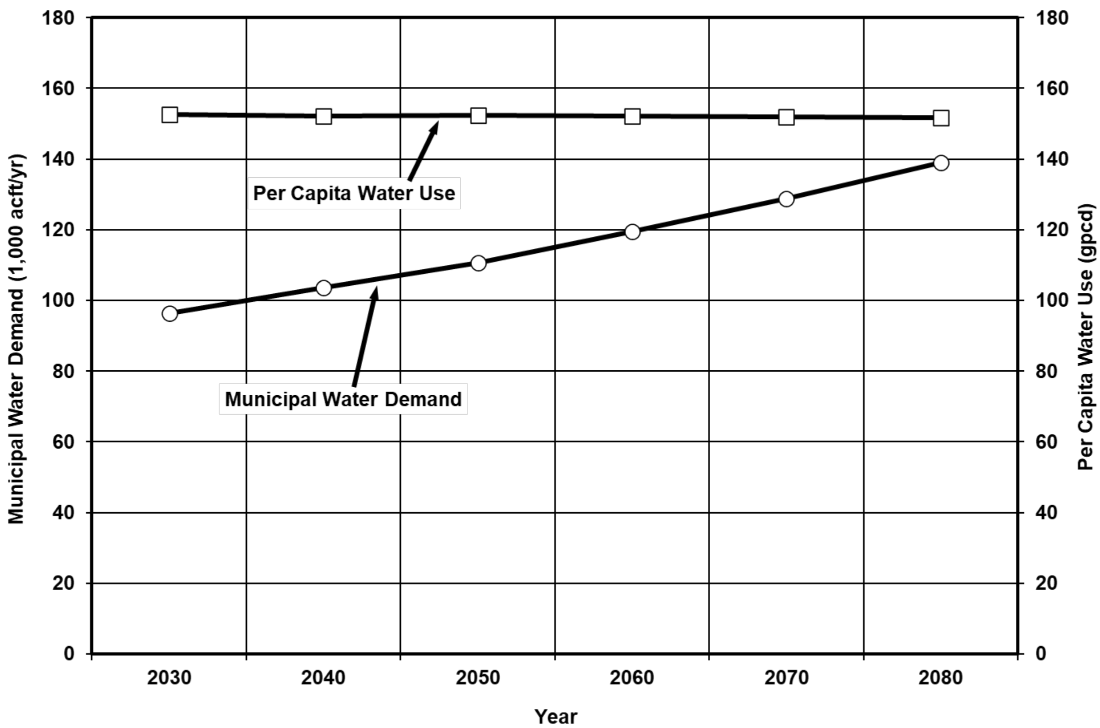

Figure 2-2. Projected Per Capita Water Use and Municipal Water Demand Llano Estacado Region – 2030 to 2080

2.3 Manufacturing Water Demand Projections

The use of water for the production of goods for domestic and foreign markets varies widely among manufacturing industries in Texas. Manufactured products in Texas range from food and clothing to refined chemical and petroleum products to computers and automobiles. Some processes require direct water consumption as part of the products being manufactured, while others require very little water consumption, but use large volumes of water for cooling or cleaning purposes. Five manufacturing industries account for approximately 90 percent of water used by all manufacturing industries in Texas. These five water-intensive industries are chemical products, petroleum refining, pulp and paper, food and kindred products, and primary metals.

The manufacturing water demand projections are based on the highest region-county manufacturing water use in the most recent five years of aggregated data (2015 through 2019) for manufacturing water users from the annual water use survey (WUS). Values from the WUS used in the maximum year calculation consist of gross intake (withdrawals and purchases) minus any sales to other

[91] One acre-foot (ac-ft) is 325,851 gallons.

entities. Demands are projected linearly using County Business Patterns[92] number of manufacturing establishments.

Major water-using manufacturing sectors in the Llano Estacado Region are food processing, industrial machinery and equipment, and fabricated metal products. Ten counties in the Llano Estacado Region have manufacturing facilities that use water. Manufacturing water demands in the Llano Estacado Region are projected to increase from 7,830 ac-ft/yr of water in 2030 to 9,387 ac-ft/yr in 2080, a 19.9 percent increase (Figure 2-3 and Table 2-3). As can be seen in Figure 2-3, manufacturing water demand is projected to increase steadily from 2030 to 2080.

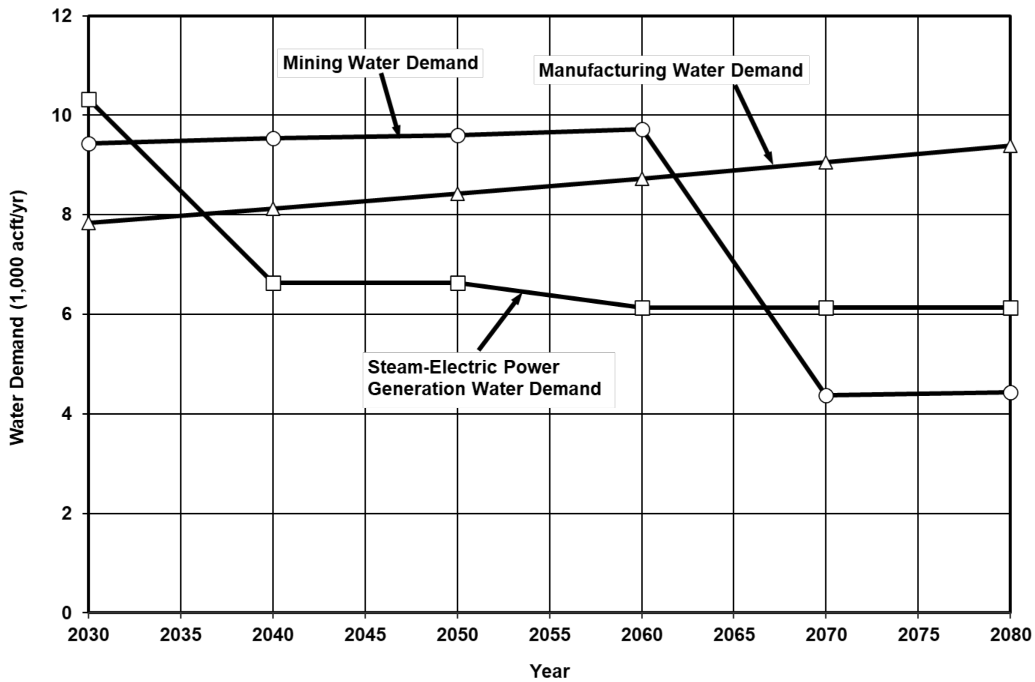

Figure 2-3. Projections of Manufacturing, Steam-Electric, and Mining Water Demands Llano Estacado Region – 2030 to 2080

[92] https://www.census.gov/programs-surveys/cbp.html, Accessed December 3, 2024

Table 2-3. Manufacturing Water Demand Projections, Llano Estacado Region, Individual Counties with River Basin Summaries

County/ River Basin	Water Demand Projections (acre-feet/year)					
	2030	2040	2050	2060	2070	2080
Counties						
Bailey	0	0	0	0	0	0
Briscoe	0	0	0	0	0	0
Castro	67	69	72	75	78	81
Cochran	0	0	0	0	0	0
Crosby	1	1	1	1	1	1
Dawson	0	0	0	0	0	0
Deaf Smith	1,498	1,553	1,610	1,670	1,732	1,796
Dickens	0	0	0	0	0	0
Floyd	0	0	0	0	0	0
Gaines	515	534	554	574	595	617
Garza	0	0	0	0	0	0
Hale	731	758	786	815	845	876
Hockley	1,232	1,278	1,325	1,374	1,425	1,478
Lamb	398	413	428	444	460	477
Lubbock	1,174	1,217	1,262	1,309	1,357	1,407
Lynn	0	0	0	0	0	0
Motley	0	0	0	0	0	0
Parmer	2,184	2,265	2,349	2,436	2,526	2,619
Swisher	0	0	0	0	0	0
Terry	30	31	32	33	34	35
Yoakum	0	0	0	0	0	0
Total	**7,830**	**8,119**	**8,419**	**8,731**	**9,053**	**9,387**
River Basin Summaries						
Brazos	3,550	3,682	3,817	3,959	4,104	4,256
Canadian	0	0	0	0	0	0
Colorado	531	550	571	591	613	635
Red	3,749	3,887	4,031	4,181	4,336	4,496
Total	**7,830**	**8,119**	**8,419**	**8,731**	**9,053**	**9,387**

Source: Texas Water Development Board (TWDB); Consensus Projections adopted by the TWDB, November 2023.

2.4 Steam-Electric Power Water Demand Projections

Steam-electric power generation in Texas is concentrated in 10 privately-owned utilities that account for 85 percent of generation. Nine percent of power generation occurs in facilities that are both publicly and privately held, and 6 percent is from publicly-owned utilities. The industry has faced and will continue to face significant changes in the structure of power generation. These changes range from new technologies to government regulations on the marketing of electricity. These changes may have an impact on how and where power will be generated and the quantities of water needed.

The steam-electric power water demand projections for each county are based upon the highest single-year county water use from within the most recent five years of data for steam-electric power water users from the annual WUS and near-term additions and retirements of generating facilities. In many cases, the steam-electric water demand projections were held flat throughout the planning period. The Llano Estacado Region asked for revisions to the draft steam-electric water demand projections for Lamb, Lubbock, and Yoakum counties based on industry specific information provided by Bret Yeary, LERWPG member representing steam-electric power generation interests, including transition from steam generation to other sources[93]. The TWDB granted those revision requests.

In the generation of steam-electric power, cooling water is circulated through the power plants, with approximately 2 percent being evaporated or consumed and the remainder being either recirculated or returned to streams. Four counties (Hale, Lamb, Lubbock, and Yoakum) in the Llano Estacado Region have power generation facilities. The LERWPG has not previously differentiated between generation technologies. Facilities in Lamb and Lubbock Counties are accurately described as 'steam electric,' as is a portion of the Yoakum County plant. The plant in Hale County produces no steam. Water demand for steam-electric power generation is projected to be 10,323 ac-ft/yr in 2030, declining to 6,625 ac-ft/yr in 2040 and 2050, and finally declining to 6,129 ac-ft/yr for the remainder of the planning period (Table 2-4 and Figure 2-3).

Table 2-4. Steam-Electric Power Water Demand Projections, Llano Estacado Region, Individual Counties with River Basin Summaries

County/ River Basin	Water Demand Projections (acre-feet/year)					
	2030	2040	2050	2060	2070	2080
Counties						
Bailey	0	0	0	0	0	0
Briscoe	0	0	0	0	0	0
Castro	0	0	0	0	0	0
Cochran	0	0	0	0	0	0
Crosby	0	0	0	0	0	0
Dawson	0	0	0	0	0	0
Deaf Smith	0	0	0	0	0	0
Dickens	0	0	0	0	0	0
Floyd	0	0	0	0	0	0
Gaines	0	0	0	0	0	0
Garza	0	0	0	0	0	0
Hale	29	29	29	29	29	29
Hockley	0	0	0	0	0	0
Lamb	5,789	3,000	3,000	3,000	3,000	3,000
Lubbock	2,909	2,000	2,000	2,000	2,000	2,000
Lynn	0	0	0	0	0	0
Motley	0	0	0	0	0	0
Parmer	0	0	0	0	0	0
Swisher	0	0	0	0	0	0
Terry	0	0	0	0	0	0
Yoakum	1,596	1,596	1,596	1,100	1,100	1,100
Total	**10,323**	**6,625**	**6,625**	**6,129**	**6,129**	**6,129**
River Basin Summaries						
Brazos	8,727	5,029	5,029	5,029	5,029	5,029
Canadian	0	0	0	0	0	0
Colorado	1,596	1,596	1,596	1,100	1,100	1,100
Red	0	0	0	0	0	0
Total	**10,323**	**6,625**	**6,625**	**6,129**	**6,129**	**6,129**

Source: Texas Water Development Board (TWDB); Consensus Projections adopted by the TWDB, November, 2023.

2.5 Mining Water Demand Projections

Although the Texas mining industry is a leader in the production of crude petroleum and natural gas in the United States, it also produces a wide variety of important non-fuel minerals. Texas is the only

[93] Personal communication, Bret Yeary, April 17, 2023.

state to produce native asphalt and is the leading producer nationally of Frasch-mined sulfur. It is also one of the leading states in the production of clay, gypsum, lime, salt, stone, and aggregate. In the Llano Estacado Region, the principal uses of water for mining are for the recovery of crude petroleum, for sand and gravel washing, and for sand used in the hydraulic fracturing process in the recovery of crude petroleum. Water use associated with mining in the Llano Estacado Region is projected to peak in 2060 and then see a sharp decline as this area sees less exploration and drilling activity (associated with oil and gas extraction) and more production activity that uses less water.

Mining water demands in the Llano Estacado Region are projected to be 9,425 ac-ft/yr in 2030 and decrease to 4,439 ac-ft/yr in 2080, a decrease of more than 50 percent (Table 2-5 and Figure 2-3).

Table 2-5. Mining Water Demand Projections, Llano Estacado Region, Individual Counties with River Basin Summaries

County/ River Basin	Water Demand Projections (acre-feet/year)					
	2030	2040	2050	2060	2070	2080
Counties						
Bailey	0	0	0	0	0	0
Briscoe	0	0	0	0	0	0
Castro	0	0	0	0	0	0
Cochran	166	166	166	166	166	166
Crosby	483	509	535	563	589	613
Dawson	5,927	6,013	6,051	6,146	2,616	2,657
Deaf Smith	0	0	0	0	0	0
Dickens	0	0	0	0	0	0
Floyd	9	9	9	10	10	10
Gaines	1,870	1,870	1,870	1,870	22	22
Garza	19	19	19	19	19	19
Hale	1	1	1	1	1	1
Hockley	69	69	69	69	69	69
Lamb	0	0	0	0	0	0
Lubbock	19	19	19	20	20	20
Lynn	15	15	15	15	15	15
Motley	0	0	0	0	0	0
Parmer	0	0	0	0	0	0
Swisher	0	0	0	0	0	0
Terry	101	101	101	101	101	101
Yoakum	746	746	746	746	746	746
Total	**9,425**	**9,537**	**9,601**	**9,726**	**4,374**	**4,439**
River Basin Summaries						
Brazos	615	641	667	697	723	747
Canadian	0	0	0	0	0	0
Colorado	8,810	8,896	8,934	9,029	3,651	3,692
Red	0	0	0	0	0	0
Total	**9,425**	**9,537**	**9,601**	**9,726**	**4,374**	**4,439**

Source: Texas Water Development Board (TWDB); Consensus Projections adopted by the TWDB, November, 2023.

2.6 Irrigation Water Demand Projections

In 2030, irrigated agriculture is projected to account for approximately 48 percent of the total water used in the state. It is projected that approximately 8.4 million ac-ft of water will be used to grow a variety of crops ranging from food and feed grains to fruits, vegetables, and cotton. Of these 8.4 million ac-ft of water to be used for irrigation in Texas, groundwater will make up approximately 70 percent, and surface water will make up the remaining 30 percent. The TWDB irrigation water demand projections show annual use in the Llano Estacado Region to be 2,174,030 ac-ft/yr in 2030, approximately 26 percent of the total projected irrigation water use in Texas in 2030 (Figure 2-4 and Table 2-6). Projected irrigation water demands in the region in 2080 are 725,085 ac-ft/yr, an almost 70 percent decline from those in 2030 (Figure 2-4 and Table 2-6). The projected decline is based upon expected increases in irrigation efficiency, reductions in profitability of irrigated agriculture, reduction in groundwater availability, and continuing conversion to rainfed cultivation practices.

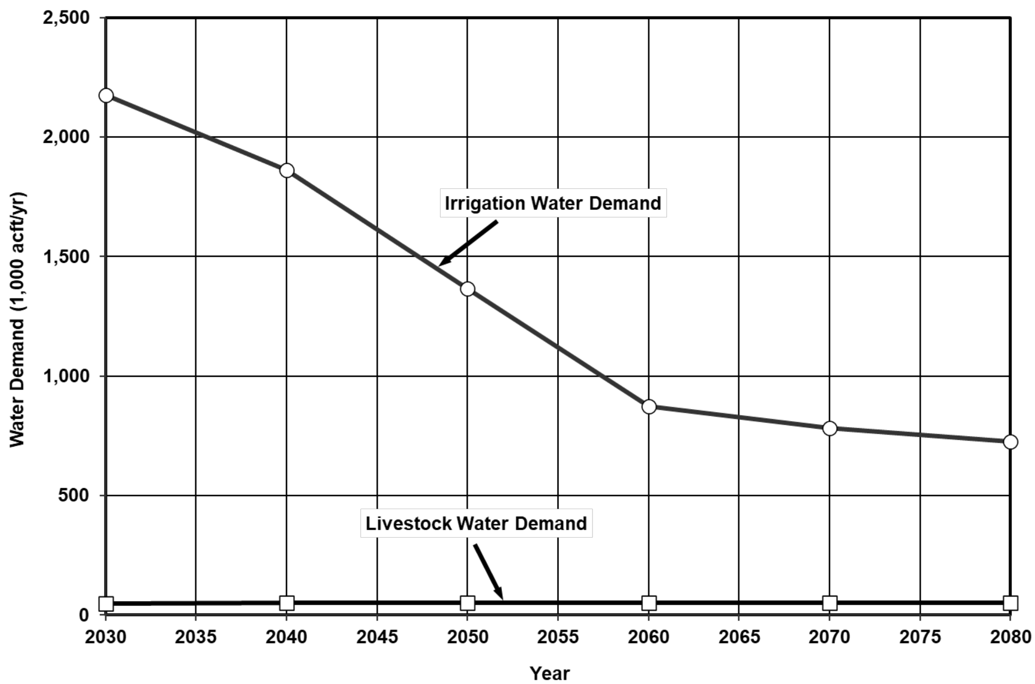

Figure 2-4. Projections of Irrigation and Livestock Water Demands Llano Estacado Region – 2030 to 2080

Table 2-6. Irrigation Water Demand Projections, Llano Estacado Region, Individual Counties with River Basin Summaries

County/ River Basin	Water Demand Projections (acre-feet/year)					
	2030	2040	2050	2060	2070	2080
Counties						
Bailey	58,170	47,535	37,454	27,373	24,677	23,508
Briscoe	17,821	13,955	10,638	7,320	6,219	5,492
Castro	252,563	199,792	111,939	24,087	11,447	4,709
Cochran	81,137	69,185	58,077	46,968	42,039	38,443
Crosby	60,292	60,292	49,031	37,771	30,463	25,891
Dawson	66,209	66,209	66,209	66,209	62,701	59,384
Deaf Smith	138,920	107,622	71,017	34,412	25,820	20,532
Dickens	7,547	7,547	7,547	7,547	7,547	7,547
Floyd	92,612	73,680	57,123	40,567	35,644	32,399
Gaines	272,219	246,656	192,147	137,639	128,768	122,585
Garza	9,899	9,899	9,899	9,899	9,899	9,899
Hale	209,768	179,867	102,409	24,951	18,147	14,107
Hockley	112,102	83,099	67,305	51,512	47,413	44,931
Lamb	168,746	142,169	86,500	24,830	20,958	19,645
Lubbock	133,360	122,065	99,966	77,867	75,089	72,947
Lynn	72,812	72,812	72,631	72,451	69,834	68,013
Motley	8,998	8,998	8,998	8,998	8,998	8,998
Parmer	138,836	120,358	69,924	19,490	14,037	10,504
Swisher	64,411	52,349	37,765	23,181	18,612	15,575
Terry	102,633	86,664	86,664	86,664	84,701	82,401
Yoakum	104,975	89,685	66,787	43,890	40,075	37,575
Total	**2,174,030**	**1,860,438**	**1,367,030**	**873,626**	**783,088**	**725,085**
River Basin Summaries						
Brazos	1,193,371	1,021,297	714,502	407,707	359,691	331,147
Canadian	1,390	1,076	710	344	258	205
Colorado	578,940	517,057	434,977	352,900	332,840	317,248
Red	400,329	321,008	216,841	112,675	90,299	76,485
Total	**2,174,030**	**1,860,438**	**1,367,030**	**873,626**	**783,088**	**725,085**

Source: Texas Water Development Board (TWDB); Consensus Projections adopted by the TWDB, November, 2023.

2.7 Livestock Water Demand Projections

In the Llano Estacado Region, livestock production is an important component of the regional economy. However, the industry consumes a relatively small amount of water. In 2030, the water use in the Llano Estacado Region for livestock purposes is projected to be 47,000 ac-ft/yr (Figure 2-4 and Table 2-7). In 2080, water used for livestock purposes is projected to be 51,433 ac-ft/yr (a 9.4 percent increase) (Figure 2-4 and Table 2-7).

Table 2-7. Livestock Water Demand Projections, Llano Estacado Region, Individual Counties with River Basin Summaries

County/ River Basin	Water Demand Projections (acre-feet/year)					
	2030	2040	2050	2060	2070	2080
Counties						
Bailey	2,471	2,829	2,854	2,790	2,730	2,673
Briscoe	299	307	316	325	333	337
Castro	9,158	10,223	10,352	10,230	10,214	10,026
Cochran	110	113	115	117	119	120
Crosby	175	180	185	189	194	196
Dawson	64	65	67	69	71	72
Deaf Smith	12,678	13,612	13,861	13,929	14,013	14,105
Dickens	388	398	408	418	428	431
Floyd	1,222	1,236	1,250	1,265	1,280	1,287
Gaines	143	146	148	151	154	156
Garza	154	157	161	165	169	170
Hale	2,674	3,040	3,049	2,961	2,878	2,796
Hockley	137	140	143	146	149	150
Lamb	4,467	5,111	5,157	5,041	4,934	4,833
Lubbock	823	830	837	844	851	853
Lynn	69	71	73	74	76	77
Motley	277	284	291	298	306	308
Parmer	7,793	8,762	8,856	8,715	8,588	8,471
Swisher	2,911	2,986	3,064	3,143	3,225	3,304
Terry	880	1,011	1,020	996	974	947
Yoakum	107	110	113	116	119	121
Total	**47,000**	**51,611**	**52,320**	**51,982**	**51,805**	**51,433**
River Basin Summaries						
Brazos	23,518	26,263	26,528	26,126	25,763	25,397
Canadian	0	0	0	0	0	0
Colorado	1,206	1,336	1,354	1,341	1,331	1,311
Red	22,276	24,012	24,438	24,515	24,621	24,725
Total	**47,000**	**51,611**	**52,320**	**51,982**	**51,715**	**51,433**

Source: Texas Water Development Board (TWDB); Consensus Projections adopted by the TWDB, November, 2023.

2.8 Total Water Demand Projections

Total water demand projections for the Llano Estacado Region are the sum of water demand projections for municipal, manufacturing, steam-electric power generation, mining, irrigation, and livestock water use sectors (Table 2-2 through Table 2-7) and are summarized in Table 2-8 and Figure 2-5. Total regional water demands are projected to be 2,345,019 ac-ft/yr in 2030, 1,554,688 ac-ft/yr in 2050, and 935,378 ac-ft/yr in 2080 (Table 2-8 and Figure 2-5).

The use sector compositions of projected water demands in the Llano Estacado Region are summarized at years 2030, 2050, and 2080 in Figure 2-5 and Table 2-9. As shown in Figure 2-5 and Table 2-9, municipal, manufacturing, mining, steam-electric, and livestock percentages of total water demands are expected to increase, while irrigation percentages are expected to decrease during the planning period.

Table 2-8. Total Water Demand Projections, Llano Estacado Region, Individual Counties with River Basin Summaries

County/ River Basin	Water Demand Projections (acre-feet/year)					
	2030	2040	2050	2060	2070	2080
Counties						
Bailey	61,881	51,628	41,582	31,453	28,719	27,523
Briscoe	18,427	14,545	11,221	7,894	6,781	6,037
Castro	263,171	211,436	123,677	35,681	22,912	16,054
Cochran	82,029	70,038	58,893	47,749	42,782	39,148
Crosby	61,656	61,637	50,348	39,064	31,731	27,124
Dawson	74,494	74,562	74,580	74,637	67,560	64,240
Deaf Smith	156,926	126,664	90,374	53,871	45,411	40,285
Dickens	8,171	8,163	8,151	8,140	8,127	8,106
Floyd	94,588	75,627	59,046	42,471	37,527	34,252
Gaines	279,263	254,364	200,522	146,635	136,590	131,134
Garza	10,784	10,763	10,736	10,697	10,656	10,610
Hale	218,881	189,302	111,753	34,097	27,094	22,876
Hockley	116,818	87,856	72,067	56,281	52,187	49,710
Lamb	181,446	152,713	94,071	35,265	31,267	29,837
Lubbock	199,536	194,158	179,090	165,730	172,288	180,111
Lynn	73,640	73,624	73,431	73,230	70,591	68,747
Motley	9,527	9,515	9,508	9,513	9,520	9,520
Parmer	150,703	133,258	82,966	32,438	26,911	23,215
Swisher	68,354	56,327	41,773	27,228	22,700	19,697
Terry	105,390	89,571	89,584	89,562	87,580	85,257
Yoakum	109,334	94,132	71,315	47,985	44,231	41,795
Total	**2,345,019**	**2,039,883**	**1,554,688**	**1,069,621**	**983,165**	**935,278**
River Basin Summaries						
Brazos	1,308,739	1,142,326	842,481	543,670	504,260	484,970
Canadian	1,391	1,077	711	345	258	205
Colorado	601,958	541,022	459,697	377,821	353,038	338,184
Red	432,931	355,458	251,799	147,785	125,609	112,019
Total	**2,345,019**	**2,039,883**	**1,554,688**	**1,069,621**	**983,165**	**935,378**

Source: Texas Water Development Board (TWDB); Consensus Projections adopted by the TWDB, November 2023.

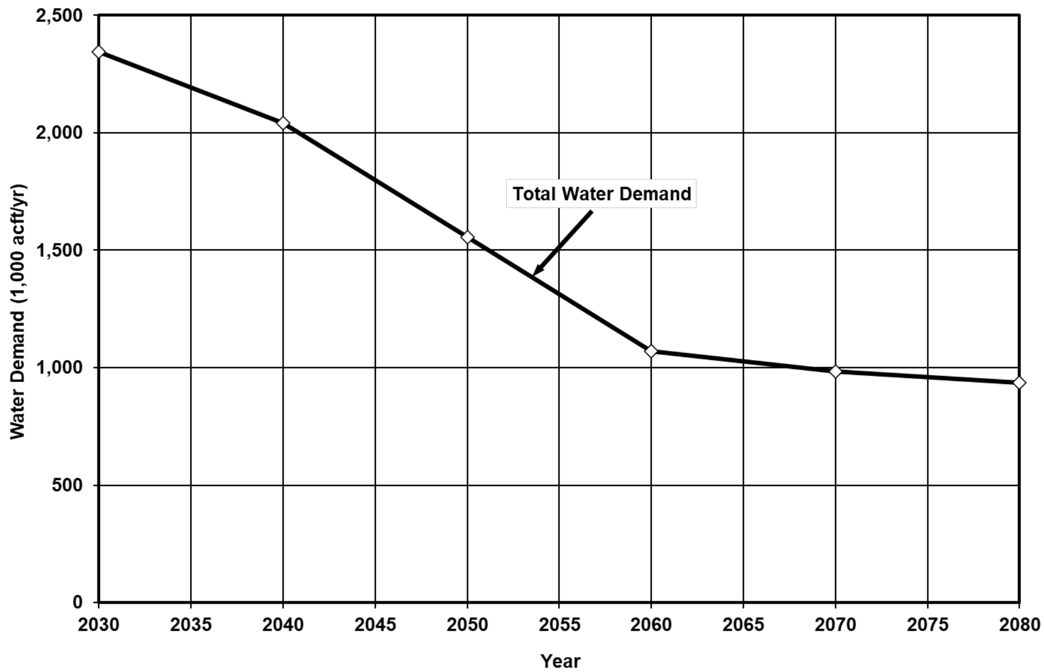

Figure 2-5. Total Water Demand Projections Llano Estacado Region – 2030 to 2080

Table 2-9. Composition of Projected Water Demands Llano Estacado Region 2030, 2050, and 2080

Water Use	2030		2050		2080	
	ac-ft	% Total	ac-ft	% Total	ac-ft	% Total
Municipal	96,411	4.11%	110,693	7.12%	138,905	14.85%
Manufacturing	7,830	0.33%	8,419	0.54%	9,387	1.00%
Steam-Electric Power	10,323	0.44%	6,625	0.43%	6,129	0.66%
Mining	9,425	0.40%	9,601	0.62%	4,439	0.47%
Irrigation	2,174,030	92.71%	1,367,030	87.93%	725,085	77.52%
Livestock	47,000	2.00%	52,320	3.37%	51,433	5.50%
Total	**2,345,019**	**100.00%**	**1,554,688**	**100.00%**	**935,378**	**100.00%**

ac-ft = acre-feet

2.9 Water Demand Projections for Counties and River Basins

In accordance with the TWDB water planning rules, water demand projections are tabulated by river basin, county or part of county located within the river basin, then city, water purveyor, or rural area of each county or part of county for the Llano Estacado Region (Appendix A).

2.10 Water Demand Projections for Major Water Providers

The TWDB defines a major water provider (MWP) as a WUG or a wholesale water provider (WWP) of particular significance to the region's water supply, as determined by the RWPG. This category may include public or private entities for any water use category. Under this definition, the list of MWPs for the Llano Estacado Region includes the following.

- Canadian River Municipal Water Authority (CRMWA);
- City of Lubbock;

- Mackenzie Municipal Water Authority (MMWA);
- White River Municipal Water District (WRMWD); and
- Red River Authority (RRA)

Projected water demands for each MWP are estimated on the basis of existing and/or future contracts with WUGs expected to continue receiving water or acquiring new water supplies from the MWP. For the sources of supply of each MWP, refer to Section 3.

2.10.1 Canadian River Municipal Water Authority

The CRMWA supplies water to eight cities (Brownfield, Lamesa, Levelland, Lubbock, O’Donnell, Plainview, Slaton, and Tahoka) located within the Llano Estacado Planning Area as well as three entities—Amarillo, Borger, and Pampa—located in the Panhandle Region (Planning Region A). Most of the CRMWA customers located in the Llano Estacado Region also obtain a portion of their supply through self-supplied groundwater. The total quantity of water CRMWA customers located in the Llano Estacado Region are projected to use in 2030 is 49,114 ac-ft/yr and is 56,266 ac-ft/yr in 2080. The City of Lubbock is the largest customer of CRMWA located in the Llano Estacado Region.

CRMWA is not projected to supply water to industrial customers located within the region; however, some cities to which CRMWA supplies water may supply water to industrial customers during the planning period. In the projections shown in Table 2-10, these amounts are included in the municipal total for CRMWA’s customers.

Table 2-10. Major Water Provider Projected Demands

Major Water Providers with Lists of Customers	Projections (acre-feet)					
	2030	2040	2050	2060	2070	2080
Canadian River MWA						
Amarillo (Region A)	41,199	45,419	49,341	50,000	50,000	50,000
Borger (Region A)	4,861	5,896	6,922	7,845	8,591	9,450
Brownfield (Region O)	1,360	1,406	1,450	1,501	1,556	1,616
Lamesa (Region O)	1,367	1,411	1,442	1,450	1,450	1,441
Levelland (Region O)	1,990	1,998	1,988	1,978	1,968	1,961
Lubbock (Region O)	40,810	46,736	47,000	47,000	47,000	47,000
O'Donnell (Region O)	102	99	98	95	92	87
Pampa Municipal Water System (Region A)	2,242	2,242	2,242	2,423	2,617	2,623
Plainview (Region O)	2,400	2,640	2,904	3,194	3,406	3,261
Slaton (Region O)	760	720	687	647	611	575
Tahoka Public Water System (Region O)	325	325	325	325	325	325
Llano Estacado (Region O) Total	49,114	55,335	55,894	56,190	56,408	56,266
Panhandle Region (Region A) Total	48,302	53,557	58,505	60,268	61,208	62,073
CRMWA Total	***97,416***	***108,892***	***114,399***	***116,458***	***117,616***	***118,339***
City of Lubbock						
Lubbock	52,502	58,086	63,949	71,414	79,414	87,986
County-Other (Garza)	520	520	520	520	520	520
County-Other (Lubbock)	806	806	806	806	806	806
Ransom Canyon	1,512	1,512	1,512	1,512	1,512	1,512
Shallowater	250	250	250	250	250	250
Lubbock Total	***55,590***	***61,174***	***67,037***	***74,502***	***82,502***	***91,074***
Mackenzie Municipal Water Authority						
Floydada	155	155	155	155	155	155
Lockney	75	75	75	75	75	75
Silverton	128	128	128	128	128	128
Tulia	210	210	210	210	210	210
Mackenzie MWA Total	***568***	***568***	***568***	***568***	***568***	***568***
White River Municipal Water District						
County-Other (Crosby)	51	51	51	51	51	51
Crosbyton	179	179	179	179	179	179
Post	414	414	414	414	414	414
Ralls	202	202	202	202	202	202
Spur	224	224	224	224	224	224
White River MWD Total	***1,070***	***1,070***	***1,070***	***1,070***	***1,070***	***1,070***
Red River Authority						
County-Other (Dickens)	1	1	1	1	1	0
County-Other (Motley)	2	1	1	1	1	1
Red River Authority Total	***3***	***2***	***2***	***2***	***2***	***1***

2.10.2 City of Lubbock

Lubbock has wholesale water supply contracts with Buffalo Springs Lake Water Supply Corporation (Garza County-Other), Lake Alan Henry Water Supply District (Garza County-Other), Lake Ransom Canyon, Shallowater, and Lubbock-Reese Redevelopment Authority (Lubbock County-Other). In addition to these entities, Lubbock has a contract to supply water to the City of Littlefield in cases of emergency. Total water use by Lubbock and its customers is projected to be 55,590 ac-ft/yr in 2030 and 91,074 ac-ft/yr in 2080 (Table 2-10).

2.10.3 Mackenzie Municipal Water Authority

The MMWA supplies water to the cities of Floydada, Lockney, Silverton, and Tulia. Floydada, Lockney, and Tulia also meet a part of their needs from groundwater (i.e., their own wells). The projected water demand for MMWA is 568 ac-ft/yr in 2030 and remains constant throughout the planning period (Table 2-10).

2.10.4 White River Municipal Water District

The WRMWD supplies water to the cities of Crosbyton, Post, Ralls, and Spur. Crosbyton and Ralls are projected to obtain a portion of their water supplies from self-supplied groundwater. Post is projected to obtain a portion of its water supply from self-supplied groundwater and a contract with the City of Slaton. Historically, the WRMWD has been the sole water provider for Spur. The total amount of water projected to be supplied in the district in 2030 is 1,070 ac-ft/yr and remains constant throughout the planning period (Table 2-10).

WRMWD purchased groundwater rights in Crosby County in 1998 and drilled several wells in 1999. The groundwater will be used during periods of drought when the water level in the reservoir is low. In addition, the City of Post has constructed a pipeline to Slaton and has a contract with Slaton for a part of Slaton's CRMWA supply for a minimum of 153.44 ac-ft/yr and a maximum of 306.88 ac-ft/yr, provided Slaton's CRMWA supply is not reduced.

2.10.5 Red River Authority

The RRA supplies water to 33 independent community water systems (within a 15-county service area), most of which are located in the Panhandle Region (Region A) and Region B water planning areas. In the Llano Estacado Region, the RRA supplies water to parts of Dickens and Motley counties. The projected water demand for RRA in 2030 is 3 ac-ft/yr and 1 ac-ft/yr in 2080 (Table 2-10).

3

Water Availability and Existing Water Supplies

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Chapter 3: Water Supply Analyses

[31 TAC §357.32]

The Llano Estacado Region is located in a semiarid climatic area of West Texas. Annual average precipitation ranges from approximately 18 inches on the eastern border to only approximately 14 inches on the western New Mexico state line. Therefore, surface water supplies are very low. However, the region is underlain with aquifers in which large quantities of water have been captured and stored over very long periods of time.

In this section, *water availability* is the maximum amount of water available from a given source during drought-of-record (DOR) conditions, regardless of whether the supply is physically or legally accessible by a water user group (WUG) or wholesale water provider (WWP). Available water sources identified in this section include (1) those currently connected and in use and (2) those not currently in use but potentially available in the future.

Existing water supply is the maximum amount of water available from an existing source during DOR conditions that is physically and legally obtainable for WUGs to use. Existing water supply calculations are limited by the following:

- The portion of each water source's availability that could be accessed for supply by each WUG in the event of a drought;
- Legal or policy constraints regarding access to the water (i.e., by contract or water right); and
- Physical constraints such as transmission or treatment facility capacity that would limit the delivery volume of treated supplies to WUGs.

3.1 Groundwater Supplies

One primary and two secondary aquifers supply water to the Llano Estacado Region. The primary aquifer is the High Plains Aquifer System (HPAS)[94] that includes Ogallala and Edwards-Trinity High Plains (ETHP) aquifers (Figure 3-1). In most areas in the Llano Estacado Region, the Texas Water Development Board (TWDB) considers the Ogallala and ETHP aquifers to be the same aquifer. In addition, in this region, the Ogallala Aquifer, and the underlying Edwards-Trinity (High Plains) Aquifer are managed as a single unit[95]. Therefore, the remainder of this chapter refers to the Ogallala Aquifer and ETHP Aquifer as one entity. The Seymour and Dockum (Santa Rosa) aquifers are the minor aquifers. The Permian Blaine Aquifer is considered a minor aquifer in Texas and is located at the east end of the High Plains in the northeast corner of Motley County within the region. The Blaine Aquifer does not provide supplies for any WUGs in the Llano Estacado Region. Additionally, limited supplies are available from other local aquifers that are not differentiated aquifers. Chapter 1

[94] https://www.twdb.texas.gov/groundwater/models/gam/hpas/hpas.asp, accessed December 3, 2024.

[95] TWDB, 2021. Explanatory Report for Desired Future Conditions Ogallala, Edwards-Trinity (High Plains), and Dockum Aquifers Groundwater Management Area 2. https://www.twdb.texas.gov/groundwater/dfc/docs/2021/GMA2_DFCExpRep_2021.pdf

describes these aquifers in detail, including water quality characteristics. For the water supply analyses in this chapter, brief aquifer descriptions follow.

3.1.1 Ogallala and Edwards-Trinity Aquifers, High Plains Aquifer System

The HPAS includes the Ogallala and ETHP Aquifers (Figure 1-5 and Figure 1-6), which are the major water-bearing formations in most of the 21 counties of the Llano Estacado Region. Most of the communities within the region obtain water from the Ogallala Aquifer as their main source of drinking water; however, approximately 95 percent of the water obtained from the Ogallala Aquifer is used for irrigation.

3.1.2 Seymour Aquifer

The Seymour Formation (Figure 1-5), which the TWDB considers a major aquifer in Texas, consists of isolated areas of alluvium found in parts of 23 north-central and High Plains counties, including parts of Briscoe and Motley counties of the Llano Estacado Region. The Seymour Aquifer supplies small quantities of water for municipal, mining, and irrigation use in those two counties.

3.1.3 Dockum Aquifer

The Dockum Group of Triassic Age underlies the Ogallala and ETHP Aquifers of the High Plains area of Texas and New Mexico, the northern part of the Edwards Plateau, and the eastern part of the Cenozoic Pecos Alluvium. Briscoe, Castro, Crosby, Deaf Smith, Dickens, Floyd, Garza, Hockley, Motley, Parmer, and Swisher counties use small quantities of water supplied by the Dockum Aquifer for municipal, irrigation, and livestock uses.

3.2 Groundwater Management

3.2.1 Groundwater Conservation Districts

In Texas, groundwater usage is legally recognized as a private property interest subject to the rule of capture and limited by regulation by local groundwater conservation districts (GCDs). There are 98 GCDs in Texas, and GCDs cover nearly 70 percent of the area of the state, including 173 of the 254 Texas counties. Because of the sizes of many of the aquifers in Texas, several GCDs manage the resources of a given aquifer. The eight GCDs in the Llano Estacado Region serve an important role in implementing groundwater management strategies (Table 3-1 and Figure 3-1). The GCDs' responsibilities and authorities vary depending upon legislation and governing law.

Table 3-1. Groundwater Conservation Districts

Groundwater Conservation District	Year Established	Counties	
		Within Llano Estacado Region	In Other Region(s)
Garza County UWCD	1996	Garza	None
Gateway GCD	2003	Motley	Childress, Cottle, Foard, Hardeman, King
High Plains UWCD No. 1	1951	Bailey, Castro, Cochran, Crosby, Deaf Smith, Floyd, Hale, Hockley, Lamb, Lubbock, Lynn, Parmer, Swisher	Armstrong, Potter, Randall
Llano Estacado UWCD	1998	Gaines	None
Mesa UWCD	1990	Dawson	None
Mesquite GCD	1986	Briscoe	Childress, Collingsworth, Hall
Sandy Land UWCD	1989	Yoakum	None
South Plains UWCD	1992	Terry, Hockley	None
None (full counties)	None	Dickens	None
None (partial counties)	None	Briscoe, Castro, Crosby, Deaf Smith, Floyd, Hockley	None

UWCD = Underground water conservation district; GCD = groundwater conservation district

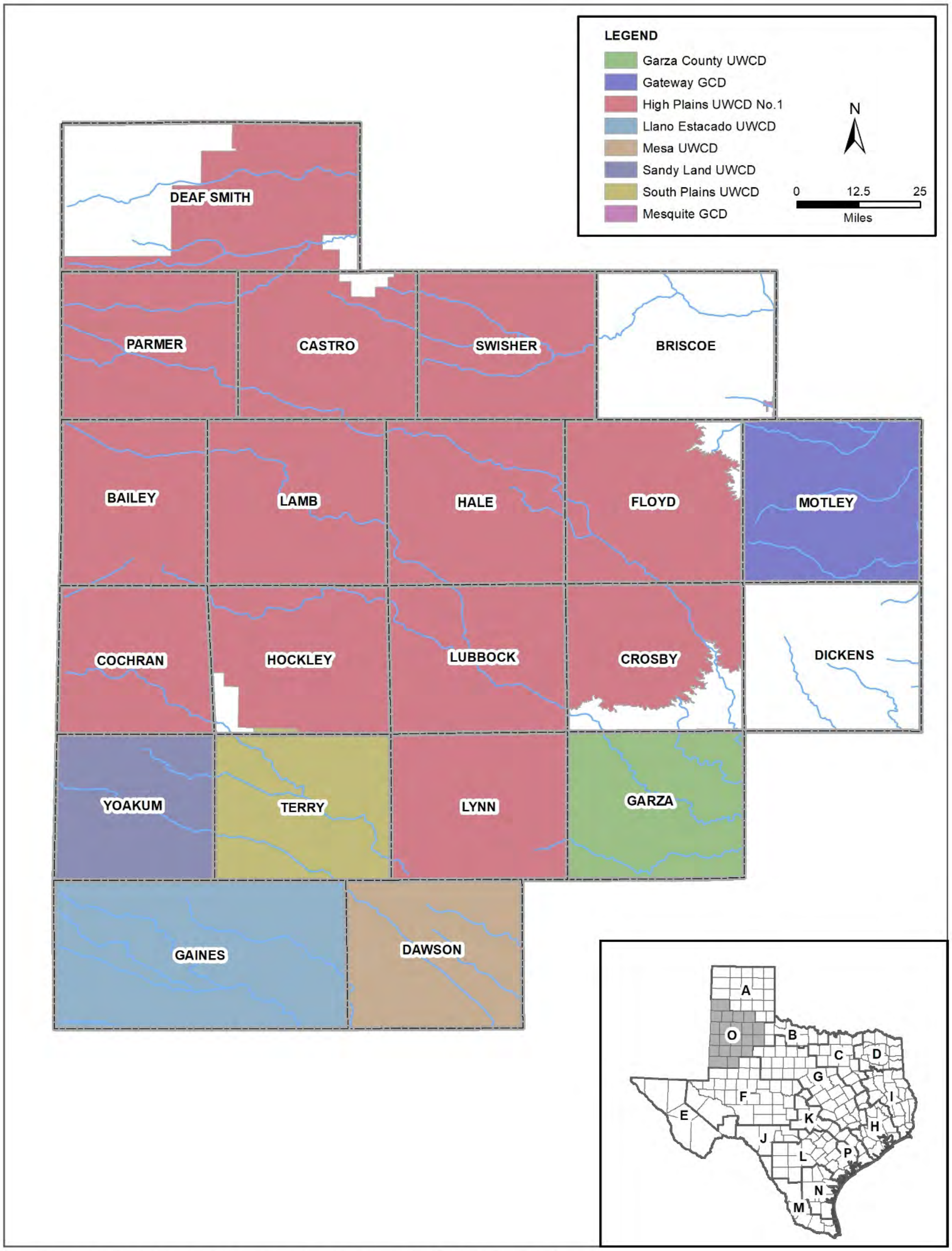

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Figure 3-1 Groundwater Conservation Districts of the Llano Estacado Region

3.2.2 Groundwater Management Areas

In 1995, groundwater management areas (GMAs) were created "in order to provide for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater, and of groundwater reservoirs or their subdivisions, and to control subsidence caused by withdrawal of water from those groundwater reservoirs or their subdivisions, consistent with the objectives of Section 59, Article XVI, Texas Constitution…" (Texas Water Code [TWC] §35.001). GMAs made it feasible to establish common groundwater management goals among multiple GCDs. The TWDB was delegated responsibility to delineate GMAs and subsequently divided Texas into 16 GMAs in 2002. These areas correspond roughly to aquifer boundaries in the state and help state agencies regulate different aspects of groundwater usage.

Source: TWDB

Figure 3-2. Groundwater Management Areas in Texas

The Texas Legislature mandated that by September 1, 2010, GCDs must establish desired future conditions (DFCs) for aquifers in each GMA. These DFCs may differ across GMAs and impact the amount of groundwater that can be pumped from a given aquifer on an annual basis. The Llano Estacado Region is located within GMA 2 and GMA 6. GMA 2 covers most of the Llano Estacado Region, with administrative boundaries that extend across 19 of the 21 counties. GMA 6 includes Briscoe (partial), Dickens, and Motley counties.

Table 3-2 provides the DFCs for the portions of GMAs 2 and 6 that intersect the boundary of Region O.

Table 3-2. Desired Future Conditions for Portions of GMAs 2 and 6 Corresponding to the Llano Estacado Region

GMA	Aquifer	DFC Description	Adoption Date
2	Ogallala and Edwards Trinity (High Plains)	Average drawdown of 28 feet between 2013 and 2080 for all of GMA 2.	8/17/2021
2	Dockum	Average drawdown of 31 feet for all of GMA 2 from 2013 to 2080.	8/17/2021
6	Dockum	Total decline in water levels will be no more than 28 feet during the period from 2013 to 2080	11/18/2021
6	Ogallala	Average drawdown of up to 28 feet between 2013 and 2080	11/18/2021
6	Seymour	Total decline in water levels will be no more than 15 feet during the period from 2013 to 2080	11/18/2021

GMA = Groundwater Management Area; DFC – desired future condition

3.2.3 Priority Groundwater Management Areas

A priority groundwater management area (PGMA) is an area designated and delineated by the Texas Commission on Environmental Quality (TCEQ) that is experiencing, or is expected to experience, critical groundwater problems within 50 years, including shortages of surface water or groundwater, land subsidence resulting from groundwater withdrawal, or contamination of groundwater supplies. The TCEQ has designated seven PGMAs in Texas[96]. Once an area is designated a PGMA, landowners have 2 years to create a GCD. Otherwise, the TCEQ is required to create a GCD or to recommend that the area be added to an existing district. The PGMA process is completely independent of the current GMA process, and each process has different goals. PGMAs also authorize county commissioners within the PGMA to promulgate groundwater restrictions.

In the Llano Estacado Region, there is one PGMA – the Briscoe, Swisher, Hale counties PGMA. The TCEQ designated this PGMA in 1990. The Swisher and Hale counties portions of the PGMA are located in High Plains Underground Water Conservation District No. 1 (HPWD). The portion of Briscoe County within this PGMA has not created a new nor joined an existing GCD. By order issued on December 12, 2014, the TCEQ found that the creation of a new standalone GCD to manage the Briscoe PGMA was not practicable and that adding the Briscoe PGMA to the HPWD was the most feasible and practicable option to protect and manage groundwater resources. The TCEQ order recommended that the western portion of Briscoe County within the PGMA be added to the HPWD. On March 13, 2015, the HPWD board of directors voted not to add the Briscoe PGMA to the HPWD. After exhausting its administrative option, and in accordance with TWC Section 35.013(i), in January 2017, the TCEQ recommended statutory action by the 85th Texas Legislature for the future management of the Briscoe County PGMA. No legislation was filed during the 85th Texas Legislature to address the issue. Since the option for TCEQ to create a standalone GCD in the PGMA portion of Briscoe County remains impracticable, no further TCEQ action is anticipated.

[96] A map showing Texas PGMAs is located at: https://www.tceq.texas.gov/assets/public/permitting/watersupply/groundwater/maps/pgma_areas.pdf

3.3 Groundwater Availability

The TWDB *General Guidelines for Regional Water Plan Development* offer the following with regard to evaluation of groundwater availability:

> *"Groundwater availability shall be based on the Modeled Available Groundwater (MAG) volumes that may be produced on an average annual basis to achieve Desired Future Conditions (DFCs) as adopted by Groundwater Management Areas (GMAs)."*

GCDs regulate groundwater locally, except in locations that do not have a district. In areas that do not have a district, including PGMAs, water availability may be set by a county commissioners' court pursuant to TWC §35.019; however, the Llano Estacado Regional Water Planning Group (LERWPG) did not receive any such information from a commissioners' court.

Districts may issue permits that regulate groundwater pumping and well spacing within their jurisdictions. Several districts within a single GMA determine the DFCs of relevant aquifers within that area. DFCs are the desired, quantified conditions of groundwater resources, such as water levels, water quality, spring flows, or volumes at a specified time or times in the future or in perpetuity. The TWDB has translated DFCs into MAG volumes using approved groundwater availability models (GAMs) or other approaches if a GAM is not applicable. A MAG volume is the amount of groundwater production, on an average annual basis, that will achieve a DFC. The DFC in a specific location may not be achieved if groundwater production exceeds the MAG volume over the long term.

In some counties where an aquifer is present, MAG volumes are not available. This circumstance may occur because the GMA has deemed an aquifer "non-relevant", as is the case for both the Ogallala and Dockum aquifers in Dickens County. For cases where a MAG is not available, an alternative strategy was used to estimate non-MAG availability. If a "non-relevant" availability estimate was provided by TWDB based on results from the GAM, then those estimates were used. This approach was used with the Ogallala and Dockum aquifers in Dickens County.

Another case where MAG volumes are not available is for "Other" aquifers, aquifers that are used locally but are not one of the 31 major or minor aquifers that the TWDB recognizes. The "Other" aquifer designation occurs in Briscoe, Crosby, Dickens, Floyd, Garza, and Motley counties. For these counties, "Other" aquifer availability was determined based on historical groundwater pumpage reports from the TWDB. The maximum annual pumpage for years 2012 to 2021 (rounded up to the nearest 1,000 acre-feet per year [ac-ft/yr]) was assumed to be available.

Therefore, in the regional water planning process, total anticipated groundwater production in any planning decade may not exceed the MAG volume in any county-aquifer location. Total groundwater production includes quantities associated with both existing supplies and any recommended water management strategies (WMSs). This restriction prevents regional water planning groups (RWPGs) from recommending WMSs with supply volumes that would exceed (i.e., "overdrafting") approved MAG volumes. Table 3-3 summarizes information pertinent to groundwater availability and existing supply by county, GCD, and aquifer for all aquifers in the Llano Estacado Region. In the rightmost column of Table 3-3, the remaining groundwater after accounting for the existing supplies, is shown for 2080. This volume of groundwater can be used for WMSs.

Table 3-3. Summary of Groundwater Availability, Existing Supply, and Volume Remaining for Water Management Strategies (2080)

County	Aquifer	2080 Modeled Available Groundwater (MAG) Volume (ac-ft/yr)	2080 Non-MAG Groundwater Volume (ac-ft/yr)	2080 Existing Supply (ac-ft/yr)	Availability Remaining for Water Management Strategies
Bailey	ETHP	32,675	--	28,821	3,854
	Dockum	949	--	0	949
Briscoe	ETHP	6,016	--	831	5,185
	Dockum	0	--	0	0
	Seymour	312	--	312	0
	Other	--	6,000	5,104	896
Castro	ETHP	24,953	--	17,038	7,915
	Dockum	484	--	425	59
Cochran	ETHP	40,036	--	27,877	12,159
	Dockum	1,106	--	0	1,106
Crosby	ETHP	29,159	--	16,484	12,675
	Dockum	4,393	--	3,685	708
	Other	--	9,000	8,461	539
Dawson	ETHP	66,945	--	66,400	545
	Dockum	640	--	0	640
Deaf Smith	ETHP	41,961	--	37,232	4,729
	Dockum	5,013	--	3,424	1,589
Dickens	Ogallala	--	5,020	45	4,975
	Dockum	--	140	93	47
	Other	--	10,000	9,702	298
Floyd	ETHP	35,987	--	20,190	15,797
	Dockum	3,674	--	20	3,654
	Other	--	16,000	15,424	576
Gaines	ETHP	131,974	--	126,614	5,360
	Dockum	880	--	0	880
Garza	ETHP	10,721	--	8,446	2,275
	Dockum	1,038	--	365	673
	Other	--	2,000	1,430	570
Hale	ETHP	30,298	--	22,779	7,519
	Dockum	1,277	--	0	1,277
Hockley	ETHP	52,400	--	50,804	1,596
	Dockum	1,204	--	28	1,176
Lamb	ETHP	45,425	--	26,599	18,826
	Dockum	1,051	--	0	1,051
Lubbock	ETHP	86,735	--	83,872	2,863
	Dockum	1,236	--	0	1,236
Lynn	ETHP	68,886	--	67,648	1,238
	Dockum	1,039	--	0	1,039
Motley	Ogallala	409	--	19	390
	Dockum	92	--	90	2
	Seymour	4,830	--	700	4,130
	Other	--	13,000	12,309	691
Parmer	ETHP	28,757	--	21,528	7,229
	Dockum	5,182	--	1,225	3,957

County	Aquifer	2080 Modeled Available Groundwater (MAG) Volume (ac-ft/yr)	2080 Non-MAG Groundwater Volume (ac-ft/yr)	2080 Existing Supply (ac-ft/yr)	Availability Remaining for Water Management Strategies
Swisher	ETHP	20,935	--	19,199	1,736
	Dockum	1,796	--	1,535	261
Terry	ETHP	84,043	--	82,754	1,289
Yoakum	ETHP	46,687	--	46,222	465
Totals		**921,198**	**61,160**	**835,734**	**146,624**

ETHP = Edwards-Trinity High Plains Aquifer system, which includes the Ogallala Aquifer; ac-ft/yr = acre-feet per year

For municipal utilities, after generally accounting for the ratio of peak to average-day water demands, existing supplies are equal to the lesser of the tested well capacities as reported to the TCEQ or the MAG as calculated by the TWDB. Existing supplies are not necessarily representative of current or projected groundwater use.

Projected groundwater supplies available in the Llano Estacado Region under DOR conditions are 2,054,463 ac-ft/yr in 2030, 1,297,703 ac-ft/yr in 2050, and 982,358 ac-ft/yr in 2080 (Table 3-4). Supplies from the Ogallala Aquifer and other aquifers are projected to hold steady on an annual basis throughout the 2030 to 2080 projection period, while supplies from the ETHP, Dockum, and Seymour aquifers are projected to decline over this time period. The supplies available from the ETHP Aquifer are projected to decline from 1,953,754 ac-ft/yr in 2030 to 884,593 ac-ft/yr in 2080.

Table 3-4. Available Groundwater Supply by Aquifer

Aquifer Name	Annual Quantity Available					
	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)	2080 (ac-ft)
ETHP	1,953,754	1,478,423	1,198,844	1,039,681	944,803	884,593
Ogallala	5,498	5,498	5,498	5,498	5,498	5,429
Dockum	32,220	32,219	32,219	31,214	31,200	31,194
Seymour	6,991	5,142	5,142	4,273	4,273	5,142
Other	56,000	56,000	56,000	56,000	56,000	56,000
Total	2,054,463	1,577,282	1,297,703	1,136,666	1,041,774	982,358
Percent of Total						
ETHP	94.10%	93.73%	92.38%	91.47%	90.69%	90.05%
Ogallala	0.27%	0.35%	0.42%	0.48%	0.53%	0.55%
Dockum	1.57%	2.04%	2.48%	2.75%	2.99%	3.18%
Seymour	0.34%	0.33%	0.40%	0.38%	0.41%	0.52%
Other	2.73%	3.55%	4.32%	4.93%	5.38%	5.70%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

ETHP = Edwards-Trinity High Plains Aquifer system, which includes the Ogallala Aquifer; ac-ft = acre-feet

3.4 Assumptions for Groundwater Supply Assessment

1. Groundwater availability by county is subdivided into river basin portions of each county according to data supplied by the TWDB. Groundwater supplies for municipal utilities are based upon well capacities obtained from TCEQ's Water Utility Database.

2. Municipal supplies from all aquifers are generally estimated as follows.
   a. For cities using groundwater, supply is based on reported well capacities with adjustments to account for a peak to average-day water demand ratio of 2:1.
   b. For rural areas not served by a water utility in a given county, known as county-other in the TWDB planning process, it is assumed that the rural household (municipal) demand would be met from aquifers underlying that river basin portion of the county. The rural supply is generally set to at least the maximum rural demand during the planning period.
3. Manufacturing supply from groundwater is associated with aquifers underlying the river basin portion of the county. The manufacturing supply is generally set equal to the maximum manufacturing demand over the 2030 to 2080 time period; however, some adjustments were made in some counties.
4. Steam-electric supply from groundwater is associated with aquifers underlying the river basin portion of the county. The steam-electric supply is generally set equal to the steam-electric demand; however, some adjustments were made in Lubbock County to account for water supply contracts.
5. Irrigation supply from groundwater is associated with aquifers underlying the river basin portion of the county. The irrigation supply is generally set equal to the irrigation demands, if possible; however, in certain situations, some adjustments were made. In cases where the total demand on that portion (i.e., county and river basin) of the aquifer exceeds the total availability, supply is reduced for irrigation demands until the total demand no longer exceeds the total availability.
6. Mining supply from groundwater is associated with aquifers underlying the river basin portion of the county. The mining supply is generally set equal to the maximum mining demand during the 2030 to 2080 planning period; however, some adjustments were made to some counties.
7. Livestock supply from groundwater is associated with aquifers underlying the river basin portion of the county. The livestock supply is generally set equal to the maximum livestock demand during the 2030 to 2080 planning period.

3.5 Surface Water Supplies

Although the Llano Estacado Region lies within the headwater areas of the Canadian, Red, Brazos, and Colorado River basins (Figure 1-5 and Figure 1-6), the region has very little surface water. Rainfall is less than 19 inches per year and provides only occasional runoff to streams. It is reported that groundwater discharge to the North Fork of the Double Mountain Fork of the Brazos River (North Fork) exists starting in the Lubbock area, so some limited baseflow from springs near the Caprock Escarpment does occur. Those flows may not be sufficient to travel downstream but do exist.[97] Even though streamflow in the region is relatively low, four dams and reservoirs (Lake Meredith, Mackenzie, White River, and Alan Henry) have been built within and near the region to capture and store most of the surface water that is available from the streams on which they are

[97] Ken Rainwater, Texas Tech University. 2020. Personal communication. February 18, 2020.

located. The four reservoirs supply water for municipal and industrial uses in 15 cities located in the region. These four reservoirs are described in the following subsections. In segments of rivers where dams have not been built, very little surface water leaves the region. Those entities that do not obtain water from the reservoirs previously mentioned must rely upon groundwater to supply their water needs due to lack of a reliable surface water resource. Even for cities that use the reservoirs as a supply, many have developed groundwater supplies for use during times of drought when surface water may not be available.

There are a limited number of surface water rights within the region (Table 3-5); however, none of those rights are reliable during a drought according to TCEQ's water availability model (WAM). A total of 94 water rights, including rights for reservoirs, exist in the Llano Estacado Region, with a total authorized diversion of approximately 116,500 ac-ft/yr. A small percentage of the water rights make up a large percentage of the authorized diversion volume. In the region, five water rights (5.3 percent) make up 100,910 ac-ft/yr (86.6 percent) of the authorized diversion volume. The remaining 89 water rights primarily consist of small irrigation and municipal rights distributed throughout the region. Appendix B provides a list of all surface water rights in the region and their authorized diversion volumes. Appendix C includes the 2024 technical memorandum that lists the versions and dates of WAM simulations completed to calculate available surface water supply, as well as the model modification assumptions and unmodified firm diversion and firm yields submitted in the hydrologic variance request documentation.

Table 3-5. Surface Water Supplies

Source	Annual Quantity Available (acre-feet)					
	2030	2040	2050	2060	2070	2080
Lake Alan Henry	11,300	11,000	10,700	10,400	10,100	9,800
Lake Mackenzie	2,900	2,900	2,900	2,900	2,900	2,900
White River Reservoir	0	0	0	0	0	0
Reservoir Total	**14,200**	**13,900**	**13,600**	**13,300**	**13,000**	**12,700**
Brazos Basin Run-of River (Crosby County)	0	0	0	0	0	0
Brazos Basin Run-of-River (Dickens County)	0	0	0	0	0	0
Brazos Basin Run-of-River (Garza County)	0	0	0	0	0	0
Brazos Basin Run-of-River (Lubbock County)	0	0	0	0	0	0
Brazos Basin Run-of-River (Lynn County)	0	0	0	0	0	0
Red Basin Run-of-River (Briscoe County)	96	96	96	96	96	96
Red Basin Run-of-River (Floyd County)	18	18	18	18	18	18
Red Basin Run-of-River (Motley County)	4	4	4	4	4	4
Red Basin Run-of-River (Parmer County)	0	0	0	0	0	0
Run-of-River Total	**118**	**118**	**118**	**118**	**118**	**118**
Surface Water Total	**14,318**	**14,018**	**13,718**	**13,418**	**13,118**	**12,818**

3.5.1 Mackenzie Reservoir and Associated Water Rights

Mackenzie Reservoir is located in the Red River Basin in Swisher and Briscoe counties. Mackenzie Reservoir has a total storage capacity of 45,500 acre-feet (ac-ft) and can supply approximately 5,200 ac-ft of water per year when the reservoir is at conservation pool elevation. Mackenzie Reservoir supplies water to the cities of Floydada, Lockney, Silverton, and Tulia. However, during recent dry years, Mackenzie Reservoir was unable to meet its contracted demands.

3.5.2 White River Lake and Associated Water Rights

White River Lake is located in the Brazos River Basin in the southeast corner of Crosby County. The White River Municipal Water District (WRMWD) owns and operates the lake, which supplies water to the cities of Crosbyton, Post, Ralls, and Spur. The lake has a surface area of 1,808 acres at conservation pool elevation, a drainage area of 173 square miles, total storage capacity of 31,846 ac-ft, supplying approximately 4,000 ac-ft/yr when at conservation pool elevation. WRMWD purchased groundwater rights and drilled wells to augment its supply to customers should the water levels in the reservoir drop below the level at which water can be removed.

3.5.3 Lake Alan Henry and Associated Water Rights

Lake Alan Henry (LAH), owned by the City of Lubbock, is located on the North Fork in Garza and Kent counties. TCEQ Permit 4146, with Priority Date of October 5, 1981, authorizes impoundment of 115,937 ac-ft and diversions of up to 35,000 ac-ft/yr of water for municipal purposes. The most recent hydrographic survey of LAH[98], completed in 2017, indicates the conservation pool of LAH has been reduced to 96,207 ac-ft from the authorized capacity of 115,937 ac-ft. Application of the estimated sedimentation accumulation rate of 231 ac-ft/yr published in the survey report results in an estimated conservation pool storage capacity of 95,514 ac-ft in 2020 and 83,964 ac-ft in 2070.

The Llano Estacado Region received approval from the TWDB to use a 2-year safe yield in the evaluation of existing and strategy supply. Based upon the hydrologic record, LAH's firm yield was calculated at 18,800 ac-ft/yr in 2030 with a 2-yr safe yield of 11,300 in 2030.

3.6 Reuse Supplies

Reuse supplies are classified as either indirect or direct.

- Indirect reuse is treated wastewater effluent that re-enters rivers or streams and is diverted and used again downstream. Indirect reuse availability is based on currently permitted reuse projects that have infrastructure in place to divert and use this water in accordance with permits issued by the TCEQ. Currently, there are no indirect reuse supplies in the Llano Estacado Region.

- Direct reuse is treated wastewater effluent recirculated within a given system. Direct reuse availability is the amount of water from direct reuse sources that is expected to be available during DOR conditions for currently installed wastewater reclamation infrastructure.

Table 3-6 provides the direct reuse water availability by county for 2030 to 2080. In the Llano Estacado Region, 12 counties have water availability from direct reuse. Lubbock County has the largest direct reuse availability with 22,523 ac-ft in 2030, increasing to 31,830 ac-ft in 2080. Lubbock County is the only county with an increasing amount of direct reuse water availability; all other counties' direct reuse water availability remains constant and is based on their permitted amount.

[98] Texas Water Development Board, 2017, Volumetric and Sedimentation Survey of Alan Henry Reservoir

Table 3-6. Direct Reuse Water Availability by County from 2020 to 2070

County	Annual Quantity Available					
	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)	2080 (ac-ft)
Bailey	825	825	825	825	825	825
Castro	4,031	4,031	4,031	4,031	4,031	4,031
Cochran	294	294	294	294	294	294
Crosby	583	583	583	583	583	583
Deaf Smith	2,810	2,810	2,810	2,810	2,810	2,810
Floyd	449	449	449	449	449	449
Hale	5,477	5,477	5,477	5,477	5,477	5,477
Hockley	1,521	1,521	1,521	1,521	1,521	1,521
Lamb	7,199	7,199	7,199	7,199	7,199	7,199
Lubbock	22,523	24,931	27,384	29,075	30,576	31,830
Lynn	346	346	346	346	346	346
Parmer	2,887	2,887	2,887	2,887	2,887	2,887
Total	48,945	51,353	53,806	55,497	56,988	58,252

ac-ft = acre-feet

3.7 Total Supply

Total supplies for groundwater, surface water, and reuse supplies in the Llano Estacado Region are depicted in Table 3-7 and for 2080 in Figure 3-3.

Table 3-7. Total Groundwater, Surface Water, and Reuse Supplies in the Llano Estacado Region

Supply	2030	2040	2050	2060	2070	2080
	acre-feet					
Reuse	48,945	51,353	53,806	55,497	56,988	58,252
Surface Water	14,318	14,018	13,718	13,418	13,118	12,818
Groundwater	2,054,463	1,577,282	1,297,703	1,136,666	1,041,774	982,358
Total Supplies	2,117,726	1,642,653	1,365,227	1,205,581	1,111,880	1,053,428

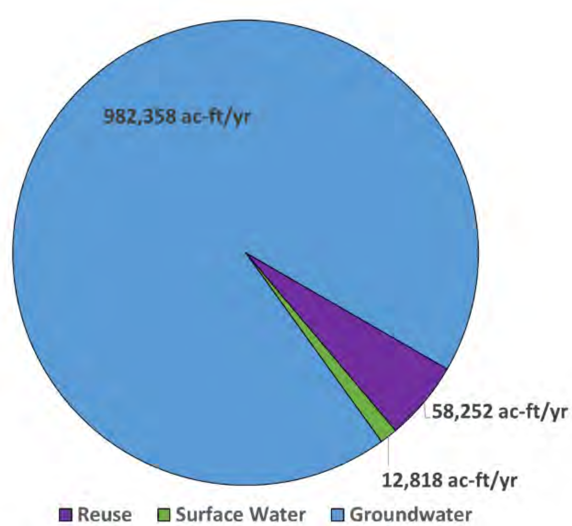

Figure 3-3. 2080 Water Supplies in the Llano Estacado Region

3.8 Supplies Available to Major Water Providers

In addition to allocating available water supplies to WUGs, supplies were also allocated to major water providers (MWPs) based on contracts or sources owned and operated by the MWP. These supplies were then allocated to WUGs based on contracts or other methods. Table 3-8 summarizes the supplies available to MWPs by decade and category of use. Only supplies used within the Llano Estacado Region and shown in the table. CRMWA and Red River have other supplies available that are used in adjacent regions

Table 3-8. Summary of Supplies Available to Major Water Providers

Major Water Provider	Category of Use	Supplies Available (ac-ft/yr)					
		2030	2040	2050	2060	2070	2080
Canadian River MWA	Municipal	45,171	45,530	41,660	38,634	35,696	35,391
	Manufacturing	0	0	0	0	0	0
	Mining	0	0	0	0	0	0
	Steam-Electric Power	0	0	0	0	0	0
	Irrigation	0	0	0	0	0	0
	Livestock	0	0	0	0	0	0
	Total Supply	**45,171**	**45,530**	**41,660**	**38,634**	**35,696**	**35,391**
City of Lubbock	Municipal	72,873	65,875	61,254	55,097	49,923	49,441
	Manufacturing	0	0	0	0	0	0
	Mining	0	0	0	0	0	0
	Steam-Electric Power	0	0	0	0	0	0
	Irrigation	0	0	0	0	0	0
	Livestock	0	0	0	0	0	0
	Total Supply	**72,873**	**65,875**	**61,254**	**55,097**	**49,923**	**49,441**
Mackenzie MWA	Municipal	2,900	2,900	2.900	2,900	2,900	2,900
	Manufacturing	0	0	0	0	0	0
	Mining	0	0	0	0	0	0
	Steam-Electric Power	0	0	0	0	0	0
	Irrigation	0	0	0	0	0	0
	Livestock	0	0	0	0	0	0
	Total Supply	**2,900**	**2,900**	**2,900**	**2,900**	**2,900**	**2,900**
White River MWD	Municipal	1,070	1,070	1,070	1,070	1,070	1,070
	Manufacturing	0	0	0	0	0	0
	Mining	0	0	0	0	0	0
	Steam-Electric Power	0	0	0	0	0	0
	Irrigation	0	0	0	0	0	0
	Livestock	0	0	0	0	0	0
	Total Supply	**1,070**	**1,070**	**1,070**	**1,070**	**1,070**	**1,070**
Red River Authority	Municipal	17	18	20	21	23	24
	Manufacturing	0	0	0	0	0	0
	Mining	0	0	0	0	0	0
	Steam-Electric Power	0	0	0	0	0	0
	Irrigation	0	0	0	0	0	0
	Livestock	0	0	0	0	0	0
	Total Supply	**17**	**18**	**20**	**21**	**23**	**24**

MWD = municipal water district

4

Identification of Water Needs

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Chapter 4: Identification of Water Needs

[31 TAC §357.33]

4.1 Water Needs Projections by Water User Group

Chapter 4 compares the water demand projections from Chapter 2 and the water supply projections from Chapter 3 to identify and estimate projected water needs in the Llano Estacado Region through the year 2080. If projected demand exceeds projected supply for a given water user group (WUG), the difference or shortage is identified as a water need for that WUG.

Chapter 2 presents demand projections for six types of water use: municipal, manufacturing, steam-electric, mining, irrigation, and livestock. These projections represent dry-year demands. Municipal water demand projections are shown for each entity that supplied more than 100 acre-feet (ac-ft) of water in any single year between 2015 and 2019. Rural areas not served by a water utility in a given county are known as county-other in the Texas Water Development Board (TWDB) planning process. Chapter 3 provides estimates of surface water availability (i.e., firm yield for reservoirs and firm diversions for run-of-river supplies) and modeled available groundwater (MAG). Appendix C lists the versions and dates of water availability model (WAM) simulations completed to calculate available surface water supply, as well as the model modification assumptions and unmodified firm diversion and firm yields submitted in the hydrologic variance request documentation.

Table 4-1 summarizes projected water needs for each WUG in the planning area by type by county. The Llano Estacado Region has a projected annual water need of 553,855 ac-ft in 2030, decreasing to 77,574 ac-ft by 2080 (Table 4-1, end of table). The decreasing water need is largely due to declining demand projections for irrigation. The irrigation need in 2030 is 552,793 ac-ft (or 99.8 percent of the total need) and decreases to 22,717 ac-ft in 2080 (or 29.3 percent of the total need). The projected needs for municipal customers increase as irrigation needs decrease over this same time period.

Table 4-1. Summary of Water Needs (Shortages) by WUG

Water User Group	Year					
	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)	2080 (ac-ft)
Bailey County						
Muleshoe	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	845	4,452	2,317	0	0	0
Livestock	0	0	0	0	0	0
County Total	**845**	**4,452**	**2,317**	**0**	**0**	**0**
Briscoe County						
Quitaque	0	0	0	0	0	0
Silverton	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
County Total	**0**	**0**	**0**	**0**	**0**	**0**
Castro County						
Dimmitt	0	0	0	0	0	0
Hart Municipal Water System	0	0	0	0	0	0
Nazareth	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	83,995	92,078	53,100	0	0	0
Livestock	0	0	0	0	0	0
County Total	**83,995**	**92,078**	**53,100**	**0**	**0**	**0**
Cochran County						
Morton Public Water System (PWS)	0	0	0	0	0	0
Whiteface	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	35,798	29,594	23,303	16,579	13,777	11,703
Livestock	0	0	0	0	0	0
County Total	**35,798**	**25,594**	**23,303**	**16,579**	**13,777**	**11,703**

Water User Group	Year					
	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)	2080 (ac-ft)
Crosby County						
Crosbyton	0	0	0	0	0	0
Lorenzo	0	0	0	0	0	0
Ralls	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
County Total	**0**	**0**	**0**	**0**	**0**	**0**
Dawson County						
Lamesa	0	0	0	0	0	0
O'Donnell	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	0	0	0	0	495	581
Livestock	0	0	0	0	0	0
County Total	**0**	**0**	**0**	**0**	**495**	**581**
Deaf Smith County						
Hereford	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	20,542	28,702	17,547	344	258	205
Livestock	0	0	0	0	0	0
County Total	**20,542**	**28,702**	**17,547**	**344**	**258**	**205**
Dickens County						
Red River Authority	0	0	0	0	0	0
Spur	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
County Total	**0**	**0**	**0**	**0**	**0**	**0**

Water User Group	Year					
	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)	2080 (ac-ft)
Floyd County						
Floydada	0	0	0	0	0	0
Lockney	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	23,439	11,747	1,480	0	0	0
Livestock	0	0	0	0	0	0
County Total	**23,439**	**11,747**	**1,480**	**0**	**0**	**0**
Gaines County						
Seagraves	0	0	0	0	0	0
Seminole	539	694	840	933	1,043	1,168
County-Other	0	0	0	0	0	0
Municipal Total	**539**	**694**	**840**	**933**	**1,043**	**1,168**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	81,492	83,803	47,803	5,995	6,126	6,249
Livestock	0	0	0	0	0	0
County Total	**82,031**	**84,497**	**48,643**	**6,928**	**7,169**	**7,417**
Garza County						
Post	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
County Total	**0**	**0**	**0**	**0**	**0**	**0**
Hale County						
Abernathy	0	0	0	0	0	0
Hale Center	0	0	0	0	0	0
Petersburg Municipal Water	0	0	0	0	0	0
Plainview	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	101,843	113,449	57,801	48	24	16
Livestock	0	0	0	0	0	0
County Total	**101,843**	**113,449**	**57,801**	**48**	**24**	**16**

Water User Group	Year					
	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)	2080 (ac-ft)
Hockley County						
Anton	0	0	0	0	0	0
Levelland	0	0	0	0	0	0
Sundown	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	24,418	15,108	9,477	0	0	0
Livestock	0	0	0	0	0	0
County Total	**24,418**	**15,108**	**9,477**	**0**	**0**	**0**
Lamb County						
Amherst	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Littlefield	0	0	0	0	0	0
Olton	0	0	0	0	0	0
Sudan	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	60,818	73,776	32,449	0	0	0
Livestock	0	0	0	0	0	0
County Total	**60,818**	**73,776**	**32,449**	**0**	**0**	**0**
Lubbock County						
Abernathy	0	0	0	0	0	0
Idalou	0	0	0	0	0	0
Lubbock	319	6,181	16,665	28,047	40,631	49,685
New Deal	0	0	0	0	0	0
Ransom Canyon	0	0	0	0	0	0
Shallowater	0	0	0	3	333	418
Slaton	204	275	327	360	386	380
Wolfforth	0	1,395	2,374	2,747	3,031	3,206
County-Other	0	0	0	0	0	0
Municipal Total	**523**	**7,851**	**19,366**	**31,157**	**44,381**	**53,689**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	27,093	32,040	15,413	0	0	0
Livestock	0	0	0	0	0	0
County Total	**27,616**	**39,891**	**34,779**	**31,157**	**44,381**	**53,689**

Water User Group	Year 2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)	2080 (ac-ft)
Lynn County						
O'Donnell	0	0	0	0	0	0
Tahoka Public WS	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	0	0	0	449	692	849
Livestock	0	0	0	0	0	0
County Total	**0**	**0**	**0**	**449**	**692**	**849**
Motley County						
Matador	0	0	0	0	0	0
Red River Authority	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
County Total	**0**	**0**	**0**	**0**	**0**	**0**
Parmer County						
Bovina	0	0	0	0	0	0
Farwell	0	0	0	0	0	0
Friona	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	69,215	70,848	37,184	2,318	1,376	800
Livestock	0	0	0	0	0	0
County Total	**69,215**	**70,848**	**37,184**	**2,318**	**1,376**	**800**
Swisher County						
Happy	0	0	0	0	0	0
Tulia	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	159	7,735	6,018	825	664	516
Livestock	0	0	0	0	0	0
County Total	**159**	**7,735**	**6,018**	**825**	**664**	**516**

Water User Group	Year					
	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)	2080 (ac-ft)
Terry County						
Brownfield	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	0	0	0	204	1,809	1,798
Livestock	0	0	0	0	0	0
County Total	**0**	**0**	**0**	**204**	**1,819**	**1,798**
Yoakum County						
Denver City	0	0	0	0	0	0
Plains	0	0	0	0	0	0
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**0**	**0**	**0**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	23,136	28,019	16,585	0	0	0
Livestock	0	0	0	0	0	0
County Total	**23,136**	**28,019**	**16,585**	**0**	**0**	**0**
Llano Estacado Region (Region O—All Counties)						
Municipal	1,062	8,545	20,206	32,090	45,424	54,857
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	552,793	591,351	320,477	26,762	25,221	22,717
Livestock	0	0	0	0	0	0
Region Total	**553,855**	**599,896**	**340,683**	**58,852**	**70,645**	**77,574**

ac-ft = acre-feet

4.1.1 Municipal WUGs with Needs

There are five municipal WUGs with a projected need (shortage) between 2030 and 2080: Seminole in Gaines County and Lubbock, Shallowater, Slaton, and Wolfforth in Lubbock County. The total municipal need for the region in 2030 is 1,062 acre-feet per year (ac-ft/yr), increasing to 54,857 ac-ft/yr in 2080 (Table 4-1). Two counties (Gaines and Lubbock) are projected to have at least one WUG with a municipal need (shortage) during the planning period, as shown in Figure 4-1.

4.1.2 Manufacturing WUGs with Needs

There are no projected manufacturing needs within the planning period.

4.1.3 Steam-Electric WUGs with Needs

There are no projected steam-electric needs within the planning period.

4.1.4 Mining WUGs with Needs

There are no projected mining needs within the planning period.

4.1.5 Irrigation WUGs with Needs

The total irrigation need for the region in 2030 is 552,793 ac-ft/yr, decreasing to 22,717 ac-ft/yr in 2080 (Table 4-1) primarily due to decreasing irrigation demands during the planning period. Sixteen counties (all counties, except Briscoe, Crosby, Dickens, Garza, and Motley) are projected to have an irrigation need (shortage) during the planning period, as shown in Figure 4-2.

4.1.6 Livestock WUGs with Needs

There are no projected livestock needs within the planning period.

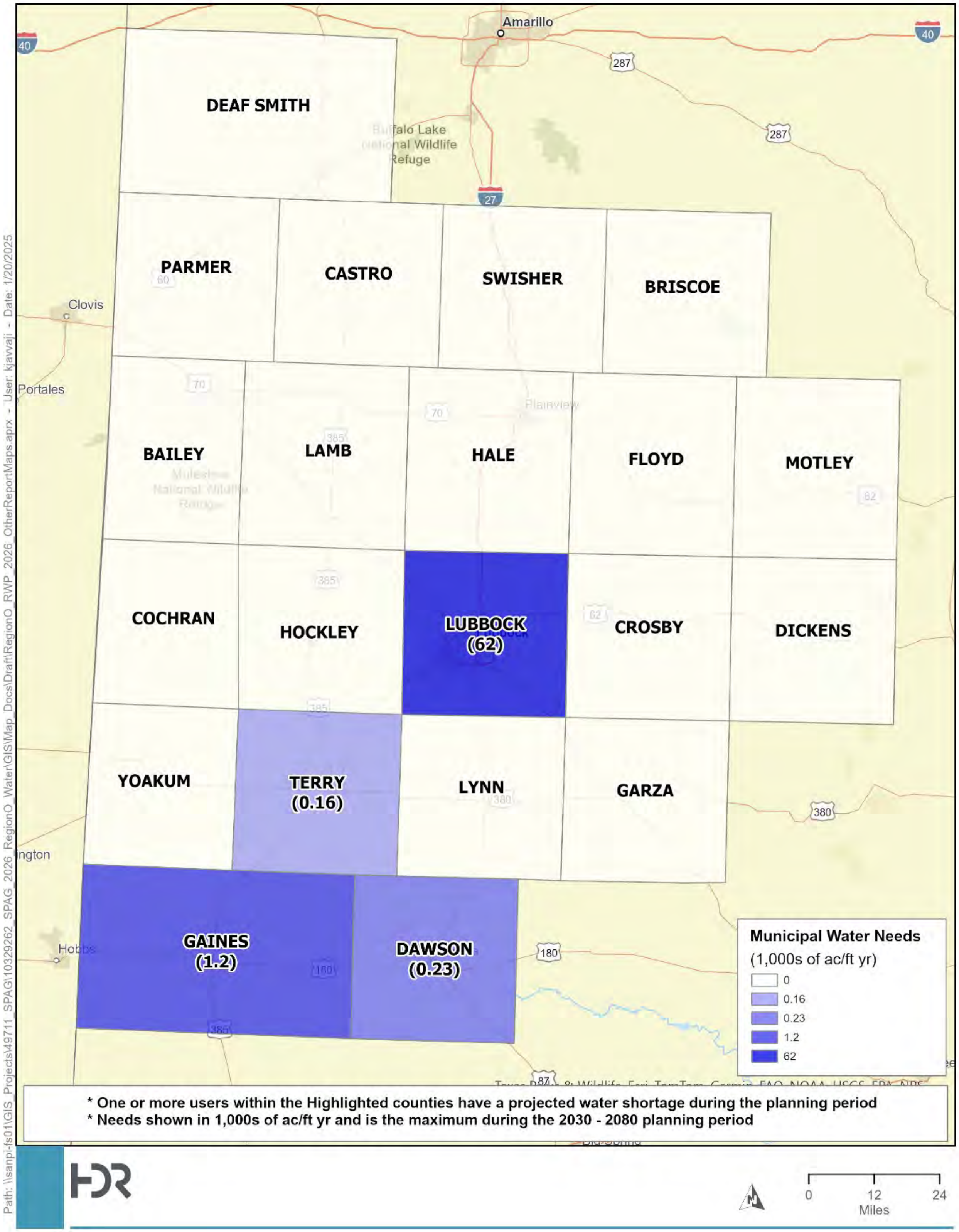

Figure 4-1. Municipal Water Needs

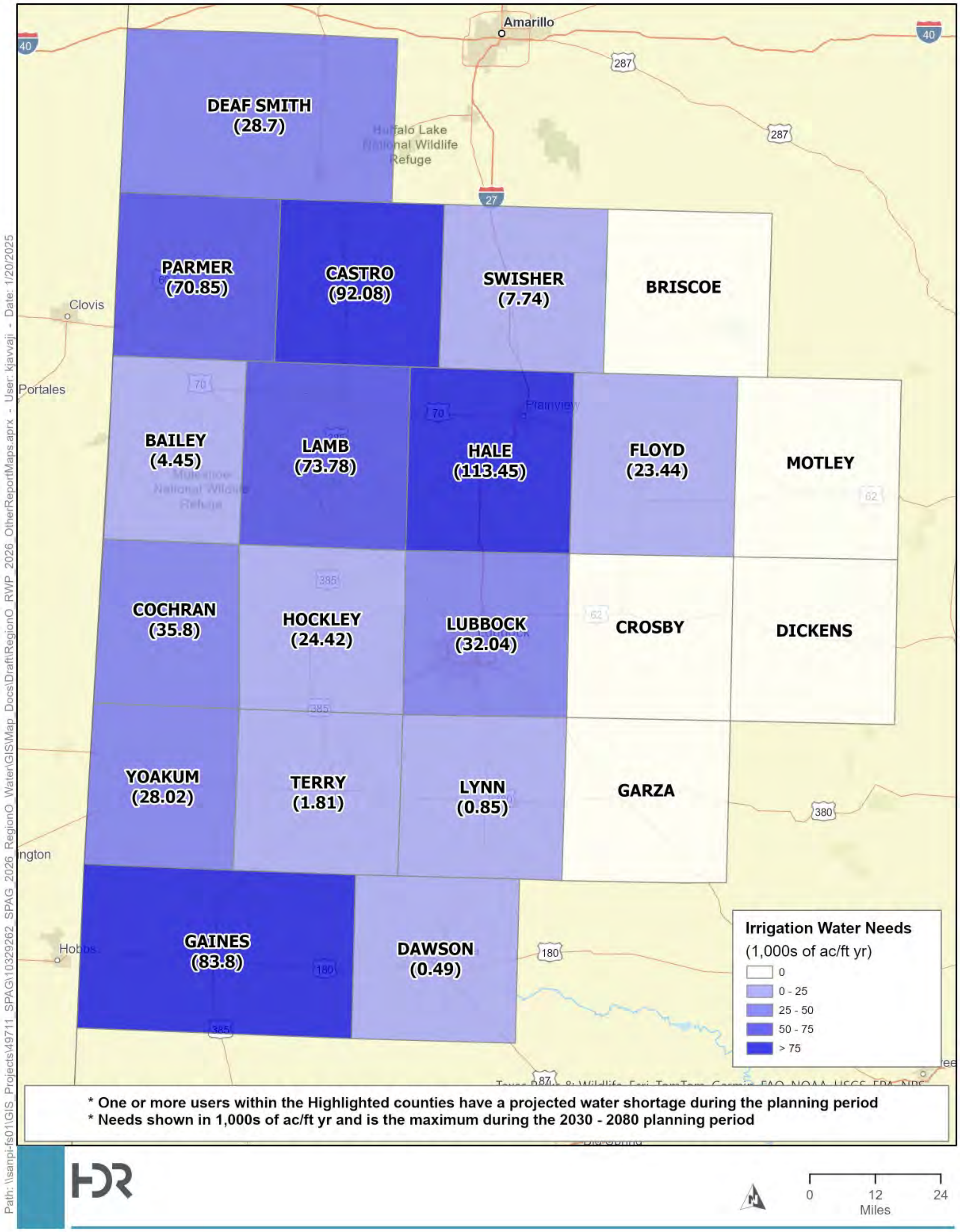

Figure 4-2. Irrigation Water Needs

4.2 Water Needs Projections by Major Water Provider

Table 4-2 summarizes projected water demands, existing supplies, and needs (shortages) for each major water provider (MWP) in the Llano Estacado planning region. Projected water demands for each MWP are estimated on the basis of existing and/or future contracts with WUGs expected to continue receiving water or acquiring new water supplies from the MWP. Supplies for each MWP are determined in accordance with procedures and assumptions described in Chapter 3 and are identified by source in Table 4-2. The Canadian River Municipal Water Authority (CRMWA) and the City of Lubbock have projected needs for additional water supply throughout the planning period. The Mackenzie Municipal Water Authority (MMWA), the White River Municipal Water District (WRMWD), and the Red River Authority (RRA), on the other hand, have existing supplies in excess or equal to projected demands throughout the planning period. These existing supplies in excess of projected demand are identified in Table 4-2 as system management supplies. Table 4-3 presents the needs for each MWP by category of use.

Table 4-2. Supplies and Needs for Major Water Providers

Major Water Providers with Lists of Customers	Projections					
	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)	2080 (ac-ft)
Canadian River Municipal Water Authority (CRMWA)						
Demands (Region O Only)	**49,114**	**55,335**	**55,894**	**56,190**	**56,408**	**56,266**
Supplies (Region O Only)						
Lake Meredith	13,561	13,976	12,018	11,869	11,797	11,698
Ogallala Aquifer (Roberts County)	31,610	31,554	29,642	26,765	23,899	23,693
Total Supplies	**45,171**	**45,530**	**41,660**	**38,634**	**35,696**	**35,391**
CRMWA System Management Supplies/(Needs)	***(3,943)***	***(9,805)***	***(14,234)***	***(17,556)***	***(20,712)***	***(20,875)***
City of Lubbock						
Demands	**73,192**	**72,056**	**77,919**	**83,144**	**91,144**	**99,716**
Supplies						
Lake Alan Henry	11,300	11,000	10,700	10,400	10,100	9,800
Ogallala Aquifer (Bailey County)	2,500	2,050	1,601	1,151	0	0
Ogallala Aquifer (Lamb County)	2,500	2,050	1,601	1,151	0	0
CRMWA	37,533	38,454	35,032	32,315	29,743	29,561
Reuse Supplies	19,040	12,320	12,320	10,080	10,080	10,080
Total Supplies	**72,873**	**65,874**	**61,254**	**55,097**	**49,923**	**49,441**
Lubbock System Management Supplies/(Needs)	***(319)***	***(6,182)***	***(16,665)***	***(28,047)***	***(41,221)***	***(50,275)***
Mackenzie Municipal Water Authority (MMWA)						
Demands	**568**	**568**	**568**	**568**	**568**	**568**
Supplies						
Lake Mackenzie	2,900	2,900	2,900	2,900	2,900	2,900
Total Supplies	**2,900**	**2,900**	**2,900**	**2,900**	**2,900**	**2,900**
MMWA System Management Supplies/(Needs)	***2,332***	***2,332***	***2,332***	***2,332***	***2,332***	***2,332***
White River Municipal Water District (WRMWD)						
Demands	**1,070**	**1,070**	**1,070**	**1,070**	**1,070**	**1,070**
Supplies						
White River Reservoir	0	0	0	0	0	0
Ogallala Aquifer (Crosby County)	1,070	1,070	1,070	1,070	1,070	1,070
Total Supplies	**1,070**	**1,070**	**1,070**	**1,070**	**1,070**	**1,070**
WRMWD Management Supplies/(Needs)	***0***	***0***	***0***	***0***	***0***	***0***
Red River Authority (RRA)						
Demands (Region O Only)	**3**	**2**	**2**	**2**	**2**	**1**
Supplies (Region O Only)						
Other Aquifer (Dickens County)	11	12	13	14	15	16
Other Aquifer (Motley County)	6	6	7	7	8	8
Total Supplies	**17**	**18**	**20**	**21**	**23**	**24**
RRA Management Supplies/(Needs)	***14***	***16***	***18***	***19***	***21***	***23***

ac-ft = acre-feet

Table 4-3. Supplies and Needs for Major Water Providers by Category of Use

Major Water Provider	Category of Use	Management Supply/(Needs) (ac-ft/yr)					
		2030	2040	2050	2060	2070	2080
Canadian River MWA	Municipal	(3,943)	(9,805)	(14,234)	(17,556)	(20,712)	(20,875)
	Manufacturing	0	0	0	0	0	0
	Mining	0	0	0	0	0	0
	Steam-Electric Power	0	0	0	0	0	0
	Irrigation	0	0	0	0	0	0
	Livestock	0	0	0	0	0	0
	Total Management Supply/(Need)	**(3,943)**	**(9,805)**	**(14,234)**	**(17,556)**	**(20,712)**	**(20,875)**
City of Lubbock	Municipal	(319)	(6,182)	(16,665)	(28,047)	(41,221)	(50,275)
	Manufacturing	0	0	0	0	0	0
	Mining	0	0	0	0	0	0
	Steam-Electric Power	0	0	0	0	0	0
	Irrigation	0	0	0	0	0	0
	Livestock	0	0	0	0	0	0
	Total Management Supply/(Need)	**(319)**	**(6,182)**	**(16,665)**	**(28,047)**	**(41,221)**	**(50,275)**
Mackenzie MWA	Municipal	2,332	2,332	2,332	2,332	2,332	2,332
	Manufacturing	0	0	0	0	0	0
	Mining	0	0	0	0	0	0
	Steam-Electric Power	0	0	0	0	0	0
	Irrigation	0	0	0	0	0	0
	Livestock	0	0	0	0	0	0
	Total Management Supply/(Need)	**2,332**	**2,332**	**2,332**	**2,332**	**2,332**	**2,332**
White River MWD	Municipal	0	0	0	0	0	0
	Manufacturing	0	0	0	0	0	0
	Mining	0	0	0	0	0	0
	Steam-Electric Power	0	0	0	0	0	0
	Irrigation	0	0	0	0	0	0
	Livestock	0	0	0	0	0	0
	Total Management Supply/(Need)	**0**	**0**	**0**	**0**	**0**	**0**
Red River Authority	Municipal	14	16	18	19	21	23
	Manufacturing	0	0	0	0	0	0
	Mining	0	0	0	0	0	0
	Steam-Electric Power	0	0	0	0	0	0
	Irrigation	0	0	0	0	0	0
	Livestock	0	0	0	0	0	0
	Total Management Supply/(Need)	**14**	**16**	**18**	**19**	**21**	**23**

4.3 Second Tier Water Needs Analysis

The second tier water needs analysis compares currently available supplies with demands after reductions from conservation and direct reuse. Conservation and direct reuse are both considered water management strategies (WMSs) and are discussed in Chapter 5.

4.3.1 Summary of Second Tier Water Needs for Water User Groups

After the implementation of conservation strategies and direct reuse, the Llano Estacado Region has a projected water need of 501,124 ac-ft/yr in 2030. Most of this is associated with irrigated agriculture that has not fully realized the benefits of conservation. By 2080, the projected need is 66,440 ac-ft/yr (Table 4-4), which represents a 14 percent reduction of total needs identified in Table 4-1.

Table 4-4. Summary of Projected Secondary Needs by Use Type

WUG Category	Needs (ac-ft/yr)					
	2030	2040	2050	2060	2070	2080
Municipal	6,763	13,862	25,652	40,763	53,230	55,322
Manufacturing	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Irrigation	494,361	513,453	268,923	16,548	13,396	11,118
Livestock	0	0	0	0	0	0
Total Second Tier Needs	**501,124**	**527,315**	**294,575**	**57,311**	**66,626**	**66,440**

4.3.2 Summary of Second Tier Water Needs for Major Water Providers

The projected water needs for major water providers (MWPs) after conservation and direct reuse is shown in Table 4-5. For providers that deliver water only to wholesale customers, the conservation savings were estimated as a part of the customer's conservation savings. However, it is uncertain if those savings will reduce contractual demands on the MWP. For MWPs that also provide retail supplies, the conservation savings reflect the savings estimated for the WUG.

Table 4-5. Summary of Second Tier Water Needs for Major Water Providers

Major Water Provider	Needs (ac-ft/yr)					
	2030	2040	2050	2060	2070	2080
Canadian River MWA	4,203	9,407	15,250	20,878	23,943	24,023
City of Lubbock	5,988	11,685	22,032	36,484	48,197	49,876
Mackenzie MWA	0	0	0	0	0	0
White River MWD	0	0	0	0	0	0
Red River Authority	0	0	0	0	0	0

MWD = municipal water district; MWA = municipal water authority

5

Water Management Strategies

A. Potentially Feasible Water Management Strategies: Surface Water

B. Potentially Feasible Water Management Strategies: Groundwater

C. Water Conservation

D. Potential Additional Water Management Strategies

E. County Plans

F. Management Supply Factor for Major Water Providers

G. WMS Implementation Status

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Chapter 5: Water Management Strategies

[31 TAC §357.34 and 31 TAC §357.35]

Chapter 5 describes the water management strategies (WMSs) to meet identified water needs delineated in Chapter 4. The chapter is divided into the following six main parts.

- Part A describes potentially feasible surface water management strategies;
- Part B describes potentially feasible groundwater water management strategies;
- Part C discusses water conservation strategies that were considered;
- Part D presents additional water management strategies considered; and
- Part E summarizes water management plans by county.
- Part F summarizes management supply factors for major water providers (MWPs).

The process for identifying, evaluating, and selecting WMSs was documented at a 2018 public meeting of the Llano Estacado Regional Water Planning Group (LERWPG) and includes the following.

1. Potentially include strategies identified in previous plans.
    a. Potentially include recommended and alternative strategies from 2016.
    b. Potentially include strategies evaluated but not recommended in 2016.
    c. Potentially include strategies evaluated in previous plans that were not moved forward.
2. Identify draft needs and develop additional ideas to meet those needs.
3. Maintain ongoing communication from local interests through the regional water planning process.

From this process, a list of potentially feasible WMSs was determined and is included in Table 5-1.

Table 5-1. List of Potentially Feasible Water Management Strategies (WMSs)

Potentially Feasible WMS	Entity	County
Municipal water conservation	Municipal	Numerous
Non-municipal water conservation	Non-municipal	Numerous
Reclaimed wastewater supplies and reuse	Farwell, Lubbock, Wolfforth	Lubbock, Parmer
Local groundwater development	Municipal	Numerous
Water loss reduction	Municipal	Numerous
Groundwater desalination	Lubbock, Seminole	Lubbock, Gaines
South Garza water supply	County-other	Garza
Bailey County Well Field capacity maintenance	Lubbock	Lubbock
Lake 7 Reuse	Lubbock	Lubbock
Lake Alan Henry Phase 2	Lubbock	Lubbock
North Fork scalping operation	Lubbock	Lubbock
South Lubbock well field	Lubbock	Lubbock
Potable reuse	Lubbock	Lubbock
Wolfforth CRMWA lease from Slaton	Wolfforth	Lubbock
Direct potable reuse to North Water Treatment Plant	Lubbock	Lubbock
Direct potable reuse to South Water Treatment Plant	Lubbock	Lubbock
North Fork diversion at CR 7300	Lubbock	Lubbock
North Fork diversion to Lake Alan Henry pump station	Lubbock	Lubbock
Post Reservoir	Lubbock	Lubbock
Reclaimed water to aquifer storage and recovery	Lubbock	Lubbock
South Fork discharge	Lubbock	Lubbock
Transportation of water between counties of surplus and need	Mining	Numerous
Brackish well field in Lubbock area	Lubbock	Lubbock
CRMWA aquifer storage and recovery	CRMWA Member Cities	many
CRMWA II (Roberts County Well Field)	CRMWA Member Cities	many
Chloride control project	WRMWD	Dickens
Enhanced recharge project	Non-municipal	Numerous

The potentially feasible strategy types that were determined to not be viable for long-term water supply for the Llano Estacado Region and are not discussed further include water right cancellation, interbasin transfers, system optimization, and emergency transfers of water. Water right cancellation and interbasin transfers are surface water strategies. There is little existing surface water in the region and little to no unappropriated surface water. Neither of these strategies would provide reliable long-term supplies. System optimization was not considered further due to the lack of large water systems in the region or systems with multiple sources of supply. Emergency transfers of water are typically employed during an emergency situation and not considered a sustainable strategy for long-term water needs.

In addition to those strategies discussed above, drought management was not considered to be a viable long-term source of additional water. Drought management is the temporary reduction in water use in direct response to a drought or water supply emergency. It is typically short-term and does not result in lasting water supply changes. If drought management measures are used as WMSs, there is little or no flexibility remaining should the drought exceed the previous drought of record (DOR) conditions.

Finally, seawater desalination was not considered due to the cost and infeasibility associated with pumping water from the Gulf of America to the Llano Estacado Region.

For each strategy contained in the regional water plan, water losses associated with transmission lines were assumed to be negligible for this process.

5.1 Strategy Evaluation

In accordance with 31 Texas Administrative Code (TAC) § 357.34, WMS are evaluated based on the following criteria.

- Quantity of Water Available
- Reliability of Water Supply
- Cost of Strategy
- Environmental Factors
- Agricultural Resources
- Other Natural Resources
- Water Quality Parameters
- Third Party Social & Economic Factors

In addition to the WMS evaluations included in Section 5, Appendix D includes listings of endangered, threatened, candidate, and species of greatest conservation need (SGCN) for areas where WMS are identified, and Appendix E quantifies the agricultural resources and environmental factors for each WMS.

A. Potentially Feasible Water Management Strategies: Surface Water

While surface water supplies are limited in the Llano Estacado Region, they can be used to diversify supplies available to many water user groups (WUGs) who rely solely on groundwater as a source of supply. There are four river basins within the Llano Estacado Region (Canadian, Red, Brazos, and Colorado). Due to limited rainfall, most streams in the region only have intermittent flow. However, periodic flood events cause large runoff events that could be used to develop surface water supplies during those peak rainfall period. In addition to surface water, water reuse is also an important water supply strategy in this plan. In many cases, WUGs import water from long distances or are facing decreasing groundwater supplies. In those cases, reusing water can make economical and practical sense. This section presents the surface water management strategies and reuse water management strategies that were considered as part of this planning process.

5.2 Lake 7 Reuse

The Lake 7 Reuse (Lake 7) strategy is included in the *2024 Lubbock Strategic Water Supply Plan*[99] and consists of a new 20,000-acre-foot (ac-ft) reservoir immediately upstream of Buffalo Springs Lake on the North Fork of the Double Mountain Fork of the Brazos River (North Fork). Supplies from Lake 7 would be used to help meet annual and peak day for the City of Lubbock demands with transmission facilities being sized with a 2.0 peaking factor.

[99] 2018 Strategic Water Supply Plan, City of Lubbock. https://ci.lubbock.tx.us/storage/images/4G1pIUEKJzRJftCGkkPQyFewa9PVdySLl4ekNLWV.pdf

The new reservoir would impound reclaimed water, developed playa lake stormwater, and natural inflows. Reclaimed water from the City of Lubbock's wastewater treatment plants (WWTPs) would be the largest component of the inflow sources, resulting in the potential for an increased concentration of total dissolved solids (TDS) in the lake compared to naturally occurring inflows. As a result, this strategy includes advanced treatment to address water quality concerns. Diversions from the lake would be transported to the new advanced treatment plant located adjacent to the City of Lubbock's North Water Treatment Plant (NWTP) for treatment and distribution.

The major infrastructure components of the Lake 7 strategy include the following.

- Construct a 20,000 ac-ft, 774-acre reservoir on the North Fork to impound reclaimed water, developed playa lake stormwater, and natural streamflows;
- Construct an 18.74-million gallon per day (mgd) intake structure and pump station at Lake 7;
- Construct a new 18.7 mgd advanced treatment plant; and
- Install a 12-mile, 36-inch transmission pipeline to deliver stored water from Lake 7 to the advanced treatment plant.

Figure 5-1 provides the location of infrastructure included in the Lake 7 strategy.

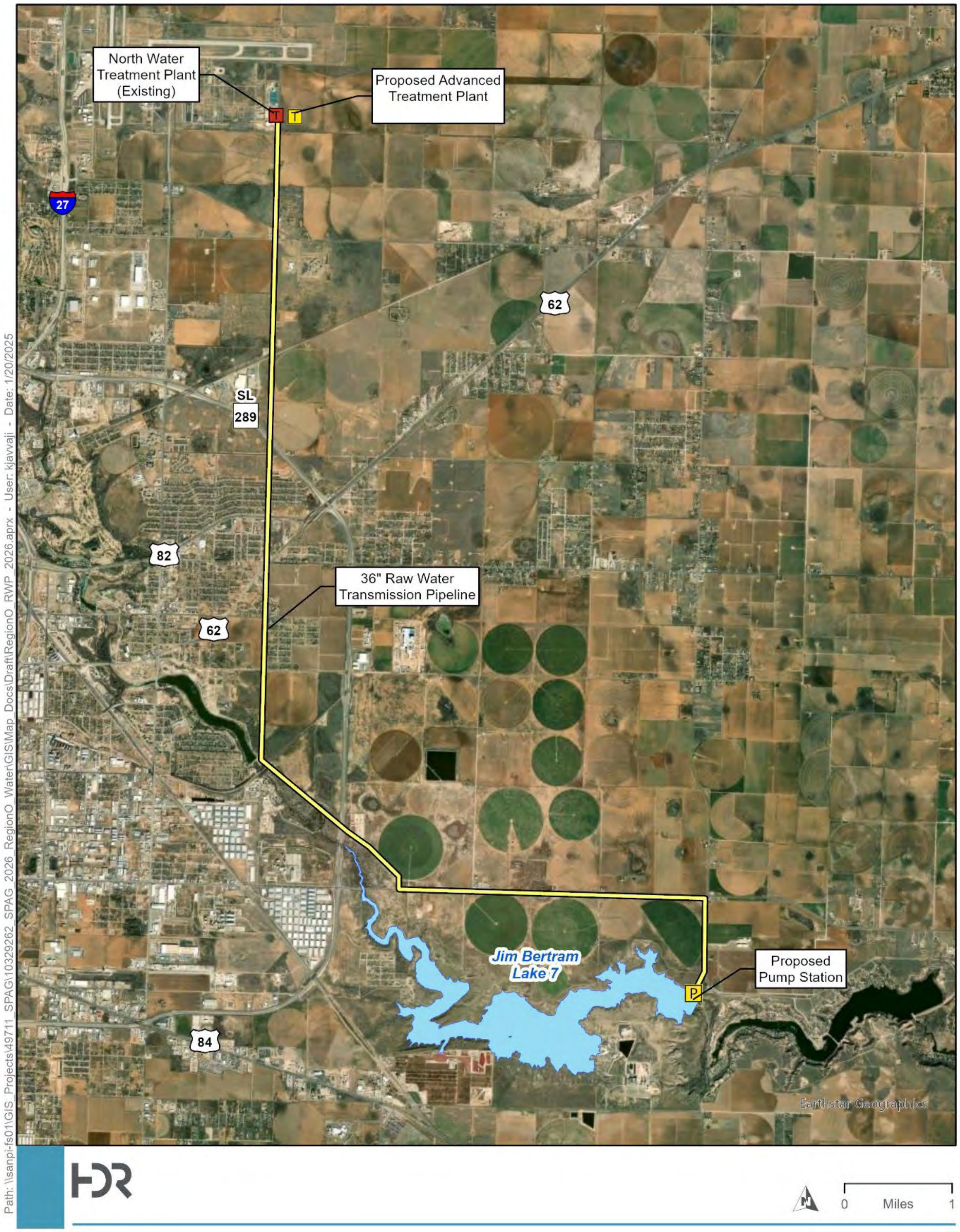

Figure 5-1. Lake 7 Reuse Strategy Infrastructure

5.2.1 Quantity of Available Water

The yield of Lake 7 is contingent upon the availability of return flows discharged by the City of Lubbock and the availability of playa lake-developed stormwater. The City of Lubbock anticipates up to 8 mgd of reclaimed water would be available for impoundment in Lake 7, and on average, over 10,500 acre-feet per year (ac-ft/yr) of playa lake-developed stormwater would contribute to Lake 7 inflows.

Water availability analyses were performed using a RiverWare model of Lake 7 created by HDR for the 2018 Lubbock Strategic Water Supply Plan and Lubbock Phase 1 Lake 7 Permit project. The RiverWare model accounts for the natural inflow (unappropriated state water), the playa lake developed water, and the reclaimed water. The City of Lubbock would manage Lake 7 with a 1-year safety reserve. The one-year safe yield of Lake 7, and the strategy supply for this evaluation, is 10,500 ac-ft/yr. This safe yield amount is subject to the city obtaining sole rights to its developed water (playa lake storm water and reclaimed water).

5.2.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-2. Assumptions associated with these costs include the following.

- The advanced water treatment plant would be constructed on City of Lubbock-owned land adjacent to the NWTP.
- Flows used to design the intake, pump station, advanced treatment plant and transmission pipelines include an estimated 5 percent downtime and are sized with a 2.0 peaking factor.
- The project is assumed to have a 2-year construction period.
- Costs do not include the distribution of the potable water from the NWTP to potential customers.

Table 5-2. Lake 7 Reuse Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Dam and Reservoir (20,000 ac-ft, 774 acres)	$143,865,000
Intake and Pump Station (18.7 mgd)	$41,590,000
Transmission Pipeline (36-in dia., 12 miles)	$58,608,000
Advanced Water Treatment Plant (18.7 mgd)	$90,955,000
Integration, Relocations, Backup Generator & Other	$214,000
TOTAL COST OF FACILITES	$335,232,000
Engineering	
- Planning (3%)	$10,057,000
- Design (7%)	$23,466,000
- Construction Engineering (1%)	$3,352,000
Legal Assistance (2%)	$6,705,000
Fiscal Services (2%)	$6,705,000
Pipeline Contingency (15%)	$8,791,000
All Other Facilities Contingency (20%)	$55,325,000
Environmental & Archaeology Studies and Mitigation	$42,000,000
Land Acquisition and Surveying (858 acres)	$2,820,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$32,127,000
TOTAL COST OF PROJECT	**$526,580,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$19,146,000
Reservoir Debt Service (3.5%, 40 years)	$11,906,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$588,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$1,040,000
Dam and Reservoir (1.5% of Cost of Facilities)	$2,158,000
Advanced Water Treatment Plant	$2,262,000
Pumping Energy Costs (0.09 $/kW-hr)	718,000
TOTAL ANNUAL COST	**$37,818,000**
Available Project Yield (ac-ft/yr)	10,500
Annual Cost of Water ($ per ac-ft), based on PF=2	$3,602
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=2	$644
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$11.05
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$1.98

ac-ft = acre-feet; ac-ft/yr = acre-feet per year; mgd = million gallons per day; in = inch; dia. = diameter;
ROI = return on investment; kW-hr = kilowatt-hours

5.2.3 Implementation Issues

5.2.3.1 Environmental Issues

The project occurs within the High Plains vegetational area[100] and is within the Kansan biotic province.[101] According to the *Vegetation Types of Texas*, the project components are within the following vegetation communities: mesquite-lotebush brush (surrounding the proposed reservoir), crops, and urban.[102] The mesquite-lotebush brush vegetation type is distributed through parts of

[100] Gould, F.W. 1975. The Grasses of Texas. Texas A&M University Press. College Station, Texas.

[101] Blair, W.F. 1950. "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117.

[102] McMahan, C.A., R.G. Frye, and K.L. Brown, 1984. The Vegetation Types of Texas. Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ February 7, 2025..

west, northwest, and north-central Texas, and includes species such as yucca (*Yucca sp.*), agarito (*Mahonia trifoliolata*), elbowbush (*Forestiera angustifolia*), juniper (*Juniper sp.*), sand dropseed (*Sporobolus cryptandrus*), Texas grama (*Bouteloua rigidiseta*), Texas wintergrass (*Nassella Leucotricha*), broom snakeweed (*Gutierrezia sarothrae*), and Englemann daisy (*Engelmannia perstenia*), among others. The crops vegetation type includes cultivated cover crops or row crops that provide food or fiber for man or domestic animals, or grasslands associated with crop rotations. Urban vegetation communities are influenced by man and include many ornamental species or maintained vegetation. Vegetation impacts would include converting approximately 774 acres from brushland to reservoir and clearing areas to install the pipeline and construct the intake and pump station and the advanced water treatment facility. Vegetation impacts would vary depending on the methods used to install the pipeline.

The Federal Emergency Management Administration (FEMA) oversees the delineation of 100-year floodplain zones on the flood insurance rate maps (FIRMs) across the United States. The term, 100-year floodplain, refers to areas that have a one percent chance of flooding in any given year. The FEMA 100-year floodplain zones within the project fall along the perimeter of the North Fork, which would be inundated[103]. Additionally, some playa lakes, which are mapped as part of the 100-year floodplain, may be present along the proposed transmission pipeline route.

The National Wetland Inventory (NWI) database indicates that the North Fork within the proposed reservoir area is primarily labeled as freshwater emergent wetland with smaller areas of freshwater forested/shrub wetland. Coordination with the U.S. Army Corps of Engineers (USACE) is required for construction within waters of the U.S. for the proposed project.[104] . Because this strategy includes a reservoir, it is expected that extensive coordination with USACE and an individual permit would be required.

The TCEQ *2024 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted June 26, 2024[105], and the TCEQ Surface Water Quality Viewer show that the North Fork (Segment 1241A) and Buffalo Springs Lake (Segment 1241C) both fully support their designated uses and contained no impairments.[106]

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (PI96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available geographic information system (GIS) datasets, the City of Lubbock Cemetery and a historical marker for the cemetery are within a one-mile buffer of the proposed project area. No other

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[103] Federal Emergency Management Agency (FEMA). 2025. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd February 7, 2025.

[104] National Wetland Inventory (NWI). 2025. Surface Waters and Wetlands HUC 12100203. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html February 7, 2025..

[105] Texas Commission on Environmental Quality (TCEQ). 2024. Draft 2016 Texas Integrated Report for the Clean Water Act Sections 305(b) and 303(d). Accessed online 2024 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d) – Texas Commission on Environmental Quality - https://www.tceq.texas.gov on February 7, 2025.

[106] TCEQ. 2019. Surface Water Quality Viewer. Accessed https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 February 7, 2025.

cemeteries, historical markers, national register properties, or national register districts are located within a one-mile buffer of the proposed project area.

A review of archaeological resources in the proposed project area should be conducted during project planning. The owner or controller of the project will be required to coordinate with the Texas Historical Commission regarding impacts to cultural resources.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by U.S. Fish and Wildlife Service (USFWS), and the Texas Parks and Wildlife Department (TPWD), as endangered, threatened, or SGCN in Lubbock County are listed in Appendix D under Lubbock County, Texas.

According to Information for Planning and Consultation (IPaC), accessed on the USFWS website on January 15, 2025, themonarch butterfly (*Danaus plexippus*), sharpnose shiner (*Notropis oxyrhynchus*), and the smalleye shiner (*Notropis buccula*) could be affected by the proposed project. The piping plover and rufa red knot were also included on the IPaC list but only need to be considered for wind energy projects. There are no critical habitats for threatened or endangered species within the proposed project area. The Texas Natural Diversity Database (TXNDD), maintained by the TPWD, documents the occurrences of rare species in Texas. The swift fox (*Vulpes velox*), an SGCN-designated species, has been documented at the Lubbock Preston Smith International Airport (between 1971 and 1972) and near the western edge of the proposed Lake 7 (in 1966). Additionally, the state threatened Texas horned lizard (*Phrynosoma cornutum)* has been documented near the Yellow House River between Old AT & SF Railway and E Loop 289 in July 2024.

If this strategy is selected, a biological survey and habitat assessment of the project area should be conducted to determine the presence of threatened and endangered species or their potential habitats. Based on the findings, an evaluation will be made to determine whether the proposed activities may impact listed species. Lake 7 would impound water and could potentially impact several aquatic species, including the federally-listed sharpnose shiner and smalleye shiner. Coordination with TPWD and USFWS regarding threatened and endangered species should be initiated early in project planning.

Summary

The primary environmental issue related to this strategy is the change in land use of 774 acres from ranchland to a reservoir site. In July 2011, the City of Lubbock provided an environmental information document (EID) to TCEQ that describes the environment that would potentially be affected by the construction of Lake 7. According to the EID, this project would have an impact on the environment, and a mitigation plan would be required to compensate for unavoidable impacts. Some of the issues identified in the EID include the following.

- No federal or state protected aquatic life has been found in the project reach, although two federally listed species of minnow – the sharpnose shiner and the smalleye shiner – would potentially be impacted in the reach downstream from the reservoir.
- A baseline survey revealed that the state-threatened Texas horned lizard is thriving in the project vicinity, so additional evaluation and a management and mitigation plan would be necessary if the reservoir is built.

- A review of Texas Historical Commission and other records identified 17 archeological sites in or near the project area that would need to be assessed.

The advanced treatment facilities would be constructed on City of Lubbock-owned property that is currently being used for similar purposes, and environmental issues are anticipated to be minimal. The transmission pipeline corridor that would convey the reclaimed water should be selected to avoid potentially sensitive areas.

5.2.3.2 Permitting Issues

The existing Texas Pollutant Discharge Elimination System (TPDES) Permit No. 10353-002 authorizes the City of Lubbock to discharge up to 14.5 mgd (16,242 ac-ft/yr) of reclaimed water at the Southeast Water Reclamation Plant (SEWRP) into the North Fork at Outfall 007. In 2005, the City of Lubbock submitted Water Rights Application No. 5921, which, among other things, seeks the right to impound and divert water from the proposed Lake 7. Although the application was declared administratively complete in April 2006, TCEQ's technical review is still ongoing.

In addition, a USACE Section 404 permit would be required prior to commencing construction of Lake 7. This reservoir is large enough to require an individual permit. Mitigation plans for the project's environmental impacts must be developed and agreed upon by USACE and other state and federal resource agencies.

TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and used as the basis for reviewing permit applications. Treatment requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, effluent quality sampling/monitoring data results, and wastewater treatment process.

Monitoring is likely to include cryptosporidium (or a surrogate organism), other regulated contaminants, and may include contaminants on the U.S. Environmental Protection Agency (EPA) Candidate Contaminant List, including emerging constituents of concern, pharmaceuticals, and personal care products.

5.2.3.3 Other

Property would need to be acquired for the lake, dam, pump station, and mitigation area. In addition, pipeline utility easements would be necessary to construct a raw water transmission line to the new advanced water treatment plant.

The geological formation that the dam foundation would be constructed upon appears to be somewhat pervious. In addition, there is the potential for considerable leakage from the reservoir conservation pool to the local groundwater aquifer system. The Comanche Peak formation could also allow vertical leakage from the reservoir through the valley floor. The City of Lubbock commissioned a study completed in 2014 to investigate these geologic formation issues that determined that such leakage could be controlled.

Wastewater effluent would constitute a large percentage of the volume in Lake 7, and the blended concentration of TDS in the lake would likely increase as a result. During drought conditions, the TDS concentration may become greater than the secondary drinking water standard requiring advanced treatment. Advanced treatment design considerations should include real-time monitoring and regular sampling to ensure process performance and avoid any acute episode of pathogens in the reclaimed water.

5.3 Lake Alan Henry Phase 2

The Lake Alan Henry (LAH) Phase 2 water supply strategy is included in the *2018 Lubbock Strategic Water Supply Plan* and would expand existing infrastructure to transport and treat an additional 15 mgd of raw water increasing total capacity to 30 mgd. The City of Lubbock began using LAH as a water supply during the fall of 2012 and used a maximum of 9,922 ac-ft in 2021, of its 13,075 ac-ft/yr, 2-year safe yield supply from this source. The existing LAH raw water supply pipeline (Phase 1) consists of the following elements:

- Lake Alan Henry Intake and Lake Alan Henry Pump Station (LAHPS);
- Post Pump Station (PPS);
- South Water Treatment Plant (SWTP);
- A 42-inch diameter raw water transmission pipeline from the LAHPS to the PPS;
- A 48-inch diameter raw water transmission pipeline from the PPS to the SWTP; and
- Treated water transmission lines that move water into three pump stations (PS #8, PS #10, and PS #14) within Lubbock's water distribution system.

Expanding the existing infrastructure is necessary to increase the delivery capacity and annual supply to the SWTP. Additional raw water transmission lines would not be necessary in Phase 2 because the existing pipelines are sized to handle up to 34 mgd.

The major infrastructure components of the LAH Phase 2 strategy include the following.

- Construct the Southland Pump Station (SLPS);
- Expand the SWTP by 15 mgd, which includes expanding the high service pump station.

Figure 5-2 provides the location of infrastructure included in the LAH Phase 2 strategy.

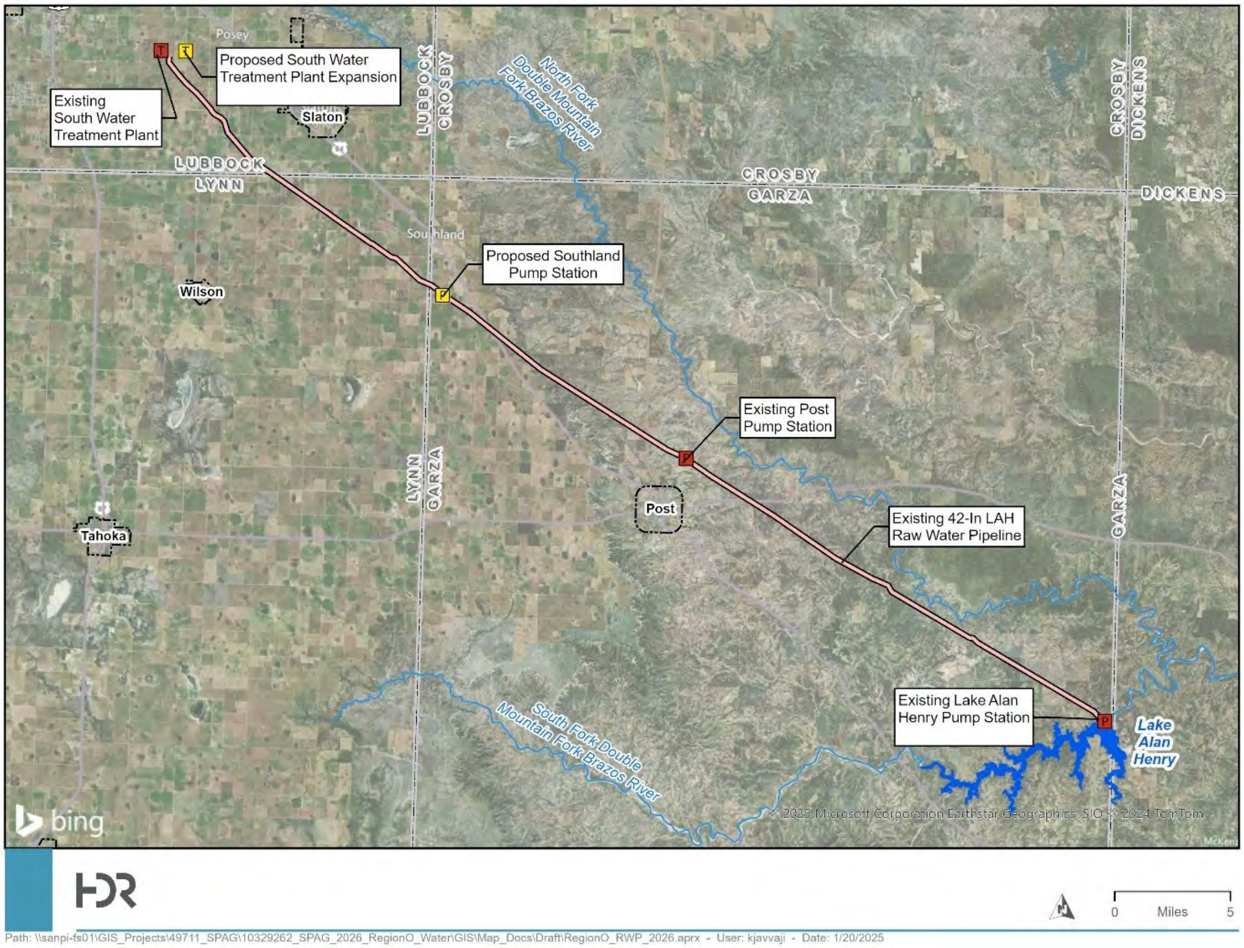

Figure 5-2. Lake Alan Henry Phase 2

5.3.1 Quantity of Available Water

The City of Lubbock intends to operate LAH near the 2-year safe yield of 13,075 ac-ft/yr. The current water supply infrastructure is capable of delivering 8,000 ac-ft/yr with a peak capacity of 15 mgd. Phase 2 would increase the total deliverable volume to the 2-year safe yield of 13,075 ac-ft/yr, an incremental increase of 5,075 ac-ft/yr, and increase the peak capacity to 30 mgd. The pump stations and the SWTP would be modified to provide a peak capacity of 30 mgd. This would allow the city to overdraft LAH temporarily at greater than its 2-year safe yield if circumstances require. The additional capacity of the raw water transmission lines may be used if needed to supplement supplies if one of the city's other supplies becomes inoperable for a time, or if other water supply strategies are implemented.

5.3.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-3. Assumptions associated with these costs include the following.

- Energy costs to transmit the additional water from the expansion through the LAHPS and LAH pipeline are included. These costs are based on an average annual delivery of an additional 4.5 mgd (5,075 ac-ft/yr) through the expanded system;
- Land for the new SLPS has already been purchased;

- Required environmental assessments have already been completed for all new infrastructure; and
- The project is assumed to have a 2-year construction period.

Table 5-3. Lake Alan Henry Phase 2 Costs (September 2023 Dollars)

Item	Estimated Cost for Facilities
Lake Alan Henry Pump Station Expansion (additional 15 mgd)	$16,032,000
Post Pump Station Expansion (additional 15 mgd)	$11,093,000
Southland Pump Station (30 mgd)	$30,927,000
Water Treatment Plant Expansion (additional 15 mgd)	$38,217,000
Integration, Relocations, Backup Generator & Other	$1,805,000
TOTAL COST OF FACILITES	**$98,074,000**
Engineering:	
- Planning (3%)	$2,942,000
- Design (7%)	$6,865,000
- Construction Engineering (1%)	$981,000
Legal Assistance (2%)	$1,961,000
Fiscal Services (2%)	$1,961,000
All Other Facilities Contingency (20%)	$19,615,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$8,489,000
TOTAL COST OF PROJECT	**$140,888,000**
ANNUAL COSTS	
Debt Service (3.5%, 20 years)	$9,786,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$18,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$1,451,000
South Water Treatment Plant Expansion	$2,675,000
Pumping Energy Costs (0.09 $/kW-hr)	$812,000
TOTAL ANNUAL COST	**$14,742,000**
Available Project Yield (ac-ft/yr)	5,075
Annual Cost of Water ($ per ac-ft), based on PF=2.61	$2,905
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=2.61	$977
Annual Cost of Water ($ per 1,000 gallons), based on PF=2.61	$8.91
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2.61	$3.00

ac-ft = acre-feet; ac-ft/yr = acre-feet per year; mgd = million gallons per day; ROI = return on investment;
kW-hr = kilowatt-hours

5.3.3 Implementation Issues

5.3.3.1 Environmental

The proposed project is not anticipated to impact land use, density, or type of development beyond that already planned in the within the project area. Permanent land use impacts in the project area would include converting land to the new SLPS and capacity expansion at the LAHPS, PPS, and the SWTP.

An environmental assessment (EA) submitted to the Texas Water Development Board (TWDB) was approved for the overall Phase 1 project[107]. EAs have also been completed for the locations of the

[107] Freese and Nichols. 2009. Environmental Assessment for the City of Lubbock Lake Alan Henry Water Supply Project. June 2009.

proposed SLPS[108] and the SWTP expansion[109]. The project occurs within the Rolling Plains and High Plains physiographic regions and is within the Kansan biotic province.[110] The TPWD categorized vegetation within the project area into four primary groups: mesquite-lotebush brush, mesquite-juniper brush, juniper, and crops.[111] Brush areas are present along the southern portion of the project area near LAH and crops are along the northwestern portion of the project corridor. Vegetation impacts would include clearing small areas for constructing and expanding the pump stations and expanding the SWTP.

FEMA oversees the delineation of 100-year floodplain zone on FIRMs across the United States. The term, 100-year flood, refers to areas that have a one percent chance of flooding in any given year. Within the project area, FEMA floodplains for Garza, Lynn and Kent counties are unmapped[112]. Playa lakes have been mapped in Lubbock County along the existing LAH pipeline and in the area of the SWTP. The new pump station should avoid impacts to 100-year floodplains or coordinate with the county's FEMA administrator.

The NWI[113] database indicates that within the project area, LAH is a lake and within the vicinity of the existing pipeline and proposed improvements, there are many creeks, freshwater ponds, and freshwater emergent wetlands, some of which may be considered waters of the U.S. A Section 404 permit from USACE is required for construction within waters of the U.S. for the proposed project. This could include Nationwide Permit (NWP) coverage, an NWP with a pre-construction notification, or an individual permit depending upon the impacts. It is likely that the expansion of infrastructure, including pump station and water treatment plant expansions and the new SLPS, could be sited to avoid impacts to waters of the U.S.

The TCEQ *2024 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted June 26, 2024[114], states that LAH (Segment 1241B) is impaired, and the water quality concern is mercury in edible tissue. Double Mountain Fork Brazos River (Segment 1241) is approximately 3.6 miles downstream from LAH and is listed as impaired for recreational use by bacteria.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of

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[108] V-Tech Environmental Services. 2008. Phase I Environmental Site Assessment, 4.82 Acre Tract, Southland, Garza County, Texas (Southland Pump Station Site), January 8, 2008.

[109] City of Lubbock. 2008. Phase I Environmental Site Assessment, West half of Section 72, Block S, Lubbock County, Texas (South Water Treatment Plant Site), August 5, 2008.

110 Blair, W.F. 1950. "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117.

111 McMahan, C. A., R. G. Frye and K. L. Brown, "The Vegetation Types of Texas – Including Cropland.

[112] FEMA. 2025. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd February 12, 2025.

[113] NWI. 2019. National Wetlands Inventory – Surface Waters and Wetlands. Viewed online National Wetlands Inventory February 12, 2025.

[114] TCEQ. 2024. 2024 Texas Integrated Report for the Clean Water Act Sections 305(b) and 303(d). Accessed online 2024 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d) - Texas Commission on Environmental Quality - www.tceq.texas.gov February 12, 2025.

publicly available GIS datasets, there are no cemeteries, historical markers, national register properties, or national register districts located within a one-mile buffer of the proposed project area.

A review of archaeological resources in the proposed project area should be conducted during project planning. The City of Lubbock would be required to coordinate with the Texas Historical Commission regarding impacts to cultural resources in accordance with the Texas Antiquities Code.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD, as endangered, threatened, or SGCN in Garza, Kent, Lubbock, and Lynn counties are listed in Appendix D under Garza, Kent, Lubbock and Lynn counties, Texas.

According to IPaC, accessed on the USFWS website on February 12, 2025, the sharpnose shiner, the smalleye shiner, and the monarch butterfly could be affected by the proposed project. Additionally, the proposed project may overlap critical habitat for the sharpnose shiner and the smalleye shiner and potential effects to critical habitat for these species must be analyzed along with impacts to the species themselves. The piping plover and rufa red knot were also included on the IPaC list but only need to be considered for wind energy projects. TPWD's TXNDD documents the occurrences of rare species in Texas. No occurrences of threatened, endangered, candidate, or rare species were documented within one mile of the proposed project area.

A biological survey and habitat assessment of the project area should be conducted to determine the presence of threatened and endangered species or their potential habitats. Based on the findings, an evaluation will be made to determine whether the proposed activities may impact listed species. This strategy would take an additional 15 mgd from LAH, which could potentially impact the federally listed sharpnose shiner and smalleye shiner and their critical habitat. Coordination with TPWD and USFWS regarding threatened and endangered species should be initiated early in project planning.

Summary

Environmental issues associated with this option should be minimal. TWDB approved an EA for Phase 1 of the project. In addition, EAs were performed at the locations of the proposed SLPS and the SWTP expansion. Therefore, no additional assessment should be necessary at these locations.

5.3.3.2 Permitting

Raw water would be obtained from LAH, which is owned by the City of Lubbock. Water Use Permit No. 4146 allows for the annual diversion of 35,000 ac-ft; therefore, no additional permitting requirements are anticipated. However, TCEQ would need to approve design modifications to the existing system.

5.3.3.3 Other Issues

No other issues are known for this strategy.

5.4 Post Reservoir

The Post Reservoir strategy is included in the *2024 Lubbock Strategic Water Supply Plan* and consists of a new reservoir located immediately northeast of Post, Texas, on the North Fork. Certificate of Adjudication No. 12-3711 authorizes the impoundment of 57,420 ac-ft of water and the diversion and use of up to 10,600 ac-ft/yr. Water would be impounded in and diverted from the reservoir and then transported to the existing PPS that delivers water from LAH to the City of Lubbock through the LAH pipeline. The 48-inch diameter LAH raw water line is adequate to convey water from both Post Reservoir and LAH. However, this strategy requires implementing both the LAH Phase 2 strategy to expand the pumping capacity of the LAH pipeline and expanding the SWTP.

The major infrastructure components of this strategy include the following.

- Construct a 57,420 ac-ft, 2,280-acre reservoir.
- Construct a new 8-mgd intake structure and pump station located at the reservoir site.
- Install a 6-mile, 24-inch transmission pipeline to deliver water from Post Reservoir to the PPS.
- Expand the PPS to transport raw water along the LAH pipeline system (included in the LAH Phase 2 strategy).
- Add the SLPS located on the LAH raw water pipeline (included in the LAH Phase 2 strategy).
- Expand the SWTP by 8 mgd.

Figure 5-3 provides the location of infrastructure included in the Post Reservoir strategy.

5.4.1 Quantity of Available Water

Analyses using Run 3 of the TCEQ Brazos WAM indicate the firm yield of the reservoir is 5,700 ac-ft/yr considering only available natural inflows and no developed playa stormwater or reclaimed water. The Brazos WAM was modified to include developed playa stormwater and reclaimed water. With these supplemental inflow sources, Post Reservoir is able to provide a firm supply equal to its authorized diversion amount of 10,600 ac-ft/yr. However, the City of Lubbock would manage the new supply using a safety reserve. As a result, the City of Lubbock plans for the Post Reservoir strategy to provide a supply of 8 mgd or 8,962 ac-ft/yr, assuming that Lake 7 would not be constructed upstream.

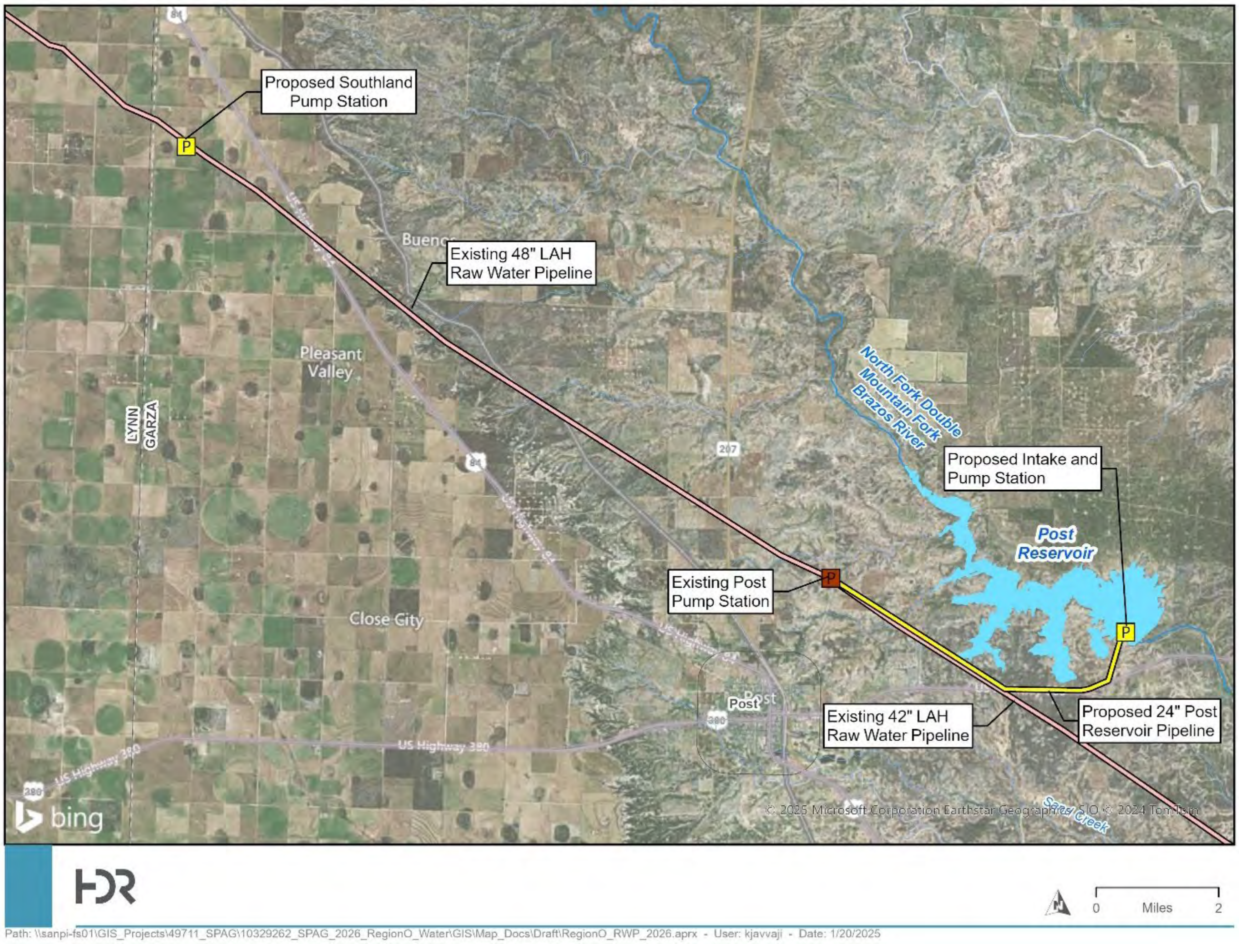

Figure 5-3. Post Reservoir Strategy

5.4.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-4 and are shown with and without the LAH pipeline expansion. Assumptions associated with these costs include the following.

- The capacity of the intake, pump station, and transmission pipeline are sized to include an estimated 5 percent downtime;
- Energy costs to transmit water through the PPS and pipeline are included;
- Costs associated with implementing the required LAH Phase 2 strategy are not included; and
- The project is assumed to have a 2-year construction period.

Table 5-4. Post Reservoir Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Dam and Reservoir (57,420 ac-ft, 2,280 acres)	$31,191,000
Intake and Pump Station (8.4 mgd)	$15,812,000
Transmission Pipeline (24-in dia., 6 miles)	$11,002,000
Transmission Pump Station(s) & Storage Tank(s)	$410,000
South Water Treatment Plant Expansion (8.0 mgd)	$24,298,000
Integration, Relocation, Backup Generator & Other	$3,298,000
TOTAL COST OF FACILITIES	**$85,796,000**
Engineering:	
- Planning (3%)	$3,122,000
- Design (7%)	$7,285,000
- Construction Engineering (1%)	$1,041,000
Legal Assistance (2%)	$2,081,000
Fiscal Services (2%)	$2,081,000
Pipeline Contingency (15%)	$1,650,000
All Other Facilities Contingency (20%)	$18,614,000
Environmental & Archaeology Studies and Mitigation	$7,495,000
Land Acquisition and Surveying (2331 acres)	$7,580,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$8,742,000
TOTAL COST OF PROJECT	$145,487,000
ANNUAL COSTS	
Debt Service (3.5%, 20 years)	$5,339,000
Reservoir Debt Service (3.5%, 40 years)	$3,154,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$143,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$406,000
Dam and Reservoir (1.5% of Cost of Facilities)	$468,000
South Water Treatment Plant Expansion	$1,736,000
Post Pipeline Pumping Energy Costs (0.09 $/kW-hr)	$243,000
Lake Alan Henry Pipeline Pumping Energy Costs (0.09 $/kW-hr)	$1,250,000
TOTAL ANNUAL COST	**$12,739,000**
Available Project Yield (ac-ft/yr)	8,962
Annual Cost of Water ($ per ac-ft), based on PF=1.98	$1,421
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.98	$474
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.98	$4.36
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.98	$1.45

ac-ft = acre-feet; ac-ft/yr = acre-feet per year; mgd = million gallons per day; in = inch; dia. = diameter; ROI = return on investment; kW-hr = kilowatt-hour

5.4.3 Implementation Issues

5.4.3.1 Environmental

The Post Reservoir strategy would convert 2,280 acres of ranchland to reservoir use. Additionally, there would be permanent land use impacts for the new intake structure. Ground disturbance for installing the new 24-inch transmission pipeline from the reservoir to PPS would depend upon the type of construction used to install the pipelines (open cut, boring, etc.).

The proposed reservoir strategy would occur within the Rolling Plains and High Plains physiographic regions of Texas and within the Kansan biotic province[115]. According to *The Vegetation Types of Texas*, the project components are within the following vegetation communities: mesquite-lotebush

[115] Blair, W.F., “The Biotic Provinces of Texas, “Tex. J. Sci. 2:93-117, 1950.

brush, Havard Shin oak-mesquite brush, juniper, and crops[116]. The mesquite-lotebush brush, principally found in the Rolling Plains, commonly includes yucca, skunkbush sumac (*Rhus trilobata*), agarita, juniper, silver bluestem (*Bothriochloa saccharoides*), Texas grama, sideoats grama (*Bouteloua curtipendula*), among other species. The Havard Shin oak-mesquite brush includes species such as sandsage (*Artemisia filifolia*), catclaw (*Senegalia wrightii*), giant dropseed (*Sporobolus giganteus Nash*), sand bluestem (*Andropogon hallii Hack.*), Illinois bundleflower (*Desmanthus illinoensis*), and yellow evening primrose (*Oenothera flava*), and is found on sandy soils in the western Rolling Plains and southwestern High Plains. Smaller areas of the juniper brush vegetation type and crops are present along areas of proposed and existing transmission pipelines. Vegetation would be cleared for the new intake structure and pump station construction and expansion. Vegetation clearing may be required for installation of the transmission pipeline, depending on construction methods.

FEMA has not mapped the project area in Garza County for 100-year floodplains.[117] The proposed Post Reservoir would impound part of the North Fork, which is identified on NWI maps as riverine with a fringe of freshwater emergent wetlands. Additionally, other tributaries of the North Fork may be crossed by transmission pipeline to the PPS. Early coordination with USACE is recommended for this project. Neither the TCEQ Surface Water Quality Viewer[118] nor the TCEQ *2016 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted October 17, 2018[119], identify impaired stream or reservoir segments within 5 miles of the proposed project.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (P196-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets, there are no state historic sites, National Register of Historic Places-listed sites, historical markers, national register properties, national register districts or cemeteries located within a one-mile buffer of the proposed project area.

A review of archeological resources in the proposed project area should be conducted during project planning. The City of Lubbock would be required to coordinate with the Texas Historical Commission regarding impacts to cultural resources in accordance with the Texas Antiquities Code.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Garza County are listed in Appendix D under Garza County, Texas.

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[116] McMahan, C.A., R.G. Frye, and K.L. Brown, 1984. The Vegetation Types of Texas. Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ March 22, 2019.

[117] FEMA, 2025. FEMA Flood Map Service Center: Search by Address. Accessed online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd February 12, 2025.

[118] TCEQ. 2025. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed May 1, 2019.

[119] TCEQ. 2024. 2024 Texas Integrated Report for the Clean Water Act Sections 305(b) and 303(d). https://www.tceq.texas.gov/downloads/water-quality/assessment/integrated-report-2024/2024-303d.

According to IPaC, provided by the USFWS on February 12, 2025, the sharpnose shiner, the smalleye shiner, and the monarch butterfly could be affected by the proposed project. Additionally, the proposed reservoir site overlaps critical habitat for the sharpnose and smalleye shiner, and impacts to critical habitat need to be analyzed along with the endangered species themselves. The piping plover and rufa red knot are also included on the IPaC list but only need to be considered for wind energy projects. The TPWD's TXNDD documents the occurrences of rare species in Texas. The chub shiner, a rare species has been documented within the North Fork, within the proposed reservoir area. No other occurrences of threatened, endangered, candidate or SGCN were documented within one mile of the proposed project area.

If this strategy is selected, a biological survey and habitat assessment of the project area should be conducted to determine the presence of threatened and endangered species or their potential habitats. Based on the findings, an evaluation will be made to determine whether the proposed activities may impact listed species. Coordination with TPWD and USFWS regarding threatened and endangered should be initiated early in project planning. Since this project could affect critical habitat for the sharpnose and smalleye shiner, it would be anticipated that extensive coordination with USFWS would be required prior to implementing this strategy.

Summary

The primary environmental concern associated with this strategy is the conversion of 2,280 acres from ranchland to a reservoir site. This change would result in the loss of riverine habitat and would significantly impact wildlife habitats, requiring mitigation efforts. The reservoir's construction is expected to have low to moderate effects on these issues. However, studies would be required to assess the actual impacts to cultural resources, wetlands, and threatened and endangered species. Two listed species of minnow – the sharpnose shiner and the smalleye shiner – would potentially be impacted in the reaches upstream and downstream from the reservoir, potentially preventing the construction of this project. Studies would be necessary to determine the actual impact to cultural resources, wetlands, and threatened and endangered species.

5.4.3.2 Permitting

The existing TPDES Permit No. 10353-002 authorizes the City of Lubbock to discharge up to 14.5 mgd (16,242 ac-ft/yr) of reclaimed water at the SEWRP into the North Fork at Outfall 007, and up to 9.0 mgd (10,089 ac-ft/yr) at FM400 at Outfall 001. The White River Municipal Water District (WRMWD) holds Certificate of Adjudication No. 12-3711, which authorizes Post Reservoir with a priority date of January 20, 1970. This certificate authorizes impoundment of 57,420 ac-ft in the reservoir. It also authorizes diversion of 5,600 ac-ft/yr for municipal use, 1,000 ac-ft/yr for industrial use, and 4,000 ac-ft/yr for mining purposes. The City of Lubbock would need to obtain ownership of the water right in order to construct the reservoir. The certificate would need to be amended so the City of Lubbock can obtain authorization to divert and use the full 10,600 ac-ft/yr for municipal purposes and obtain clarification regarding 19,000 ac-ft of sediment reserve identified in the special conditions of the certificate. In addition, a USACE Section 404 permit would be required prior to commencing construction of the Post Reservoir. This lake is large enough to require an individual permit. Mitigation plans for the project's environmental impacts must be developed and agreed upon by USACE and other interested state and federal resource agencies.

5.4.3.3 Other Issues

Property would need to be acquired for the lake, dam, pump station, and habitat mitigation area. In addition, pipeline utility easements would be necessary to construct a raw water transmission line to the PPS.

5.5 North Fork Scalping Operation

The North Fork Scalping Operation strategy was evaluated in the *2024 Lubbock Strategic Water Supply Plan* and would increase the yield of LAH by collecting and re-directing stormwater from the North Fork into the lake. To accomplish this, a diversion dam and reservoir would need to be built on the North Fork in Garza County to capture stormwater flows and provide adequate pumping head for the intake pump station. Stormwater would be delivered to a point on Gobbler Creak upstream of LAH via a 5-mile, 72-inch pipeline. The intake, pump station, and pipeline would have a capacity to divert large amounts of water during a short-duration, high-flow event. A stilling basin would be necessary at the discharge location on Gobbler Creek to decrease the velocity of the scalped water and reduce erosion. The water from the stilling basin would then flow through Gobbler Creek and naturally drain into LAH. This strategy requires the implementation of the LAH Phase 2 strategy to deliver the additional supplies from LAH to the SWTP.

The major infrastructure components of this strategy include the following.

- Construct a 1,000-ac-ft, 650-acre diversion reservoir on the North Fork to aid in the capture of high flows for scalping;
- Construct a new 162-mgd intake structure and pump station at the diversion site;
- Install 5-mile, 96-inch transmission pipeline to deliver the scalped high flows from the North Fork to LAH;
- Construct a stilling basin located at the discharge point located on Gobbler Creek;
- Construct the SLPS and expand the LAHPS and PPS (included in LAH Phase 2 strategy); and
- Expand the SWTP by 7.8 mgd.

Figure 5-4 provides the location of infrastructure included in the North Fork Scalping Operation strategy.

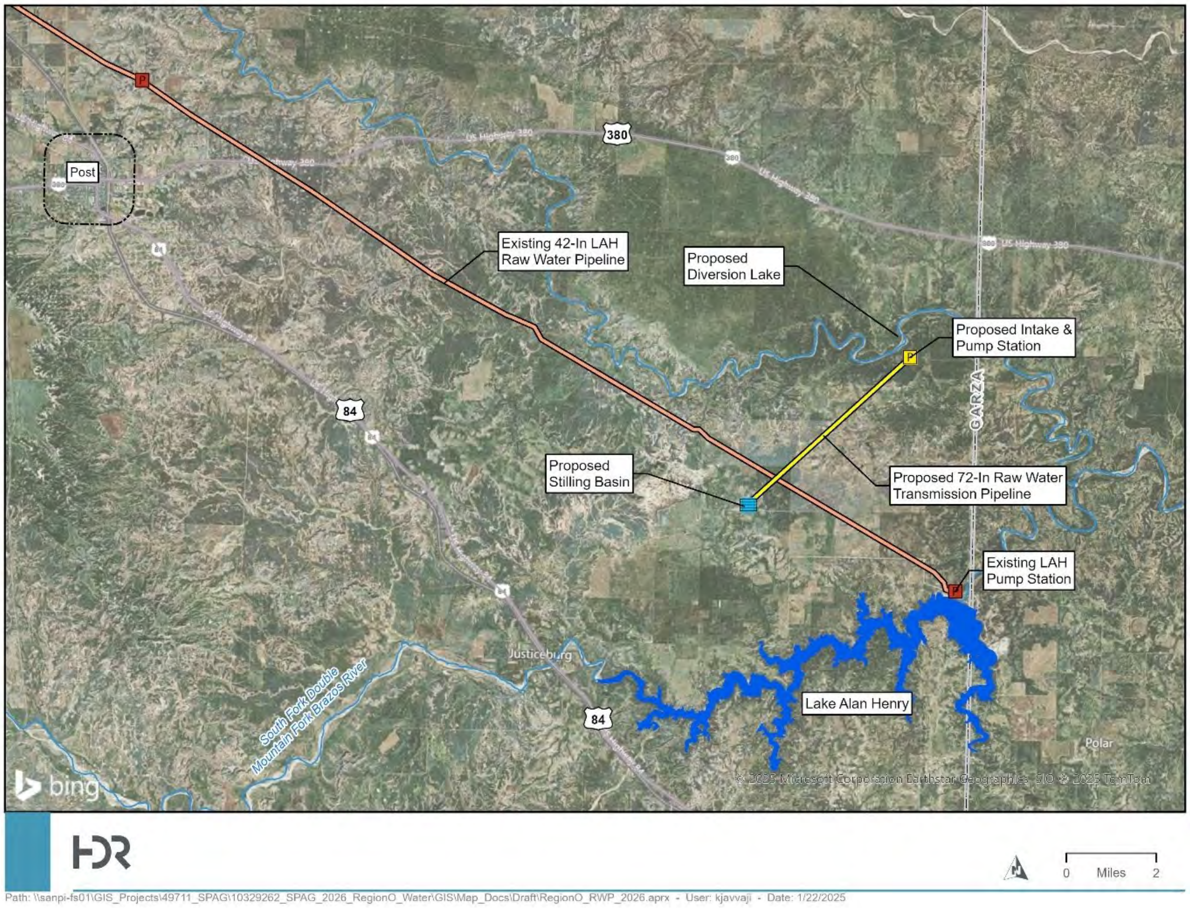

Figure 5-4. North Fork Scalping Operation Strategy

5.5.1 Quantity of Available Water

Unappropriated streamflow in the North Fork is limited; therefore, for the strategy to be feasible, the City of Lubbock would need to reach an agreement with Brazos River Authority (BRA) for the subordination of Possum Kingdom Reservoir to the North Fork scalping operations. A daily water availability analysis performed in the Lubbock Lake Alan Henry RiverWare Model that incorporates the subordination of Possum Kingdom Reservoir resulted in estimates of a firm yield increase for Lake Alan Henry by only 225 ac-ft/yr and a safe yield increase by only 75 ac-ft/yr. Of the 28,855 days in the models' period of record (1940 through 2018), 3,923 (14 percent) days had water available for diversion and only 2,428 (8 percent) days would have led to the operation of the North Fork Scalping Operation where there was water available for diversion and the reservoir had capacity to accommodate all or a portion of the water from the scalping flows. The North Fork Scalping operation did not have a significant impact on the firm yield and 2-year safe yield because the water from the operation was mainly available when there were significant quantities of water already in the reservoir. Minimal to no water was available during the largest droughts across the 1940-2018 time period. As a result, the City of Lubbock determined that the North Fork Scalping Operation Strategy is not a feasible project.

5.6 Direct Potable Reuse to North Water Treatment Plant

This Direct Potable Reuse to North Water Treatment Strategy is included in the *2024 Lubbock Strategic Water Supply Plan*. The strategy would deliver an average of 9 mgd of reclaimed water from the SEWRP to a new advanced water treatment plant located adjacent to the City of Lubbock's NWTP. After advanced treatment (RO, UV disinfection, and advanced oxidation process [AOP], the reclaimed water would then be discharged into the raw water headworks of the NWTP and blended with other raw water supplies from the Canadian River Municipal Water Authority (CRMWA) before undergoing conventional treatment for distribution to customers.

Reverse osmosis (RO) reject water from the advanced water treatment plant would be conveyed via pipeline and discharged into the North Fork near the SEWRP. The reject water pipeline route is downhill and available pressure head from the RO membranes would be sufficient to convey the reject water to the discharge point. Therefore, a new pump station is not required to deliver the reject water from the advanced treatment plant to the discharge point on the North Fork.

The NWTP has an existing treatment capacity adequate to treat and distribute the additional reclaimed water discharged into the NWTP headworks from the new advanced treatment facility. For DPR to occur, a new advanced treatment facility is required to pretreat the source before being delivered to the NWTP.

The major infrastructure components of this strategy include the following.

- Construct a 9.5-mgd advanced treatment plant adjacent to the NWTP (sized to include an estimated 5 percent downtime);
- Construct a 9.5-mgd pump station at the SEWRP (sized to include an estimated 5 percent downtime);
- Install a 24-inch, 6-mile transmission pipeline to deliver the treated reclaimed water to the advanced treatment plant; and
- Install an 8-inch, 6-mile transmission line to the North Fork Double Mountain Fork of the Brazos River to discharge the RO reject water.

Figure 5-5 provides the location of the infrastructure needed for the strategy.

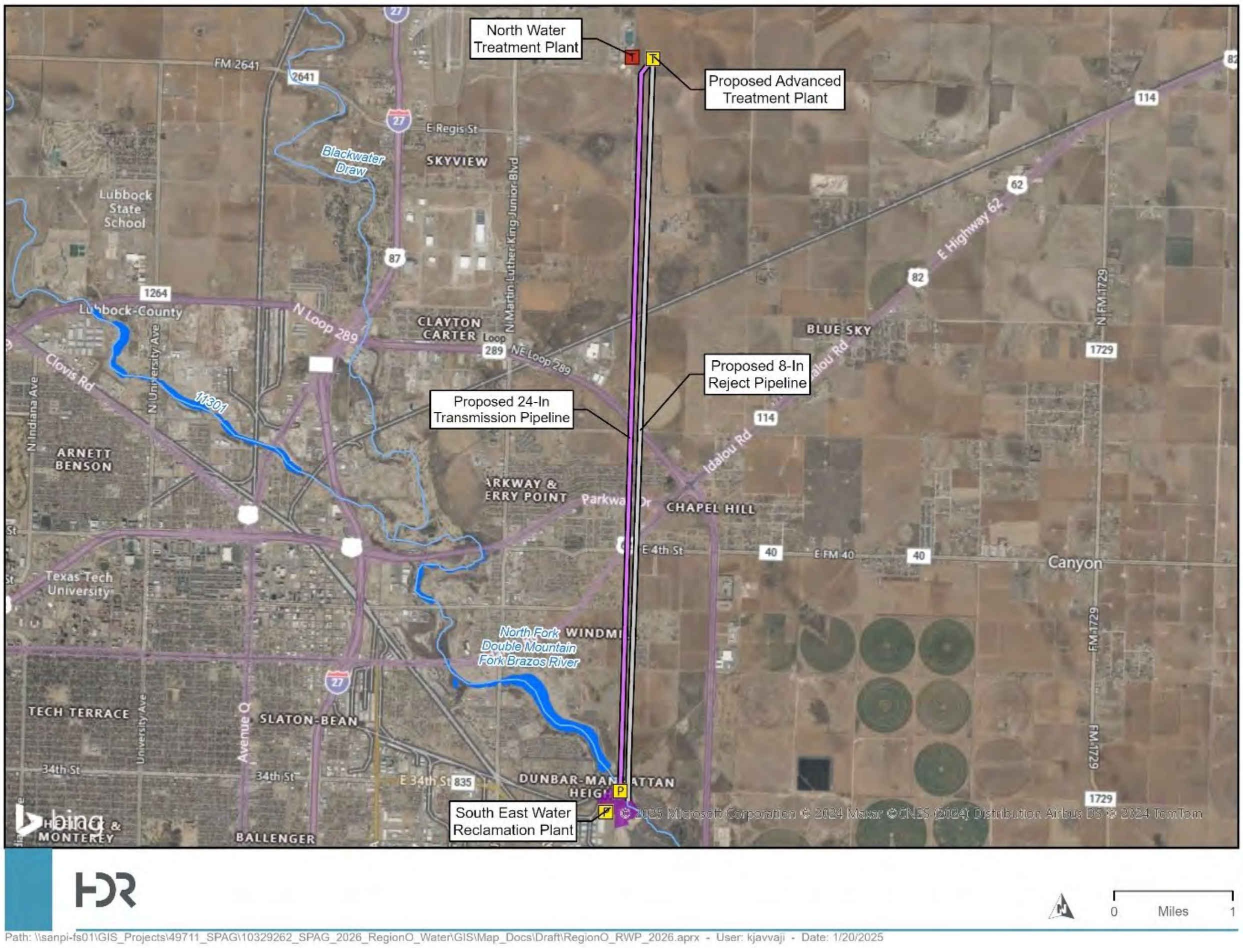

Figure 5-5. Direct Potable Reuse to North Water Treatment Plant

5.6.1 Quantity of Available Water

This strategy is designed to treat an average of 9 mgd (10,089 ac-ft/yr) to the ATP; however, the efficiency of the RO is assumed to be 92 percent resulting in 0.72 mgd of reject and 8.28 mgd of treated reclaimed water delivered to the NWTP each year.

5.6.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-5. Assumptions associated with these costs include the following.

- The advanced water treatment plant would be constructed on City of Lubbock-owned land adjacent to the NWTP;
- The capacity of the pump station, advanced water treatment plant, and transmission pipeline includes an estimated 5 percent downtime;
- Concentrate reject from the RO plant would be discharged in the North Fork; and
- The project is assumed to have a 2-year construction period.

Table 5-5. Direct Potable Reuse to North Water Treatment Plant Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Pump Station at Southeast Water Reclamation Plant (9.5 mgd)	$2,246,000
Transmission Pipeline (24-in dia., 6 miles)	$21,008,000
Transmission Pipeline (8-in dia., 6 miles) – Already Constructed	$8,586,000
Advanced Treatment Plant (9.5 mgd)	$86,823,000
Integration, Relocations, Backup Generator & Other	$77,000
TOTAL COST OF FACILITIES	**$118,740,000**
Engineering:	
- Planning (3%)	$3,560,000
- Design (7%)	$8,306,000
- Construction Engineering (1%)	$1,187,000
Legal Assistance (2%)	$2,373,000
Fiscal Services (2%)	$2,373,000
Pipeline Contingency (15%)	$4,438,000
All Other Facilities Contingency (20%)	$17,815,000
Environmental & Archaeology Studies and Mitigation	$232,000
Land Acquisition and Surveying (89 acres)	$182,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$10,344,000
TOTAL COST OF PROJECT	**$169,550,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$11,924,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$296,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$56,000
Water Treatment Plant	$2,065,000
Pumping Energy Costs (0.09 $/kW-hr)	$514,000
TOTAL ANNUAL COST	**$14,855,000**
Available Project Yield (ac-ft/yr)	9,274
Annual Cost of Water ($ per ac-ft), based on PF=1	$1,602
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$316
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$4.91
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.97

ac-ft = acre-feet; ac-ft/yr = acre-feet per year; mgd = million gallons per day; in = inch; dia. = diameter;
ROI = return on investment; kW-hr = kilowatt-hours

5.6.3 Implementation Issues

5.6.3.1 Environmental Issues

In 2022, the TCEQ developed a regulatory guidance manual outlining agency rules that apply to direct potable reuse (DPR) projects, which will include advanced treatment of effluent over and above the traditional effluent treatment. The proposed project is not anticipated to impact land use, density, or type of development beyond that already planned within the project area. Permanent land use impacts in the project area would include constructing the advanced water treatment plant, pump station, and pipelines.

The project occurs within the High Plains vegetational area and is within the Kansan biotic province.[120] TPWD defines vegetation within the project area as row crops, improved grasslands,

[120] Blair, W.F. 1950. "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117.

and low-intensity urban.[121] Vegetation impacts would include the clearing of areas for the new water treatment plant, pump station, wells, ground storage tank and pipelines.

FEMA oversees the delineation of 100-year floodplain zone on FIRMs across the United States. The term, 100-year flood, refers to areas that have a one percent chance of flooding in any given year. The FEMA 100-year floodplain zones within the project area fall along the perimeter of the North Fork, and also near the NWTP just north of where the pipeline would intersect E. Regis Street[122]. Only a small portion of the proposed pipeline would be located within the 100-year floodplain.

The pipeline would extend to the SEWRP located on the south side of the North Fork. NWI shows the are where the pipeline crosses the North Fork as palustrine shrub/scrub wetlands. No other features identified by NWI are shown as intersecting the proposed water transmission pipeline or any other project components. A Section 404 permit from USACE is required for construction within waters of the U.S. for the proposed project.[123]. This could include NWP coverage, an NWP with a pre-construction notification, or an individual permit depending upon the impacts. Impacts from this proposed project resulting in a loss of less than 0.5 acres of waters of the U.S. would likely be covered under an NWP.

The TCEQ *2024 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted June 26, 2024[124], and the TCEQ Surface Water Quality Viewer show that the North Fork (Segment 1241A) is impaired for bacteria in water (recreation use).[125] No impaired stream segments were located within 5 miles of the proposed project components.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of publicly available GIS datasets, the City of Lubbock Cemetery is located just to the northwest of the SEWRP. The cemetery also includes a historical marker. No other cemeteries, historical markers, national register properties, or national register districts were identified within a one-mile buffer of the proposed project area.

A review of archaeological resources in the proposed project area should be conducted during project planning. The City of Lubbock is required to coordinate with the Texas Historical Commission regarding impacts to cultural resources in accordance with the Texas Antiquities Code.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Lubbock County are listed in Appendix D under Lubbock County, Texas.

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[121] TPWD, 2014. “ Ecological Mapping System of Texas (EMST) – High Plains GIS layer.

[122] FEMA. 2023. USA Flood Hazard GIS Layer.

[123] NWI. 2025. Surface Waters and Wetlands. Accessed online National Wetlands Inventory February 12, 2025.

[124] TCEQ. 2024. 2024 Texas Integrated Report for the Clean Water Act Sections 305(b) and 303(d). Accessed online 2024 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d) - Texas Commission on Environmental Quality - www.tceq.texas.gov February 12, 2025.

[125] TCEQ. 2025. Surface Water Quality Viewer. Accessed online Surface Water Quality Viewer February 12, 2025.

According to IPaC, provided by USFWS on February 12, 2025, the sharpnose shiner, the smalleye shiner, and the monarch butterfly could be affected by the proposed project. The piping plover and rufa red knot are also listed but only need to be considered for wind energy projects. Impacts to the sharpnose and smalleye shiner from reduced downstream flows should be considered and impacts to the monarch butterfly from vegetation clearing should be considered. There is no critical habitat for any listed species at the location of the proposed project. TPWD's TXNDD documents the occurrences of rare species in Texas. The Texas horned lizard, a state threatened species, was documented just southeast of the SEWRP as was the swift fox, an SGCN-designated species. Another occurrence of the swift fox was documented approximately one mile northwest from the NWTP. No other occurrences of threatened, endangered, candidate, or SGCN species were documented within one mile of the proposed project area.

If this strategy is selected, a biological survey and habitat assessment of the project area should be conducted to determine the presence of threatened and endangered species or their potential habitats. Based on the findings, an evaluation will be made to determine whether the proposed activities may impact listed species. Coordination with TPWD and USFWS regarding threatened and endangered species should be initiated early in project planning.

Summary

The advanced treatment facilities would be constructed on City of Lubbock-owned property, which is currently being used for similar purposes and environmental issues should be minimal. The transmission line corridor that would convey the reclaimed and concentrate water should be selected to avoid potentially sensitive areas. Studies would be necessary to determine the actual impact to cultural resources, wetlands, and threatened and endangered species.

5.6.3.2 Permitting Issues

The drinking water produced for the project would meet or exceed all state and federal drinking water standards. TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. TCEQ will require a pilot study prior to regulatory approval and for determining design values for the treatment technologies. Treatment requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, results of effluent quality sampling/monitoring data, and wastewater treatment process.

Disposal of residuals from the project would meet all state and federal requirements for discharge of waste. A TPDES permit would be required to discharge RO concentrate.

Stream crossings would be subject to Section 404 of the Clean Water Act. Due to the minimal and temporary impacts associated with the pipeline installation, it is likely that most of the proposed project would be authorized by NWP 58.

Water quality monitoring is likely to include cryptosporidium (or a surrogate organism), other regulated contaminants, and may include contaminants on EPA's Candidate Contaminate List, including emerging constituents of concern and pharmaceuticals and personal care products.

5.6.3.3 Other

Due to the nature of the project, it is assumed that a public outreach plan is needed for the proposed reuse project. Advanced treatment design considerations should include real-time monitoring and regular sampling to ensure process performance and avoid any acute episode of pathogens in the reclaimed water.

5.7 Direct Potable Reuse to South Water Treatment Plant

This Direct Potable Reuse to South Water Treatment Plant strategy is included in the *2024 Lubbock Strategic Water Supply Plan*. The strategy would convey an average of 9 mgd of reclaimed water from the SEWRP to a new advanced treatment plant adjacent to the City of Lubbock's SWTP. After advanced treatment, the reclaimed water would then be discharged into the raw water headworks of the SWTP and blended with other raw water supplies before undergoing conventional treatment for distribution to customers.

RO reject water from the advanced water treatment plant would be conveyed via pipeline and discharged into the North Fork near the SEWRP. The reject water pipeline route is downhill and available pressure head from the RO membranes would be sufficient to convey the reject water to the discharge point. Therefore, a new pump station is not required to deliver the reject water from the advanced treatment plant to the discharge point on the North Fork.

The major infrastructure components of this strategy include the following.

- Construct a 9.5-mgd advanced treatment plant at the SWTP (sized to include an estimated 5 percent downtime);
- Construct a 0.45-million-gallon (MG) ground storage tank and 465-horsepower (hp) pump station at the SEWRP;
- Install a 7.5-mile, 24-inch diameter transmission pipeline to the SWTP.
- Expand the SWTP's treatment facilities by 8.3 mgd.
- An 8-inch, 7.5-mile transmission line to the North Fork to discharge the RO reject water.

Figure 5-6 provides the relative locations of the infrastructure needed for the strategy.

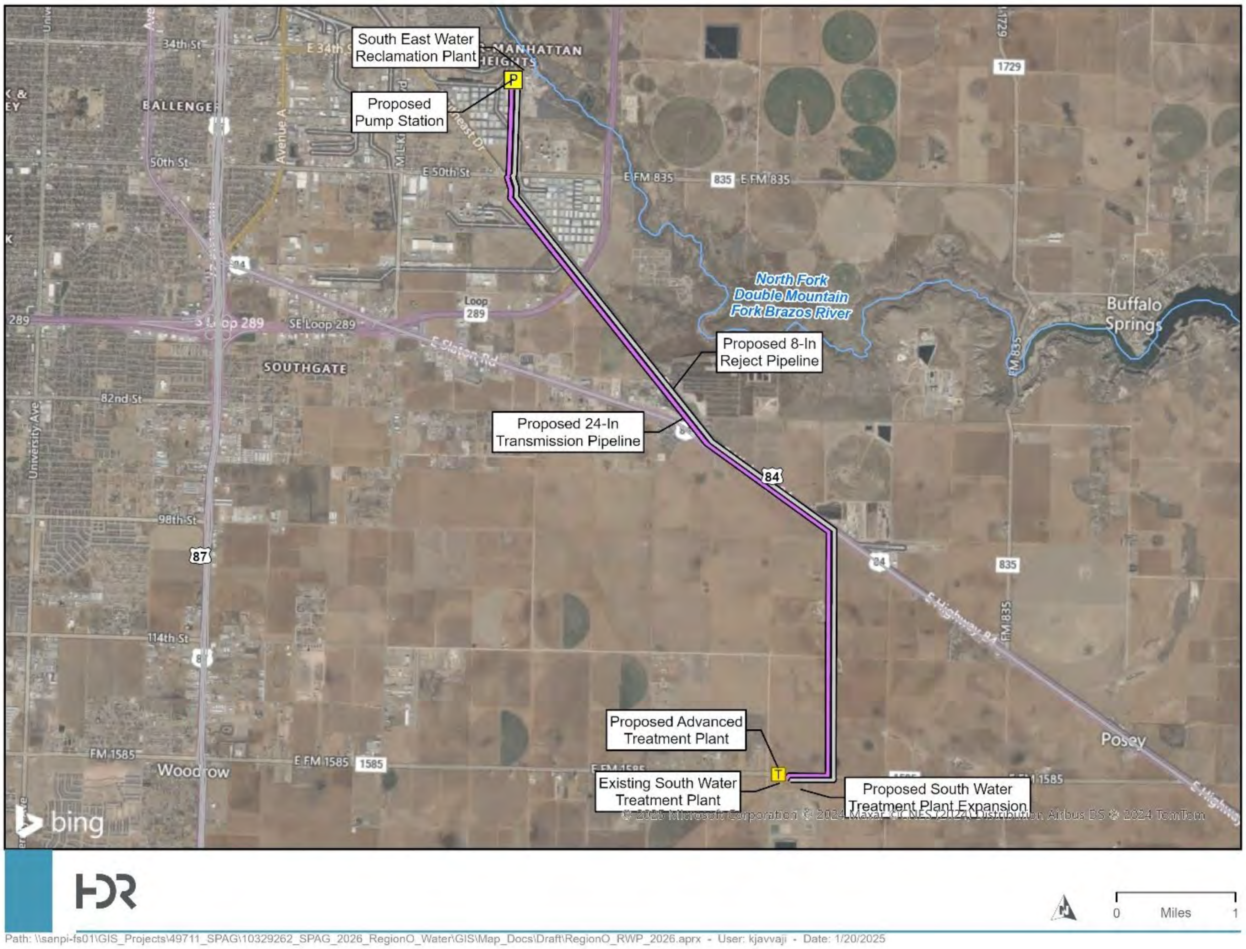

Figure 5-6. Direct Potable Reuse to South Water Treatment Plant

5.7.1 Quantity of Available Water

This strategy is designed to treat an average of 9 mgd (10,089 ac-ft/yr) at the advanced treatment plant; the efficiency of the RO is assumed to be 92 percent resulting in 0.72 mgd of reject and 8.28 mgd of treated reclaimed water delivered to the SWTP each year.

5.7.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-6. Assumptions associated with these costs include the following.

- The advanced water treatment plant would be constructed on City of Lubbock-owned land adjacent to SWTP;
- The capacity of the pump station, advanced water treatment plant, and transmission pipeline includes an estimated 5 percent downtime;
- Concentrate reject from the advanced treatment plant would be discharged in the North Fork; and
- The project is assumed to have a 2-year construction period.

Table 5-6. Direct Potable Reuse to South Water Treatment Plant Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Pump Station and Storage Tank (9.5 mgd)	$5,828,000
Transmission Pipeline (24-in dia., 7.5 miles)	$17,247,000
RO Concentrate Pipeline (8-in dia., 7.5 miles)	$6,410,000
South Water Treatment Plant Expansion (8.3 mgd)	$24,792,000
Advanced Treatment Plant (9.5 mgd)	$86,823,000
Integration, Relocations, Backup Generator & Other	$152,000
TOTAL COST OF FACILITIES	**$141,252,000**
Engineering:	
- Planning (3%)	$4,233,000
- Design (7%)	$9,877,000
- Construction Engineering (1%)	$1,411,000
Legal Assistance (2%)	$2,822,000
Fiscal Services (2%)	$2,822,000
Pipeline Contingency (15%)	$3,549,000
All Other Facilities Contingency (20%)	$23,489,000
Environmental & Archaeology Studies and Mitigation	$221,000
Land Acquisition and Surveying (59 acres)	$157,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$12,330,000
TOTAL COST OF PROJECT	**$202,163,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$14,214,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$250,000
Pump Stations (2.5% of Cost of Facilities)	$113,000
Water Treatment Plant	$3,732,000
Advanced Water Treatment Plant	$4,838,000
Pumping Energy Costs (0.09 $/kW-hr)	$640,000
TOTAL ANNUAL COST	**$23,787,000**
Available Project Yield (ac-ft/yr)	9,274
Annual Cost of Water ($ per ac-ft), based on PF=1	$2,565
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$1,032
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$7.87
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$3.17

ac-ft = acre-feet; ac-ft/yr = acre-feet per year; mgd = million gallons per day; in = inch; dia. = diameter; ROI = return on investment; kW-hr = kilowatt-hours

5.7.3 Implementation Issues

5.7.3.1 Environmental Issues

In 2022, the TCEQ developed a regulatory guidance manual outlining agency rules that apply to direct potable reuse (DPR) projects, which include advanced treatment of effluent, over and above the traditional effluent treatment. The proposed strategy is not anticipated to impact land use, density, or type of development beyond that already planned within the project area. Permanent land use impacts in the project area would include construction of the advanced water treatment plant, pump station, and pipelines.

The project occurs within the High Plains vegetational area[126] and is within the Kansan biotic province.[127] According to *The Vegetation Types of Texas*, the project components are within the following vegetation communities: crops and urban.[128] The crops vegetation type includes any cultivated cover crops or row crops that provide food and/or fiber for man or domestic animals. Urban vegetation includes planted and maintained vegetation associated with urban areas. Vegetation impacts would include clearing areas for the new water treatment plant, pump station, wells, ground storage tank, and pipelines.

FEMA oversees the delineation of 100-year floodplain zone on FIRMs across the United States. The term, 100-year flood, refers to areas that have a one percent chance of flooding in any given year. The North Fork, and Dunbar Historical Lake, just north of the SEWRP are within 100-year floodplain designated as a regulatory floodway. Additionally, 100-year floodplains are delineated along portions of the proposed transmission pipeline route along Southeast Drive.[129.]

NWI's database indicates that the North Fork adjacent to the SEWRP is a freshwater emergent wetland and riverine[130]. Additionally, a few freshwater ponds and freshwater emergent wetlands were identified along the proposed pipeline route, these may or may not be considered waters of the U.S. A Section 404 permit from the USACE is required for construction within waters of the U.S. for the proposed project. This could include NWP coverage, an NWP with a pre-construction notification, or an individual permit depending upon the impacts.

The TCEQ *2024 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted June 26, 2024[131,] and the TCEQ Surface Water Quality Viewer show that the North Fork (Segment 1241A) is impaired for recreation use by bacteria. Buffalo Springs Lake (Segment 1241C) was fully supporting its designated uses and contained no impairments.[132]

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (PI96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of publicly available GIS datasets, the City of Lubbock Cemetery and a historical marker for the cemetery are within a one-mile buffer of the proposed project area. No other cemeteries, historical markers, national register properties, or national register districts are located within a one-mile buffer of the proposed project area.

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[126] Gould, F.W. 1975. The Grasses of Texas. Texas A&M University Press. College Station, Texas.

[127] Blair, W.F. 1950. "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117.

[128] McMahan, C. A., R. G. Frye and K. L. Brown. 1984. "The Vegetation Types of Texas – Including Cropland. Accessed online: https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/

[129] FEMA. 2025. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online FEMA's National Flood Hazard Layer (NFHL) Viewer_February 12, 2025.

[130] NWI, 2025. Surface Waters and Wetlands. Accessed online National Wetlands Inventory February 12, 2025.

[131] TCEQ. 2024. 2024 Texas Integrated Report for the Clean Water Act Sections 305(b) and 303(d). Accessed online Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d) - Texas Commission on Environmental Quality - www.tceq.texas.gov February 12, 2025.

[132] TCEQ. 2025. Surface Water Quality Viewer. Accessed https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 Surface Water Quality Viewer February 12, 2025.

A review of archaeological resources in the proposed project area should be conducted during project planning. The owner or controller of the project would be required to coordinate with the Texas Historical Commission regarding impacts to cultural resources in accordance with the Texas Antiquities Code.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS, and TPWD, as endangered, threatened, or SGCN in Lubbock County are listed in Appendix D under Lubbock County, Texas.

According to IPaC, provided by USFWS on February 12, 2025, the sharpnose shiner, the smalleye shiner, and the monarch butterfly could be affected by the proposed project. Impacts to the sharpnose and smalleye shiner from reduced downstream flows should be considered. There is no critical habitat for any listed species at the location of the proposed project. The piping plover and rufa red knot were also listed on the IPaC but only need to be considered for wind energy projects. TPWD's TXNDD documents the occurrences of rare species in Texas. The swift fox, a species of greatest conservation need, and the Texas horned lizard, a state threatened species have been documented in the northern portion of the project area, near the SEWRP. No other occurrences of threatened, endangered, candidate, or SGCN species were documented within one mile of the proposed project area.

If this strategy is selected, a biological survey and habitat assessment of the project area should be conducted to determine the presence of threatened and endangered species or their potential habitats. Based on the findings, an evaluation will be made to determine whether the proposed activities may impact listed species. Coordination with TPWD and USFWS regarding threatened and endangered species should be initiated early in project planning.

Summary

The advanced treatment facility would be constructed on property owned by the City of Lubbock, which is currently being used for similar purposes and environmental issues should be minimal. The transmission line corridor that would convey the reclaimed and concentrated water should be selected to avoid potentially sensitive areas. Studies would be necessary to determine the actual impact to cultural resources, wetlands, and threatened and endangered species.

5.7.3.2 Permitting Issues

The drinking water produced for the project would meet or exceed all state and federal drinking water standards. TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. TCEQ will require a pilot study prior to regulatory approval and for determining design values for the treatment technologies. Treatment requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, results of effluent quality sampling/monitoring data, and wastewater treatment process.

Disposal of residuals from the project would meet all state and federal requirements for discharge of waste. A TPDES permit would be required to discharge RO concentrate.

Stream crossings, if any, would be subject to Section 404 of the Clean Water Act. Due to the minimal and temporary impacts associated with the pipeline installation, it is likely that most of the proposed project would be authorized by NWP 58.

Monitoring is likely to include cryptosporidium (or a surrogate organism), other regulated contaminants, and may include contaminants on EPA's Candidate Contaminate List, including emerging constituents of concern and pharmaceuticals and personal care products.

5.7.3.3 Other Issues

Due to the nature of the project, it is assumed a public outreach plan is needed for the proposed DPR project. Advanced treatment design considerations should include real-time monitoring and regular sampling to ensure process performance and avoid any acute episode of pathogens in the reclaimed water.

5.8 North Fork Diversion at CR 7300

The North Fork Diversion at County Road (CR) 7300 strategy is an indirect reuse strategy included in the *2024 Lubbock Strategic Water Supply Plan*. The City of Lubbock is permitted to discharge 9 mgd of treated effluent at SEWRP Outfall 001 located at the intersection of FM 400 and the North Fork. The City of Lubbock would construct a low head channel dam and diversion facility 2.7 river miles downstream from SEWRP Outfall 001 to recapture the discharged effluent. The relatively short distance between the discharge and diversion points would not likely provide sufficient natural attenuation and blending of supply for enhanced water quality. Therefore, additional advanced treatment facilities are assumed to be required to address potential water quality concerns.

After diversion, the water (reclaimed effluent commingled with actual flows) would be pumped through the transmission line to the new advanced treatment plant located adjacent to the SWTP. After advanced treatment, the water would then be discharged into the raw water headworks of the SWTP and blended with other raw water supplies before undergoing conventional treatment for distribution to customers. An expansion of the SWTP would be necessary to make this strategy viable.

The reject water pipeline route is downhill and available pressure head from the RO membranes would be sufficient to convey the reject water to the discharge point. Therefore, a new pump station is not required to deliver the reject water from the advanced treatment plant to the discharge point on the North Fork.

The major infrastructure components of this strategy include the following.

- Construct a low head channel dam, 9.5-mgd intake structure, and pump station at the CR 7300 crossing to divert the City of Lubbock's treated effluent return flows from the North Fork (sized to include an estimated 5 percent downtime);
- Install an 8-mile, 24-inch transmission pipeline to deliver the water to the SWTP;
- Construct a 9.5-mgd advanced treatment plant at the SWTP (sized to include an estimated 5 percent downtime);
- Install an 8-inch, 7.5-mile transmission line to discharge RO concentrate in the North Fork; and

- Expand the SWTP by 9 mgd (sized to include an estimated 5 percent downtime and 8 percent RO reject)

Figure 5-7 depicts the relative locations of the required CR 7300 infrastructure.

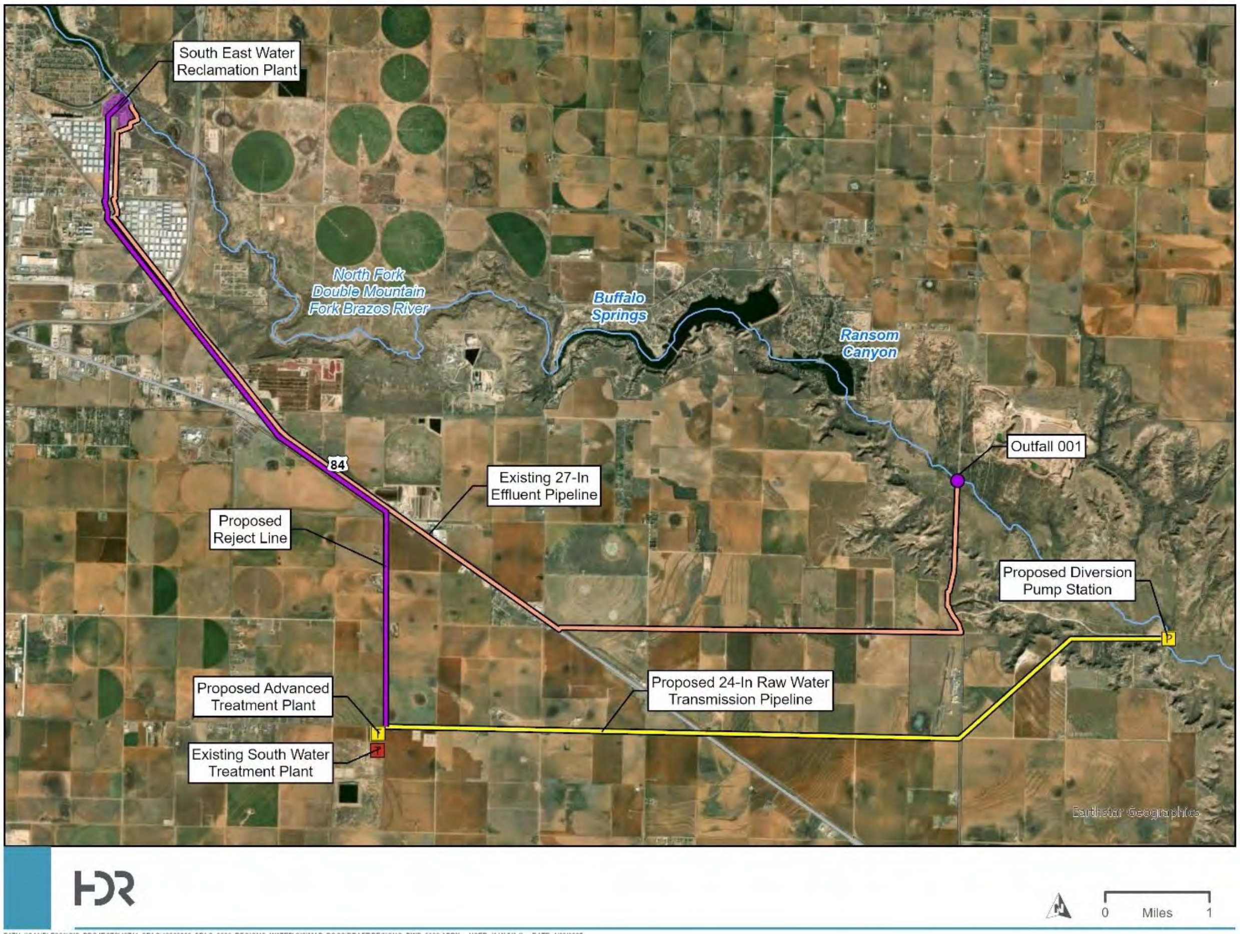

Figure 5-7. North Fork Diversion at County Road 7300

5.8.1 Quantity of Available Water

This strategy is designed to treat and deliver an average of 9 mgd (10,089 ac-ft/yr) to the advanced treatment plant. However, carriage losses within the 2.7-mile conveyance reach of the North Fork are estimated to be negligible, and the efficiency of the RO is assumed at 92 percent. The resulting average supply delivered to the SWTP is 8.28 mgd or 9,274 ac-ft/yr.

5.8.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-7. Assumptions associated with these costs include the following.

- The advanced water treatment plant would be constructed on City of Lubbock-owned land adjacent to SWTP;
- Intake, pump station, and transmission pipeline are designed for an estimated at 5 percent downtime; and
- The project is assumed to have a 2-year construction period.

Table 5-7. North Fork Diversion at County Road 7300 Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Channel Dam	$2,990,000
Intake Pump Station (9.5 mgd)	$31,558,000
Transmission Pipeline (24-in dia., 8 miles)	$17,338,000
Reverse Osmosis Concentrate Pipeline (8-in dia., 7.5 miles)	$6,855,000
South Water Treatment Plant Expansion (9 mgd)	$26,448,000
Advanced Treatment Plant (9.5 mgd)	$90,609,000
Integration, Relocations, Backup Generator & Other	$389,000
TOTAL COST OF FACILITIES	**$176,187,000**
Engineering:	
- Planning (3%)	$5,286,000
- Design (7%)	$12,333,000
- Construction Engineering (1%)	$1,762,000
Legal Assistance (2%)	$3,524,000
Fiscal Services (2%)	$3,524,000
Pipeline Contingency (15%)	$3,629,000
All Other Facilities Contingency (20%)	$30,399,000
Environmental & Archaeology Studies and Mitigation	$478,000
Land Acquisition and Surveying (108 acres)	$346,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$15,411,000
TOTAL COST OF PROJECT	**$252,879,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$17,765,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$246,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$789,000
Dam and Reservoir (1.5% of Cost of Facilities)	$45,000
Water Treatment Plant	$3,941,000
Advanced Water Treatment Facility	$7,919,000
Pumping Energy Costs (0.09 $/kW-hr)	$1,011,000
TOTAL ANNUAL COST	**$23,797,000**
Available Project Yield (ac-ft/yr)	9,274
Annual Cost of Water ($ per ac-ft), based on PF=1	$2,566
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$650
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$7.87
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.00

ac-ft = acre-feet; ac-ft/yr = acre-feet per year; mgd = million gallons per day; in = inch; dia. = diameter; ROI = return on investment; kW-hr = kilowatt-hours

5.8.3 Implementation Issues

5.8.3.1 Environmental Issues

The project occurs within the High Plains vegetational area[133] and is within the Kansan biotic province.[134] According to *The Vegetation Types of Texas*, the diversion pipeline and proposed SWTP expansion are within the following vegetation communities: mesquite-lotebush brush (found along the river at the diversion point), juniper, and crops.[135] The mesquite-lotebush brush vegetation

[133] Gould, F.W. 1975. The Grasses of Texas. Texas A&M University Press. College Station, Texas.

[134] Blair, W.F. 1950. “The Biotic Provinces of Texas, “Tex. J. Sci. 2:93-117.

[135] McMahan, C. A., R. G. Frye and K. L. Brown. 1984. “The Vegetation Types of Texas – Including Cropland. Accessed online: https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/

type is distributed through parts of west, northwest and north-central Texas and includes species such as yucca, agarito, elbowbush, juniper, sand dropseed, Texas grama, Texas wintergrass, broom snakeweed and Englemann daisy, among others. The juniper brush vegetation type includes brushy areas dominated by juniper. Most of the project components are within the crops vegetation type, which includes cultivated cover crops or row crops that provide food or fiber for man or domestic animals, or grasslands associated with crop rotations. Vegetation impacts would include clearing areas for constructing the intake structure, installing the transmission pipeline, and expanding at the SWTP. Vegetation impacts would vary depending on the methods used to install the pipeline.

FEMA oversees the delineation of 100-year floodplain zone on FIRMs across the United States. The term, 100-year flood, refers to areas that have a one percent chance of flooding in any given year. The FEMA 100-year floodplain zones within the project fall along an area flanking the perimeter of the North Fork[136]. Additionally, some playa lakes, which are mapped as part of the 100-year floodplain, may be present along the proposed transmission pipeline route.

NWI's database indicates that the North Fork, where the proposed intake structure would be constructed, is identified as freshwater emergent wetland and freshwater forested/shrub wetland. The proposed pipeline would also cross several tributaries of the North Fork. A Section 404 permit from USACE would be required for construction within WOTUS for the proposed project.[137]. This could include NWP coverage, an NWP with a pre-construction notification, or an individual permit depending upon the impacts.

The TCEQ *2024 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted June 26, 2024[138], and the TCEQ Surface Water Quality Viewer show that the North Fork (Segment 1241A) is impaired for recreation use by bacteria. Buffalo Springs Lake (Segment 1241C) was fully supporting its designated uses and contained no impairments.[139]

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets, no cemeteries, historical markers, national register properties, or national register districts are located within a one-mile buffer of the proposed project area.

A review of archaeological resources in the proposed project area should be conducted during project planning. The owner or controller of the project would be required to coordinate with the Texas Historical Commission regarding impacts to cultural resources.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to

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[136] FEMA. 2019. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd February 20, 2025.

[137] NWI. 2025. Surface Waters and Wetlands, HUC 12100203. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html February 20, 2025.

[138] TCEQ. 2024. Draft 2024 Texas Integrated Report for the Clean Water Act Sections 305(b) and 303(d). Accessed online https://www.tceq.texas.gov/waterquality/assessment/16twqi/16txir, February 20, 2025.

[139] TCEQ. 2025. Surface Water Quality Viewer. Accessed https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 February 20, 2025.

assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Lubbock County are listed in Appendix D under Lubbock County, Texas.

According to IPaC, accessed on the USFWS website on February 20, 2025, the proposed threatened monarch butterfly, federally endangered sharpnose shiner and smalleye shiner could be affected by the proposed project. The piping plover and rufa red knot were also included on the IPaC list but only need to be considered for wind energy projects. There are no critical habitats for threatened or endangered species within the proposed project area. TPWD's TXNDD documents the occurrences of rare species in Texas. The swift fox (*Vulpes velox*), an SGCN-designated species, has been documented at the Lubbock Preston Smith International Airport (between 1971 and 1972) and near the western edge of the proposed Lake 7 (in 1966). Additionally, the state threatened Texas horned lizard has been documented overlapping the northern end of the project area, near the Yellow House River between Old AT & SF Railway and E Loop 289 in July of 2024.

A biological survey and habitat assessment of the project area should be conducted to determine the presence of threatened and endangered species or their potential habitats. Based on the findings, an evaluation will be made to determine whether the proposed activities may impact listed species. Coordination with TPWD and USFWS regarding threatened and endangered species should be initiated early in project planning.

Summary

The primary environmental issue related to this strategy includes constructing the diversion facilities. There would be a potential impact on animal habitats, which must be mitigated. Studies would be necessary to determine the actual impact to cultural resources, wetlands, and threatened and endangered species. However, the construction of the diversion facilities should have a low to moderate impact relative to most of these concerns.

5.8.3.2 Permitting Issues

The City of Lubbock started discharging at Outfall 001 in May 2003 pursuant to TPDES Permit No. 10353-002. Outfall 001 is permitted to discharge a maximum of 9.0 mgd (10,089 ac-ft/yr). In April 2004, the City of Lubbock filed an amendment to Water Use Permit 3985 with TCEQ. This permit authorizes the diversion of up to 10,089 ac-ft annually (minus 0.47 percent carriage losses) at the CR 7300 facility.

5.8.3.3 Other Issues

Property would need to be acquired at the proposed diversion location. In addition, pipeline utility easements would be necessary to construct a raw water transmission line to the SWTP and the reject line at the North Fork discharge location.

5.9 North Fork Diversion to Lake Alan Henry Pump Station

The North Fork Diversion to Lake Alan Henry Pump Station strategy is an indirect reuse strategy included in the *2024 Lubbock Strategic Water Supply Plan*. Under this strategy, the City Lubbock would discharge up to an average of 9 mgd of treated wastewater effluent as permitted from Outfall 001. The water would be conveyed using the bed and banks of the North Fork for approximately 67 miles before diversion and delivery via pipeline to the LAHPS. Accounting for carriage losses, approximately 6.7 mgd of the discharged treated effluent is estimated to be available for diversion.

The relatively long distance between the discharge and diversion points would likely provide sufficient natural attenuation and blending of supply to eliminate the need for advanced treatment.

From the LAHPS, the water would be transported to the SWTP near Lubbock via the existing LAH raw water pipeline. This strategy requires the implementation of the LAH Phase 2 strategy to deliver the additional supplies through the LAH pipeline. This strategy could be combined with the North Fork Scalping Operation strategy (diverting stormwater flows) because both strategies could use the same diversion dam and lake, and pipeline easement.

The major infrastructure components of this strategy include the following.

- Construct a 7-mgd intake structure and pump station at the North Fork diversion location.
- Construct a low head channel dam to allow for the diversion of the reclaimed water at low flows;
- Install a 5-mile, 24-inch transmission pipeline to deliver the diverted water to the LAHPS; and
- Expand the SWTP by 6.7 mgd.

Figure 5-8 provides the relative locations of the infrastructure needed for the strategy.

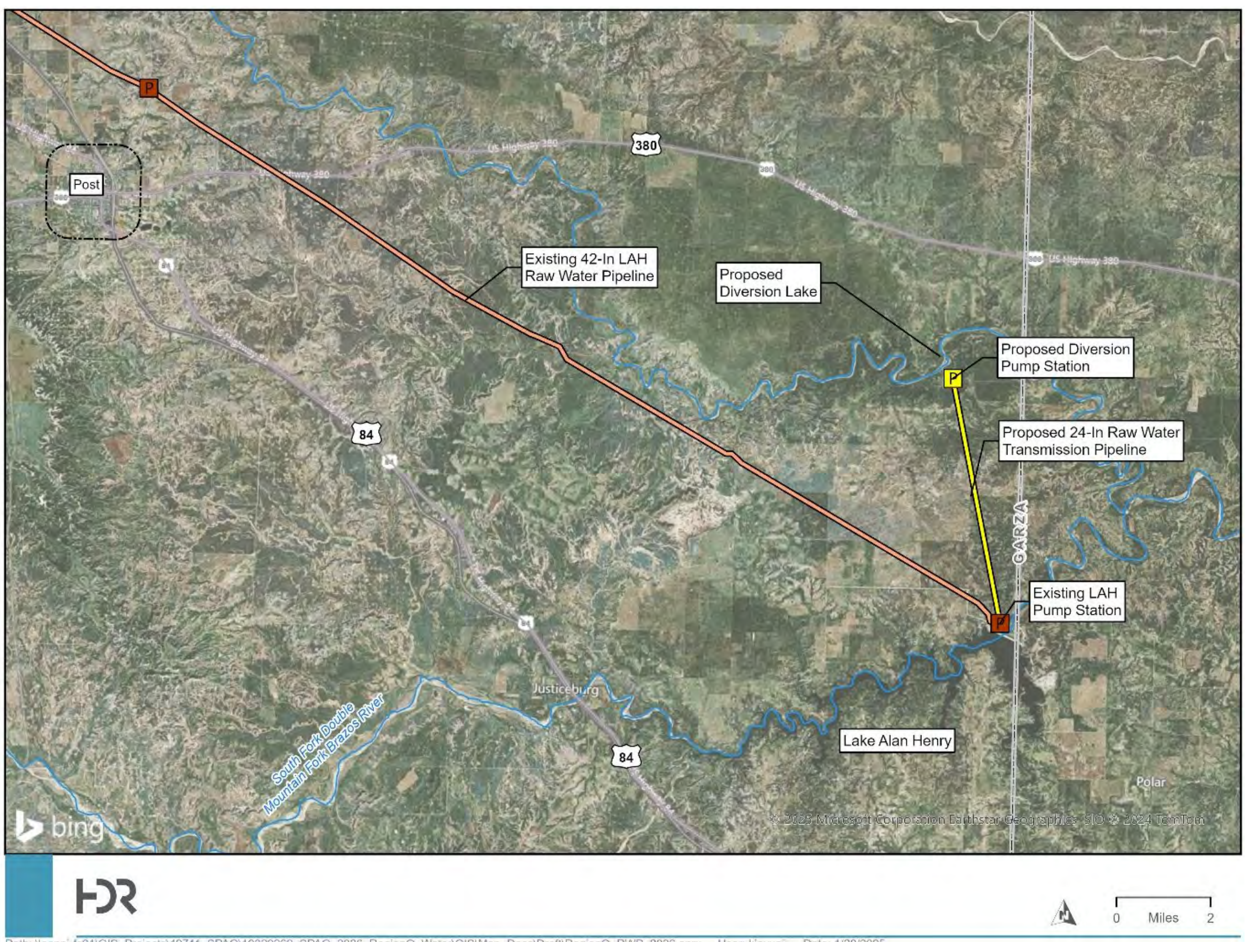

Figure 5-8. North Fork Diversion to Lake Alan Henry Pump Station

5.9.1 Quantity of Available Water

The strategy is estimated to provide a constant 6.7 mgd or 7,510 ac-ft/yr of reclaimed water for treatment at the SWTP. This quantity is calculated based on 9 mgd of treated effluent being discharged by the City of Lubbock at Outfall 001, reduced by approximately 26 percent due to carriage losses between the discharge and diversion points on the North Fork.

The treated effluent discharged by the City of Lubbock would originate from privately owned groundwater sources and would be considered groundwater-based effluent, not state water. As a result, diversion and use of the groundwater-based effluent would not be subject to priority calls from downstream water right holders or TCEQ-adopted environmental flow standards. However, a water right for the use of the bed and banks of the North Fork to convey the treated effluent would be required, and TCEQ could decide to include some amount of environmental flow provisions as part of a special condition to the permit.

5.9.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-8. Assumptions associated with these costs include the following.

- Costs associated with implementing the required LAH Phase 2 strategy are not included;
- Intake, pump station, and transmission pipeline are designed for an estimated at 5 percent downtime;
- Energy costs to transmit water through the LAHPS and LAH pipeline are included; and
- The project is assumed to have a 2-year construction period.

Table 5-8. North Fork Diversion to Lake Alan Henry Pump Station Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Channel Dam	$2,990,000
Intake Pump Stations and Channel Dam (7.1 mgd)	$14,052,000
Transmission Pipeline (24-in dia., 5.3 miles)	$9,722,000
South Water Treatment Plant Expansion (6.7 mgd)	$21,007,000
Integration, Relocations, Backup Generator & Other	$143,000
TOTAL COST OF FACILITIES	**$47,914,000**
Engineering:	
- Planning (3%)	$1,437,000
- Design (7%)	$3,354,000
- Construction Engineering (1%)	$479,000
Legal Assistance (2%)	$958,000
Fiscal Services (2%)	$958,000
Pipeline Contingency (15%)	$1,458,000
All Other Facilities Contingency (20%)	$7,639,000
Environmental & Archaeology Studies and Mitigation	$175,000
Land Acquisition and Surveying (40 acres)	$131,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$4,184,000
TOTAL COST OF PROJECT	**$68,687,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$4,823,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$99,000
Dam and Reservoir (1.5% of Cost of Facilities)	$351,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$45,000
Water Treatment Plant	$1,553,000
Pumping Energy Costs (0.09 $/kW-hr)	$1,277,000
TOTAL ANNUAL COST	**$8,148,000**
Available Project Yield (ac-ft/yr)	7,510
Annual Cost of Water ($ per ac-ft), based on PF=1	$1,085
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$443
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$3.33
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.36

ac-ft = acre-feet; ac-ft/yr = acre-feet per year; mgd = million gallons per day; in = inch; dia. = diameter;
ROI = return on investment; kW-hr = kilowatt-hours

5.9.3 Implementation Issues

5.9.3.1 Environmental Issues

The strategy occurs within the High Plains vegetational area[140] and is within the Kansan biotic province.[141] According to *The Vegetation Types of Texas*, the diversion site and pipeline from the diversion point to LAH are within the mesquite-lotebush brush vegetation community.[142] The mesquite-lotebush brush vegetation type is distributed through parts of west, northwest and north-central Texas and includes species such as yucca, agarito, elbowbush, juniper, sand dropseed, Texas grama, Texas wintergrass, broom snakeweed and Englemann daisy, among others. Vegetation impacts would include clearing areas to install the 5-mile pipeline and construct the

[140] Gould, F.W. 1975. The Grasses of Texas. Texas A&M University Press. College Station, Texas.

[141] Blair, W.F. 1950. “The Biotic Provinces of Texas, “Tex. J. Sci. 2:93-117.

[142] McMahan, C. A., R. G. Frye and K. L. Brown. 1984. “The Vegetation Types of Texas – Including Cropland. Accessed online: https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/

intake and pump stations and any areas required to expand existing facilities. Vegetation impacts would vary depending on the methods used to install the pipeline.

FEMA oversees the delineation of 100-year floodplain zone on FIRMs across the United States. The term, 100-year flood, refers to areas that have a one percent chance of flooding in any given year. FEMA 100-year floodplain zones have not been mapped within unincorporated areas of Garza County, where new infrastructure would be developed[143].

NWI's database indicates that the North Fork, where the proposed intake structure would be constructed, is identified as freshwater emergent wetland and riverine. The proposed pipeline would also cross several tributaries of both the North Fork and the South Fork, along with several Palustrine Emergent Wetlands (PEM). A Section 404 permit from USACE is required for construction within WOTUS for the proposed project.[144.] This could include NWP coverage, an NWP with a pre-construction notification, or an individual permit depending upon project impacts.

The TCEQ *2024 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted June 26, 2024[145], and the TCEQ Surface Water Quality Viewer identifies LAH (Segment 1241B) as impaired with mercury in edible tissue as the water quality concern. Double Mountain Fork Brazos River (Segment 1241) is approximately 3.6 miles downstream of LAH and is listed as impaired for bacteria for recreational use.[146]

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets, no cemeteries, historical markers, national register properties, or national register districts are located within a one-mile buffer of the proposed project area.

A review of archaeological resources in the proposed project area should be conducted during project planning. The owner or controller of the project would be required to coordinate with the Texas Historical Commission regarding impacts to cultural resources.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies and project requiring federal approvals, are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Garza County are listed in Appendix D under Garza County, Texas.

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[143] FEMA. 2025. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd February 21, 2025.

[144] NWI. 2025. Surface Waters and Wetlands, HUC 12100203. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html February 21, 2025.

[145] TCEQ. 2025. Draft 2024 Texas Integrated Report for the Clean Water Act Sections 305(b) and 303(d). Accessed online https://www.tceq.texas.gov/waterquality/assessment/16twqi/16txir, February 21, 2025.

[146] TCEQ. 2025. Surface Water Quality Viewer. Accessed https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 February 21, 2025.

According to IPaC, accessed on the USFWS website on February 21, 2025, the monarch butterfly, sharpnose shiner, and the smalleye shiner could be affected by the proposed project. The piping plover and rufa red knot were also included on the IPaC list but only need to be considered for wind energy projects. Additionally, the proposed project may overlap critical habitat for the sharpnose shiner and the smalleye shiner and potential effects to critical habitat for these species must be analyzed along with impacts to the species themselves. TPWD's TXNDD documents the occurrences of rare species in Texas. No occurrences of threatened, endangered, or candidate were documented within one mile of the proposed project area.

A biological survey and habitat assessment of the project area should be conducted to determine the presence of threatened and endangered species or their potential habitats. Based on the findings, an evaluation will be made to determine whether the proposed activities may impact listed species. Coordination with TPWD and USFWS regarding threatened and endangered species should be initiated early in project planning.

Summary

The primary environmental issue related to this strategy is the change in land use from ranchland to a low-head diversion lake, resulting in potential impacts to listed species habitats, which must be mitigated. Studies would be necessary to determine the actual impact to cultural resources, wetlands, and threatened and endangered species. However, the construction of the diversion lake should have low to moderate impacts associated with most of these concerns. The sharpnose shiner and smalleye shiner exist within this part of the Brazos River Basin and are listed on the federal threatened and endangered species list. The location of the diversion lake and intake pump station is in the critical habitat area of the shiners, which would make permitting of those structures difficult. Other threatened species that potentially live in the region surrounding the North Fork include the Texas horned lizard and the Palo Duro mouse.

5.9.3.2 Permitting Issues

The City of Lubbock started discharging at Outfall 001 in May 2003 under its existing discharge permit TPDES Permit 10353-002. Outfall 001 is permitted to discharge a maximum of 9.0 mgd (10,089 ac-ft/yr). In order to implement this strategy, the City of Lubbock would need to apply to TCEQ for a new water use permit that includes a bed and banks authorization allowing for the transportation and diversion of up to 10,089 ac-ft annually (minus carriage losses) of the City of Lubbock's return flows at the diversion location.

5.9.3.3 Other Issues

Property would need to be acquired at the proposed diversion location to accommodate the pumping facilities. In addition, pipeline utility easements would be necessary to construct a raw water transmission line to the LAHPS.

5.10 South Fork Discharge

The South Fork Discharge strategy is an indirect reuse strategy included in the *2018 Lubbock Strategic Water Supply Plan*. The strategy would discharge treated effluent into the South Fork to increase the firm yield of LAH. The City of Lubbock operates an existing pipeline that transports reclaimed water from the SEWRP to the Hancock Land Application Site (HLAS) located north of the community of Wilson, Texas. This strategy extends the existing reclaimed water pipeline from the HLAS to a discharge location on a tributary of the South Fork. The reclaimed water would then be conveyed for approximately 36 miles using the bed and banks of the South Fork to LAH. The reclaimed water would then be diverted from LAH and pumped to the SWTP via the LAH pipeline.

The relatively long distance between the discharge point and LAH and the mixing of the reclaimed water with stored water in the lake would likely provide sufficient natural attenuation and blending for enhanced water quality. Therefore, additional advanced treatment facilities are assumed to not be necessary for this strategy. This strategy requires the implementation of the LAH Phase 2 strategy to deliver the additional supplies through the LAH pipeline.

The major infrastructure components of this strategy include the following.

- Construct a new 9-mgd pump station at the HLAS;
- Install an 18-mile, 24-inch transmission pipeline to discharge reclaimed water into the South Fork tributary;
- Construct a stilling basin located at the discharge point of the 24-inch transmission pipeline; and
- Expand the SWTP by 7.3 mgd and associated high service pump station.

Figure 5-9 provides the relative locations of the infrastructure needed for strategy.

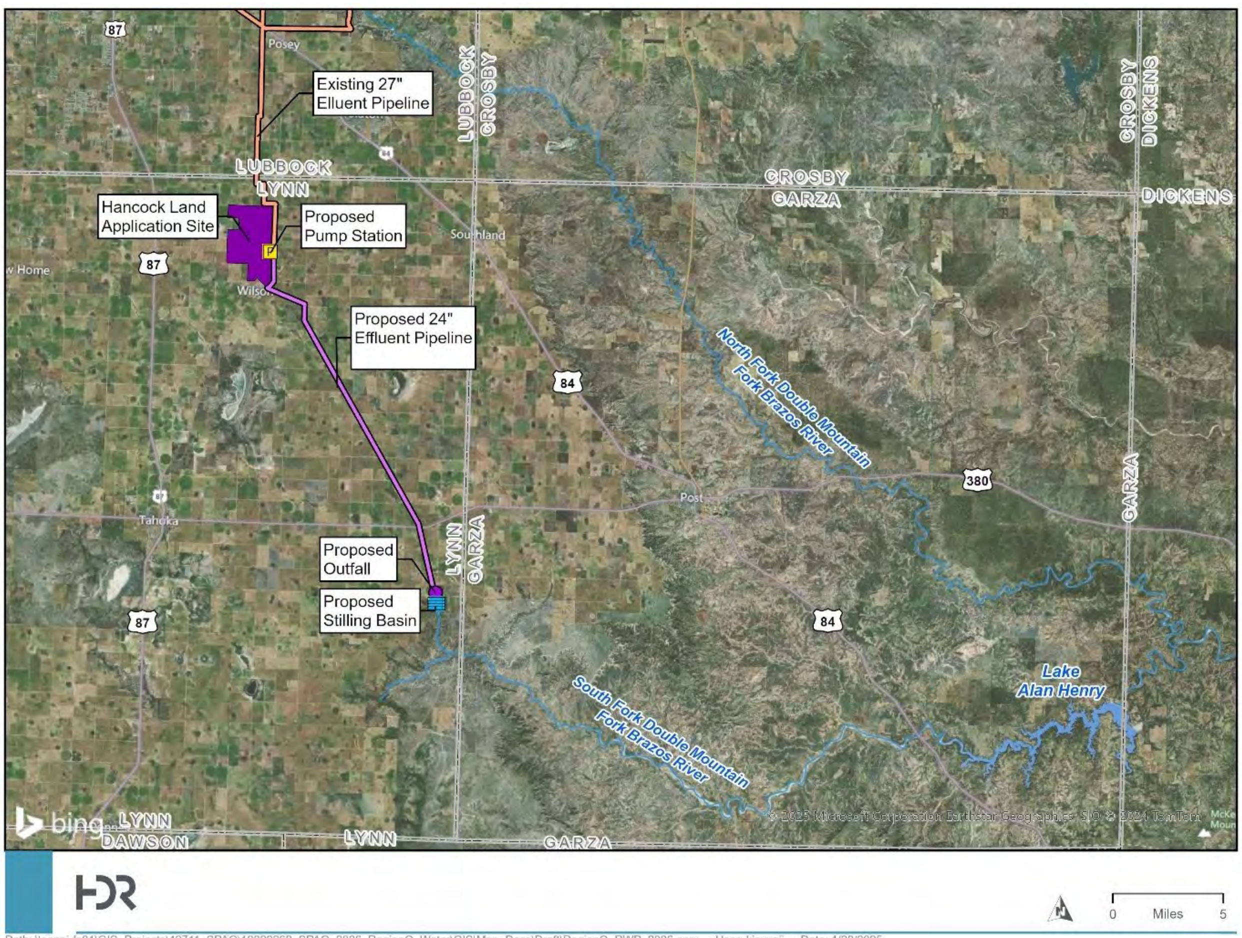

Figure 5-9. South Fork Discharge Strategy

5.10.1 Quantity of Available Water

The City of Lubbock would discharge up to 9 mgd of reclaimed water into the South Fork tributary. The water would flow 36 river miles to LAH where the water would be stored until pumped back to the SWTP. Carriage losses from the discharge point to LAH are estimated to be 19 percent or 1.7 mgd. Therefore, this strategy is estimated to provide an additional peak day of 7.3 mgd or an average of 8,183 ac-ft/yr of water supply.

The treated effluent discharged by the City of Lubbock would originate from privately owned groundwater sources and would not be considered state water. As a result, diversion and use of the groundwater-based effluent would not be subject to priority calls from downstream water right holders or TCEQ-adopted environmental flow standards. However, a water right for the use of the bed and banks of the South Fork to convey the treated effluent would be required.

5.10.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-9. Assumptions associated with these costs include the following.

- Costs associated with implementing the required LAH Phase 2 strategy are not included;
- Energy costs to transmit water through the LAHPS and pipeline are included; and
- The project is assumed to have a 2-year construction period.

Table 5-9. South Fork Discharge Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Pump Station (7.7 mgd)	$2,330,000
Transmission Pipeline (24-in dia., 18 miles)	$35,873,000
South Water Treatment Plant Expansion (7.3 mgd)	$22,427,000
Integration, Relocations, Backup Generator & Other	$52,000
TOTAL COST OF FACILITIES	**$60,682,000**
Engineering:	
- Planning (3%)	$1,820,000
- Design (7%)	$4,248,000
- Construction Engineering (1%)	$607,000
Legal Assistance (2%)	$1,214,000
Fiscal Services (2%)	$1,214,000
Pipeline Contingency (15%)	$5,373,000
All Other Facilities Contingency (20%)	$4,972,000
Environmental & Archaeology Studies and Mitigation	$570,000
Land Acquisition and Surveying (121 acres)	$412,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$5,269,000
TOTAL COST OF PROJECT	**$86,381,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$6,074,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Facilities)	$359,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$58,000
Water Treatment Plant	$1,638,000
Pumping Energy Costs (0.09 $/kW-hr)	$1,239,000
TOTAL ANNUAL COST	**$9,368,000**
Available Project Yield (ac-ft/yr)	8,183
Annual Cost of Water ($ per ac-ft), based on PF=1	$1,145
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$403
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$3.51
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.24

ac-ft = acre-feet; ac-ft/yr = acre-feet per year; mgd = million gallons per day; in = inch; dia. = diameter;
ROI = return on investment; kW-hr = kilowatt-hours

5.10.3 Implementation Issues

5.10.3.1 Environmental Issues

The proposed project improvements occur within the High Plains vegetational area[147] and within the Kansan biotic province.[148] According to *The Vegetation Types of Texas*, the project components are within the crops vegetation community.[149] Crops include cultivated cover crops or row crops which provide food or fiber for man or domestic animals, or grasslands associated with crop rotations. Vegetation impacts would include clearing areas to install the 18-mile transmission pipeline and construct the stilling basin and HLAS pump station. Vegetation impacts would vary depending on the methods used to install the pipeline.

[147] Gould, F.W. 1975. The Grasses of Texas. Texas A&M University Press. College Station, Texas.

[148] Blair, W.F. 1950. “The Biotic Provinces of Texas, “Tex. J. Sci. 2:93-117.

[149] McMahan, C. A., R. G. Frye and K. L. Brown. 1984. “The Vegetation Types of Texas – Including Cropland. Accessed online: https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/

FEMA oversees the delineation of 100-year floodplain zone on FIRMs across the United States. The term, 100-year flood, refers to areas that have a one percent chance of flooding in any given year. The FEMA 100-year floodplains have not been mapped in unincorporated areas of Lynn County, where the new project components would be located.[150].

NWI's database indicates that the tributary to the South Fork, where treated effluent would be discharged and a stilling basin constructed, is riverine. Along the proposed pipeline route from the HLAS to the tributary, there are numerous playa lakes identified in the NWI as freshwater ponds or freshwater emergent wetlands, some of which may be considered WOTUS. A Section 404 permit from USACE is required for construction within WOTUS for the proposed project.[151.] This could include NWP coverage, an NWP with a pre-construction notification, or an individual permit depending upon the impacts.[152]

The TCEQ *2024 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted June 26, 2024[153], and the TCEQ Surface Water Quality Viewer do not identify any stream segments within Lynn County, where the strategy would require new infrastructure or infrastructure improvements. The South Fork (Segment 1241D) is fully supporting of its designated uses with no impairments. However, further downstream, LAH (Segment 1241B) is impaired, and the water quality concern is mercury in edible tissue. Double Mountain Fork Brazos River (Segment 1241) is approximately 3.6 miles downstream of LAH and is listed as impaired for bacteria for recreational use.[154]

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets, there were several historical markers and a cemetery within a one-mile buffer of the proposed project improvements in Lynn County. These include Historical Marker 2255 marking Grasslands and the Grassland Cemetery, both located near the tributary to the South Fork. Three historical markers were within the town of Wilson; these include the Site of Mackenzie Cavalry Camp (#4827), Spanish Explorers Route (#4999), and Wilson Mercantile Company (#5857). No other cemeteries, historical markers, national register properties, or national register districts are located within a one-mile buffer of the proposed project area.

A review of archaeological resources in the proposed project area should be conducted during project planning. The owner or controller of the project would be required to coordinate with the Texas Historical Commission regarding impacts to cultural resources.

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[150] FEMA. 2025. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd February 21, 2025.

[151] NWI. 2025. Surface Waters and Wetlands HUC 12100203. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html February 21, 2025.

[152] NWI. 2025. Surface Waters and Wetlands HUC 12050004. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html February 21, 2025.

[153] TCEQ. 2025. Draft 2024 Texas Integrated Report for the Clean Water Act Sections 305(b) and 303(d). Accessed online https://www.tceq.texas.gov/waterquality/assessment/16twqi/16txir February 21, 2025..

[154] TCEQ. 2025. Surface Water Quality Viewer. Accessed https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 February 21, 2025.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies, or projects requiring a federal approval, are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Lubbock and Lynn counties are listed in Appendix D under Lubbock and Lynn counties, Texas. The list for Lubbock County is included in the table, even though the strategy would rely on existing infrastructure in Lubbock County.

According to IPaC, accessed on the USFWS website on February 21, 2025, the monarch butterfly, sharpnose shiner, and the smalleye shiner could be affected by the proposed project. There are no critical habitats for threatened or endangered species within the proposed project area. The sharpnose shiner and smalleye shiner should be considered for this project since the proposed project could affect the quantity and quality of water flowing into occupied habitat. The Texas Natural Diversity Database (TXNDD), maintained by the TPWD, documents the occurrences of rare species in Texas. The swift fox, an SGCN-designated species, has been documented at the Lubbock Preston Smith International Airport (between 1971 and 1972) and near the western edge of the proposed Lake 7 (in 1966). Additionally, the state threatened Texas horned lizard has been documented near the Yellow House River between Old AT & SF Railway and E Loop 289 in July of 2024.

A biological survey and habitat assessment of the project area should be conducted to determine the presence of threatened and endangered species or their potential habitats. Based on the findings, an evaluation will be made to determine whether the proposed activities may impact listed species. Coordination with TPWD and USFWS regarding threatened and endangered species should be initiated early in project planning.

Summary

This strategy should have minimal impact on the environment since the return flows would be discharged into an existing river basin. The discharge parameters dictated by TCEQ in the TPDES permit that would be required should ensure that the treated effluent would not impair this segment of the South Fork. Mitigation for the impact to wildlife habitats has already been accomplished for LAH.

5.10.3.2 Permitting Issues

The City of Lubbock’s existing discharge permit (TPDES Permit WQ0010353002) will need to be amended to include an additional outfall on the South Fork. If the existing HLAS pipeline is used, the amendment must include a request to discharge up to 10,089 ac-ft annually into the South Fork. The current permit only authorizes the discharge of treated effluent at FM 400 and the North Fork (Outfall 001) and at the SEWRP (Outfall 007). A water rights permit (bed and banks permit) would be required pursuant to Texas Water Code (TWC) Section 11.042 to authorize the conveyance and diversion of the City of Lubbock’s reclaimed water. In addition, authorization to construct the discharge facility would be required.

5.10.3.3 Other

Pipeline utility easements would be necessary to extend the existing reclaimed water pipeline to the South Fork. Easements would also be required for the construction of the stilling basin.

5.11 City of Plainview Reuse

The City of Plainview does not currently provide any of its wastewater effluent as a reuse water supply; however, the City of Plainview is evaluating a project to provide a portion of their effluent discharge as a reuse supply to local golf courses and other open areas with a possible second phase to deliver treated effluent back to the water treatment plant.

Phase 1 of the project would use up to 50 percent of the average effluent discharge from the WWTP, or about 0.6 MGD (Figure 5-10). This reuse would be treated to Type II reuse standards with tertiary treatment and disinfection being added at the WWTP. This treated effluent would then be delivered to a local golf course through a 12-inch diameter pipeline. The pipeline would be sized to deliver 2.4 mgd as a peak use irrigation supply.

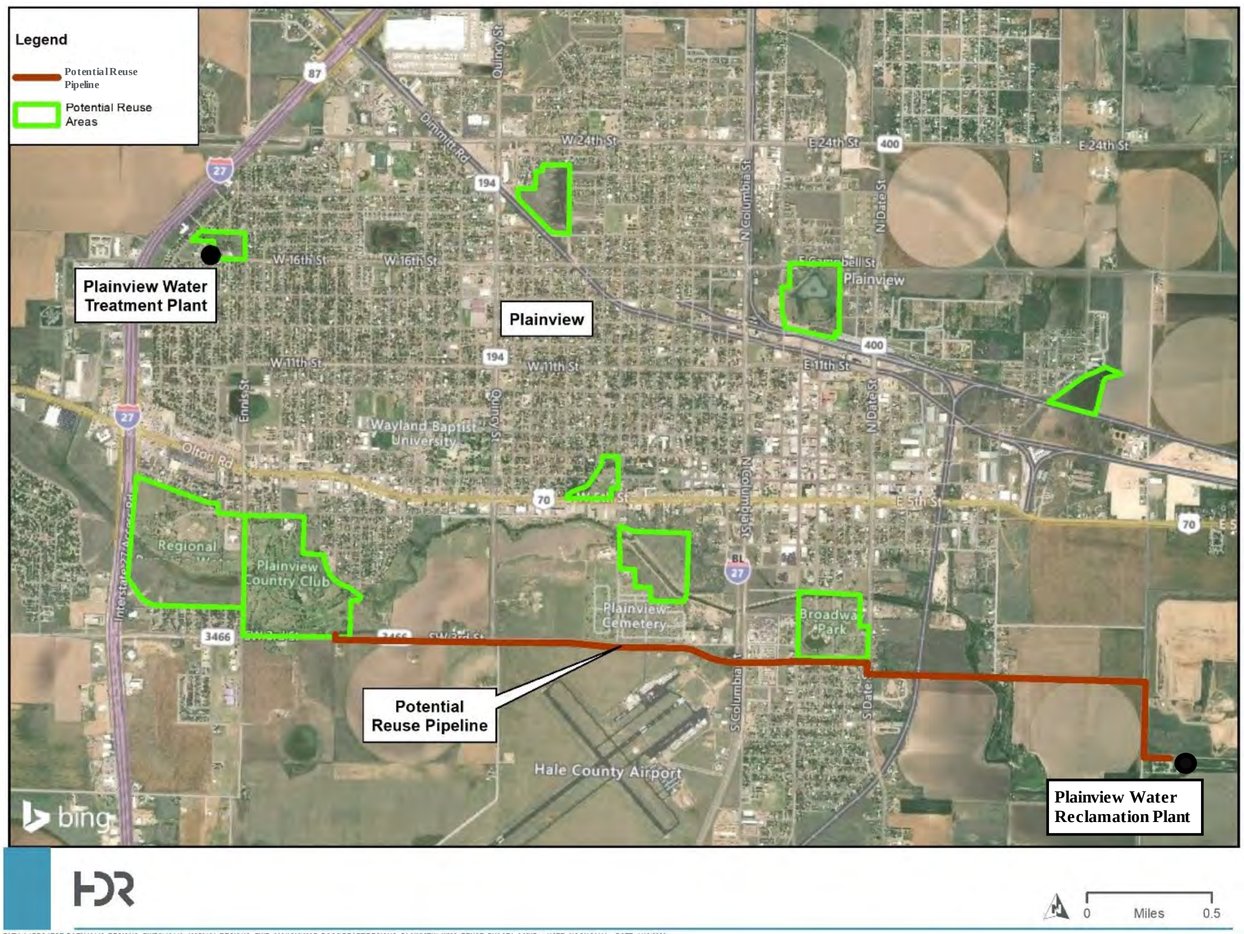

Figure 5-10. City of Plainview Reuse Option, Phase 1

Phase 2 of the project would use up to 100 percent of the average effluent discharge from the WWTP, or about 1.2 mgd (Figure 5-11). With this phase, the original pipeline would be extended to allow the effluent to be delivered to the city WWTP. In addition, a 1.2-mgd advanced treatment facility would be added to the existing WWTP. This would give the City of Plainview the operational flexibility to take all of the reuse water for DPR or meet reuse demand along the pipeline route (golf course, airport, recreation fields, or cemeteries).

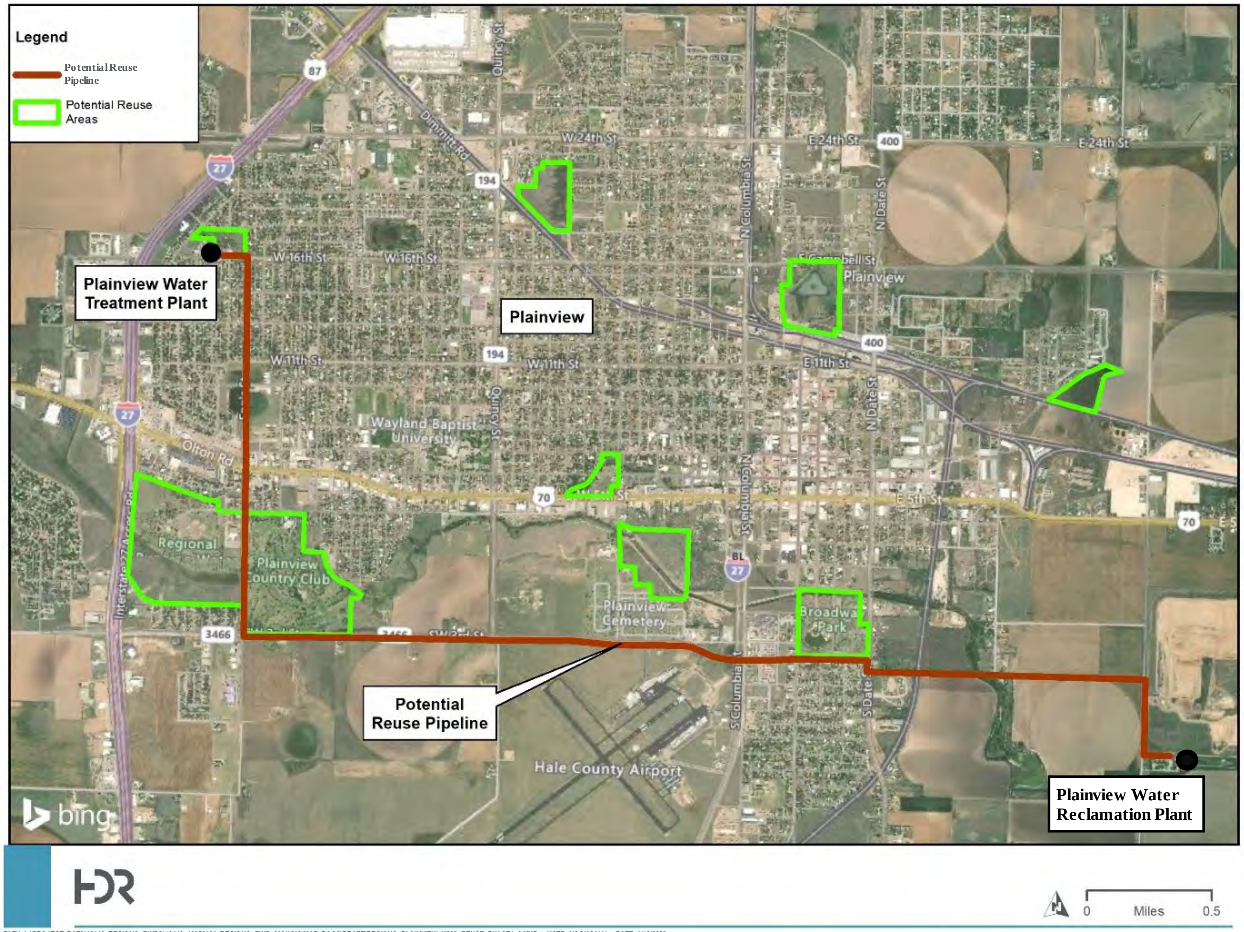

Figure 5-11. City of Plainview Reuse Option, Phase 2

Wastewater reuse would be defined as the types of projects that use treated wastewater effluent as a replacement for potable water supply, reducing the overall demand for fresh water supply. Wastewater reuse typically involves a capital project connecting the treatment plant discharge facilities to an individual area that has a relatively high, localized use that can be met with non-potable water. Examples most frequently include the irrigation of golf courses and other public lands and specific industries or industrial use areas.

Wastewater reuse can be classified into two forms, defined by how the reuse water is handled.

1. Direct Reuse – Pipe treated wastewater directly from wastewater plant to place of use (also called "flange-to-flange").
2. Indirect Reuse – Discharge treated wastewater to river, stream, or lake for subsequent diversion downstream (also called "bed and banks").

5.11.1 Direct Reuse

All direct reuse water supply options assume that treated wastewater remains under the control (in pipelines or storage tanks) at all times from treatment to point of use by the entity treating the wastewater and/or supplying reuse water.

Wastewater reuse quality and system design requirements are regulated by the TCEQ through 30 TAC §210. TCEQ allows two types of reuse as defined by the use of the water and the required water quality.

- Type 1 – Public or food crops generally can come in contact with reuse water; and
- Type 2 – Public or food crops cannot come in contact with reuse water.

Current TCEQ criteria for reuse water are shown in Table 5-10. Trends across the country indicate that criteria for unrestricted reuse water will likely become more stringent over time. The water quality required for Type 1 reuse water is more stringent with lower requirements for oxygen demand (BOD_5 or $CBOD_5$), turbidity, and fecal coliform levels.

Table 5-10. TCEQ Quality Standards for Reuse Water

Parameter	Allowable Level
Type 1 Reuse	
BOD_5 or $CBOD_5$	5 mg/L
Turbidity	3 NTU
Fecal Coliform	20 CFU / 100 ml[1]
Fecal Coliform (not to exceed)	75 CFU / 100 ml[2]
Type 2 Reuse : For a system other than a pond system	
BOD_5	20 mg/L
or $CBOD_5$	15 mg/L
Fecal Coliform	200 CFU / 100 ml[1]
Fecal Coliform (not to exceed)	800 CFU / 100 ml[2]
Type 2 Reuse: For a pond system	
BOD_5	30 mg/L
Fecal Coliform	200 CFU / 100 ml[1]
Fecal Coliform (not to exceed)	800 CFU / 100 ml[2]

Notes:
[1] geometric mean
[2] single grab sample
mg/L = milligrams per liter; NTU = nephelometric turbidity units; CFU = colony forming unit

5.11.2 Indirect Reuse

Indirect reuse is the discharge of treated wastewater to rivers, streams, or lakes for subsequent diversion downstream (also called “bed and banks”).

Applications for indirect reuse are currently being evaluated on a case-by-case basis, and the requirements for indirect reuse are in the process of becoming better defined. Some relevant sections of the TWC are presented here in an effort to present the framework that is informing the current deliberations on indirect reuse. State water is defined in the TWC as follows.

> *§ 11.021. STATE WATER. (a) The water of the ordinary flow, underflow, and tides of every flowing river, natural stream, and lake, and of every bay or arm of the Gulf of Mexico, and the storm water, floodwater, and rainwater of every river, natural stream, canyon, ravine, depression, and watershed in the state is the property of the state.*
>
> *(b) Water imported from any source outside the boundaries of the state for use in the state and which is transported through the beds and banks of any navigable stream within the state or by utilizing any facilities owned or operated by the state is the property of the state.*

Indirect reuse or "bed and banks" delivery is addressed in the TWC as follows.

§ 11.042. DELIVERING WATER DOWN BANKS AND BEDS.

(a) Under rules prescribed by the commission, a person, association of persons, corporation, water control and improvement district, water improvement district, or irrigation district supplying stored or conserved water under contract as provided in this chapter may use the bank and bed of any flowing natural stream in the state to convey the water from the place of storage to the place of use or to the diversion point of the appropriator.

(b) A person who wishes to discharge and then subsequently divert and reuse the person's existing return flows derived from privately owned groundwater must obtain prior authorization from the commission for the diversion and the reuse of these return flows. The authorization may allow for the diversion and reuse by the discharger of existing return flows, less carriage losses, and shall be subject to special conditions if necessary to protect an existing water right that was granted based on the use or availability of these return flows. Special conditions may also be provided to help maintain in stream uses and freshwater inflows to bays and estuaries. A person wishing to divert and reuse future increases of return flows derived from privately owned groundwater must obtain authorization to reuse increases in return flows before the increase.

(c) Except as otherwise provided in Subsection (a) of this section, a person who wishes to convey and subsequently divert water in a watercourse or stream must obtain the prior approval of the commission through a bed and banks authorization. The authorization shall allow to be diverted only the amount of water put into a watercourse or stream, less carriage losses and subject to any special conditions that may address the impact of the discharge, conveyance, and diversion on existing permits, certified filings, or certificates of adjudication, in stream uses, and freshwater inflows to bays and estuaries. Water discharged into a watercourse or stream under this chapter shall not cause a degradation of water quality to the extent that the stream segment's classification would be lowered. Authorizations under this section and water quality authorizations may be approved in a consolidated permit proceeding.

(d) Nothing in this section shall be construed to affect an existing project for which water rights and reuse authorizations have been granted by the commission before September 1, 1997.

5.11.3 Direct and Indirect Potable Reuse

Reclaimed water can either be used for potable or non-potable purposes. Reuse applications typically refer to non-potable reuse when the reclaimed water does not get used for potable, drinking water system purposes. With advanced water treatment methods available, there are two options for potable use of reclaimed water. The two options are indirect potable reuse and DPR. Indirect potable reuse is defined as "the use of reclaimed water for potable purposes by discharging to a water supply source, such as surface water or ground water." The mixed reclaimed and natural waters then get additional treatment at a water treatment plant before entering the drinking water distribution system. DPR is defined as "the introduction of advanced treated reclaimed water either directly into the potable water system or into the raw water supply entering the water treatment plant." Under these definitions, aquifer storage and recovery is defined as a type of indirect potable reuse.

Potable reclaimed water supplied to consumers is held to stricter standard than non-potable reclaimed water use and is required to meet federal and state drinking water standards.

5.11.4 Strategy Costs

Costs associated with this strategy are presented in Table 5-11. Assumptions associated with these costs include the following.

- The advanced water treatment plant would be constructed on City of Plainview-owned land adjacent to the WWTP;
- The capacity of the pump station, advanced water treatment plant and transmission pipeline includes an estimated 5 percent downtime; and
- The project is assumed to have a 2-year construction period.

Table 5-11. City of Plainview Reuse Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities	
	Phase 1	Phase 1+2
Primary Pump Station (2.4 MGD)	$1,754,000	$2,305,000
Transmission Pipeline (12 in dia., 5.8 miles)	$8,509,000	$12,815,000
Transmission Pump Station(s) & Storage Tank(s)	$1,937,000	$1,937,000
Two Water Treatment Plants (2.4 MGD and 2.4 MGD)	$2,283,000	$2,283,000
Advanced Water Treatment Facility (1 MGD)	---	$12,437,000
Integration, Relocations, Backup Generator & Other	$4,000	$17,000
TOTAL COST OF FACILITIES	**$14,487,000**	**$31,524,000**
Engineering:		
- Planning (3%)	$435,000	$946,000
- Design (7%)	$1,014,000	$2,207,000
- Construction Engineering (1%)	$145,000	$315,000
Legal Assistance (2%)	$290,000	$630,000
Fiscal Services (2%)	$290,000	$1,922,000
Pipeline Contingency (15%)	$1,276,000	$3,742,000
All Other Facilities Contingency (20%)	$1,196,000	$198,000
Environmental & Archaeology Studies and Mitigation	$136,000	$198,000
Land Acquisition and Surveying (45 acres)	$351,000	$557,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$638,000	$1,387,000
TOTAL COST OF PROJECT	**$20,258,000**	**$44,058,000**
ANNUAL COST		
Debt Service (3.5 percent, 20 years)	$1,425,000	$3,099,000
Operation and Maintenance	-	-
Pipeline and Storage Tanks (1% of Facilities)	$104,000	$148,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$44,000	$51,000
Water Treatment Plant	$806,000	$806,000
Advanced Water Treatment Facility	--	$883,000
Pumping Energy Costs (0.08 $/kW-hr)	$6,000	$25,000
TOTAL ANNUAL COST	**$2,385,000**	**$5,012,000**
Available Project Yield (ac-ft/yr)	672	1,344
Annual Cost of Water ($ per ac-ft)	$3,549	$3,729
Annual Cost of Water After Debt Service ($ per ac-ft)	$1,429	$1,423
Annual Cost of Water ($ per 1,000 gallons)	$10.89	$11.44
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$4.38	$4.37

ac-ft = acre-feet; ac-ft/yr = acre-feet per year; mgd = million gallons per day; in = inch; dia. = diameter; ROI = return on investment; kW-hr = kilowatt-hours
Phase 1 – Indirect non-potable reuse
Phase 1 + 2 – Direct potable reuse

5.11.5 Implementation Issues

5.11.5.1 Environmental Issues

In 2022, the TCEQ developed a regulatory guidance manual outlining agency rules that apply to DPR projects, which includes advanced treatment of effluent over and above the traditional effluent treatment. The proposed strategy is not anticipated to impact land use, density, or type of development beyond that already planned within the project area. Permanent land use impacts in the project area would include constructing the advanced water treatment plant, pump station, and pipelines.

The proposed project occurs within the High Plains physiographic region of Texas and is within the Kansan biotic province[155]. The project components are within areas defined as mesquite shrub and row crops vegetation types[156]. The mesquite shrub vegetation type commonly includes grassland pricklypear, cholla, blue grama, hairy grama, purple three-awn, buffalograss, and other grasses, shrubs, and herbaceous species. Crops include cultivated cover or row crops providing food or fiber and also may include grassland associated with crop rotations. Ecological Mapping Systems of Texas (EMST) data, more detailed vegetation data recently produced by the TPWD[157], show the area containing barren land, active sand dunes and row crops habitats.

Areas of 100-year floodplain (Zone AE) are located along Running Water Draw within the proposed project area. Portions of the potential pipeline may be located within these floodplains. Freshwater emergent wetlands, forested/shrub wetlands, and ponds were identified on the NWI maps adjacent to the potential pipeline. The NWI maps also identified freshwater emergent wetlands along Running Water Draw adjacent to the potential pipeline. An NWP or coordination with the USACE may be required for impacts to WOTUS. No surface waters were identified on the TCEQ Surface Water Quality Viewer[158] within the proposed project area or within 5 miles.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (P196-515), and the Archeological and Historic Preservation Act (PL93-291). The City of Plainview, as the owner or controller of the project, would be required to comply with the antiquities code. Based on the review of available GIS datasets, Plainview Cemetery in Plainview Memorial Park and 11 historical markers (959, 1270, 1228, 1403, 1477, 1949, 2112, 2327, 3017, 3445, 4206, 4598, 5389, 5480 and 5674) were identified in the datasets within a one-mile buffer of the proposed project area. No state historic sites or National Register of Historic Places-listed sites were located within a one-mile buffer of the proposed project area. A review of archeological resources in the proposed project area should be conducted during project planning.

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[155] Blair, W.F. 1950. “The Biotic Provinces of Texas, “Tex. J. Sci. 2:93-117.

[156] McMahan, C.A., R.G. Frye, and K.L. Brown, 1984. The Vegetation Types of Texas. Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ March 22, 2019.

[157] TPWD, Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

[158] TCEQ, Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed January 13, 2020.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies and project requiring federal approvals, are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Hale County are shown in Appendix D under Hale County, Texas.

According to IPaC, accessed on the USFWS website on February 21, 2025, the monarch butterfly, sharpnose shiner, and the smalleye shiner could be affected by the proposed project. The piping plover and rufa red knot were also included on the IPaC list but only need to be considered for wind energy projects. There are no critical habitats for threatened or endangered species within the proposed project area. Reduced effluent return rates could potentially affect the sharpnose or smalleye shiner if area tributaries flow into occupied habitat. There are no critical habitats in the project area. TPWD's TXNDD documents the occurrences of rare species in Texas. There were three documented occurrences of the swift fox, an SGCN-designated species, in the area of proposed improvements. The most recent documented recording of this species within the project area was in 1963. No other documented occurrences of threatened, endangered or rare species or natural communities were reported within 5 miles of the project area.

A biological survey and habitat assessment of the project area should be conducted to determine the presence of threatened and endangered species or their potential habitats. Based on the findings, an evaluation will be made to determine whether the proposed activities may impact listed species. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

Summary

The advanced treatment facilities would be constructed on City of Plainview-owned property, which is currently being used for similar purposes and environmental issues should be minimal. The transmission line corridor that would convey the reclaimed should be selected to avoid potentially sensitive areas. Studies would be necessary to determine the actual impact to cultural resources, wetlands, and threatened and endangered species.

5.11.5.2 Permitting Issues

The drinking water produced for the project would meet or exceed all state and federal drinking water standards. TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. TCEQ will require a pilot study prior to regulatory approval and for determining design values for the treatment technologies. Treatment requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, results of effluent quality sampling/monitoring data, and wastewater treatment process.

Stream crossings would be subject to Section 404 of the Clean Water Act. Due to the minimal and temporary impacts associated with the pipeline installation, it is likely that most of the proposed project would be authorized by NWP 58.

5.11.5.3 Other

Due to the nature of the project, it is assumed that a public outreach plan is needed for the proposed reuse project. Advanced treatment design considerations should include real-time monitoring and regular sampling to ensure process performance and avoid any acute episode of pathogens in the reclaimed water.

5.12 City of Plainview Reuse Effluent and Brackish Dockum Aquifer Supply for Industrial Facility Operation

The City of Plainview currently produces 1.25 MGD of stream quality effluent that is discharged into the Running Water Draw, then to White River to White River Lake in Segment No. 1240 of the Brazos River Basin. In Phase 1 of the water strategy for the industrial facility, approximately 1 million gallons per day (MGD) of this reclaimed water will be redirected to the newly constructed industrial facility. To meet Type II reuse standards, the wastewater treatment plant (WWTP) will implement tertiary treatment and disinfection processes. The treated effluent will then be transported to the industrial facility via a 12-inch to 14-inch diameter pipeline.

In Phase 2, an on-site wellfield will be developed at the industrial facility, comprising three production wells. Groundwater in the region is anticipated to have total dissolved solids (TDS) concentrations below 1,000 mg/L, making it suitable for industrial use. However, if TDS levels exceed this threshold, the water will require treatment at a dedicated facility. These wells will extract water from the Dockum Aquifer, with a combined yield projected at approximately 1 MGD. To ensure uninterrupted operations during maintenance, a contingency well will also be included. The Plainview municipal water user group (WUG) is evaluating the Dockum Aquifer as a potential source for desalinated water. Should the Dockum Aquifer turn out to be a brackish source requiring desalination, an additional well may be needed to achieve the intended yield of 1 MGD after desalination. In the effort to be conservative, 4 wells have been costed with the assumption that desalination will be required.

Once the wellfield is operational, the industrial facility is expected to become self-sufficient, eliminating its reliance on additional water supplies from the City of Plainview. Depending on the salinity of the extracted groundwater, construction of a desalination plant may be considered to meet water quality requirements.

Major assumptions include the following:

- Four high-capacity Dockum production wells drilled to the top of the Permian, which is expected to operate at an average rate of 250 gpm per well (0.5 MGD) with a peak rate of 350 gpm.
- The depth to the base of the Dockum (top of Permian) is approximately 820 feet below ground level.
- Sparse and relatively old data suggests that TDS concentration in the Dockum range from approximately 340 to 1070 mg/L. For the preliminary strategy design, the estimated average TDS is 700 mg/L. However, there is a possibility that the TDS concentration surpasses 1,000 mg/L. If higher salinity water is encountered, it would necessitate the construction of a desalination plant to treat the water. To account for this possibility, the cost of a desalination plant and disposal wells have been incorporated into the strategy.
    - The desalination plant has been costed out assuming full buildout conditions of 6 MGD.

- The total capacity of the active production wells is 1000 gpm (1.4 MGD)

Major design features include the following.

- Install approximately 42 miles of 12-inch to 14-inch diameter transmission pipeline
- Construct four Dockum production wells, one of which would be considered a contingency or standby well, located on the industrially owned property.
- Installation of a desalination water plant in the case that high salinity water is encountered.
  - o Use RO technology at the desalination plant and operate at 75 percent efficiency;
  - o Produce water with a TDS concentration of approximately 500 mg/L that requires approximately 75 percent of the raw Dockum water to go through the RO process;
  - o Produce 1.40 mgd of product water, requiring approximately 1.75 mgd of raw water, and the concentrate discharge is approximately 0.35 mgd and has a TDS concentration of approximately 80,000 mg/L;
  - o Install an estimated three disposal wells discharging into the Permian, assuming the injection rates are 100 gpm and that these wells would be approximately 4,000 feet deep;
  - o Install approximately 0.75 miles of 6- to 8-inch diameter injection well piping;
  - o Discharge concentrate into a ground storage tank and then pump to the disposal wells.
- Site wells to meet TCEQ sanitary distance requirements.
- Size well pumps to deliver the raw water directly to the industrial facility.
- Install collector pipelines between wells and deliver water to terminal at head of new pipeline.

Figure 5-12 depicts the relative locations of the well field, new wells, transmission lines, and associated infrastructure.

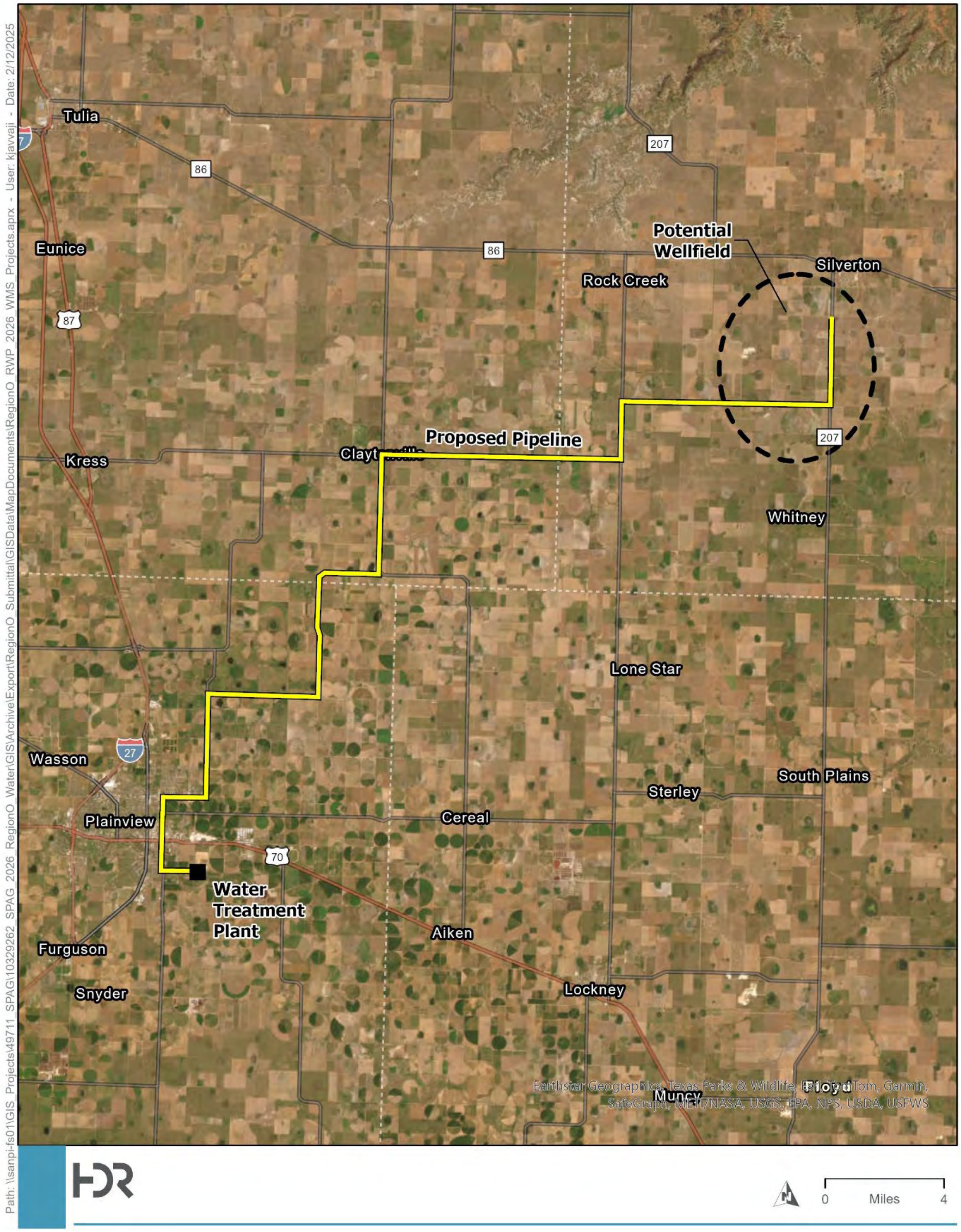

Figure 5-12. City of Plainview Reuse Effluent and Brackish Dockum Aquifer Supply for Industrial Facility Operation

5.12.1 Quantity of Available Water

This strategy is designed to help the industrial facility meet its peak demands. The well field is estimated to produce 1.0 MGD (1121 ac-ft/yr).

5.12.2 Strategy Costs

A cost summary is provided in Table 5-12. Assumptions and conditions associated with these costs include the following.

- Engineering, legal, fiscal service, and contingency costs combined are 35 percent of the total cost of facilities required by this strategy.
- Power is available at $0.09 per KW-hr.
- Interest during construction is 3.5 percent, and a 0.5 percent return on investment.
- Project will be financed for 20 years at a 3.5 percent interest rate.

Table 5-12. City of Plainview Reuse Effluent and Brackish Dockum Aquifer Supply for Industrial Facility Operation

Item	Estimated Costs for Facilities
Transmission Pipeline (12-14 in. dia., 42.4 miles)	$51,019,000
Well Fields (Wells, Pumps, and Piping)	$6,175,000
Water Treatment Plant (6 MGD)	$54,859,000
Integration, Relocations, Backup Generator & Other	$14,000
TOTAL COST OF FACILITIES	**$113,796,000**
- Planning (3%)	$3,396,000
- Design (7%)	$7,924,000
- Construction Engineering (1%)	$1,132,000
Legal Assistance (2%)	$2,264,000
Fiscal Services (2%)	$2,264,000
Pipeline Contingency (15%)	$7,653,000
All Other Facilities Contingency (20%)	$12,435,000
Environmental & Archaeology Studies and Mitigation	$1,387,000
Land Acquisition and Surveying (170 acres)	$315,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$4,939,000
TOTAL COST OF PROJECT	**$156,905,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$11,039,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$583,000
Water Treatment Plant	$10,387,000
Pumping Energy Costs (1022657 kW-hr @ 0.09 $/kW-hr)	$125,000
TOTAL ANNUAL COST	**$22,134,000**
Available Project Yield (acft/yr)	1,121
Annual Cost of Water ($ per acft), based on PF=1.5	$19,745
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$9,897
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$60.59
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$30.37

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; $/ac-ft = dollars per acre-foot; PF = peak factor

5.12.3 Implementation Issues

5.12.3.1 Environmental Issues

project occurs within the High Plains physiographic regions of Texas and is within the Kansan biotic province.[159] The project components are within an area defined as mesquite shrub and crops vegetation types.[160] The mesquite shrub vegetation type is found on the High Plains, Rolling Plains, and northwestern Edwards Plateau. Commonly associated plants include narrow-leaf yucca, tasajillo (*Opuntia leptocaulis*), juniper, cholla, blue grama, hairy grama, purple three-awn (Aristida purpurea), buffalograss (*Bouteloua dactyloides*), sandlily (*Leucocrinum montanum*), sandsage, and wild buckwheat, among others. Crops include a variety of cultivated row or cover crops. EMST data and TPWD's more detailed and recently produced vegetation data[161], identify several different habitat types within the proposed well field areas including playa grassland, mesquite and sand sage shrubland, short and mixed grass prairie, herbaceous vegetation, and areas of urban high and low intensity. Vegetation impacts would include clearing areas for construction of approximately 3 new wells and collection pipelines.

Areas of 100-year floodplain (Zone A) and special flood hazard areas (without a base flood elevation Zone AE) are located in areas of playas along N Date Street near the water treatment plant, and along FM 2286 within the proposed pipeline area.[162] For this project, wells would be placed outside the floodway or 100-year floodplain. Portions of the pipeline could be located within these floodplains. Several freshwater emergent wetlands or ponds were identified on the NWI maps adjacent to the potential pipeline route. The NWI maps also identified freshwater emergent wetlands within the potential well field. An NWP or coordination with the USACE may be required for impacts to waters of the U.S. No TCEQ surface water segments were identified, and no surface water quality concerns were noted on the TCEQ Surface Water Quality Viewer[163] within the proposed project area, or within 5 miles.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (P196-515), and the Archeological and Historic Preservation Act (PL93-291). The owner of the project would be required to comply with the antiquities code. Based on the review of available GIS datasets, Silverton Cemetery and 7 historical markers (512, 513, 1675, 1770, 3393, 4051, and 5842) were identified in the datasets within a one-mile buffer of the proposed project area. No state historic sites or National Register of Historic Places-listed sites were located within a one-mile buffer of the proposed project area. A review of archeological resources in the proposed project area should be conducted during project planning.

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[159] Blair, W.F. 1950. "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117.

[160] McMahan, C.A., R.G. Frye, and K.L. Brown. 1984. "The Vegetation Types of Texas." Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ October 21, 2024.

[161] TPWD. 2024. Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

[162] FEMA. 2024. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online: https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd&extent=-101.81119270873995,33.60458113606791,-101.64502449584957,33.6760378967513 November 4, 2024.

[163] TCEQ. 2024. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed November 4, 2024.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies and projects requiring federal approvals, are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Briscoe County are shown in Appendix D under Briscoe County, Texas.

According to IPaC, accessed on the USFWS website on February 21, 2025, the monarch butterfly, sharpnose shiner, and the smalleye shiner could be affected by the proposed project. The piping plover and rufa red knot were also included on the IPaC list but only need to be considered for wind energy projects. There are no critical habitats for threatened or endangered species within the proposed project area. There are three documented occurrences of the swift fox, an SGCN-designated species, in the area of proposed improvements. The most recent documented recording of this species within the project area was in 1963. No other documented occurrences of threatened, endangered or rare species or natural communities were reported within 5 miles of the project area. .

A biological survey and habitat assessment of the project area should be conducted to determine the presence of threatened and endangered species or their potential habitats. Based on the findings, an evaluation will be made to determine whether the proposed activities may impact listed species. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

The installation of wells and collection pipelines should be planned and installed so that sensitive habitats, cultural resources, and other sensitive areas are avoided.

Summary

The industrial facility would be constructed near the City of Silverton in Briscoe County. Water would be received from the City of Plainview Water Treatment Plant, and environmental issues should be minimal. The transmission line corridor that would convey the water should be selected to avoid potentially sensitive areas. Studies would be necessary to determine the actual impact to cultural resources, wetlands, and threatened and endangered species.

5.12.4 Permitting Issues

Phase 1 would require the City of Plainview’s existing discharge permit to be amended and a 210 Permit authorization by the TCEQ. Regarding Phase 2, the proposed well field property is not located within the jurisdiction of a GCD, and do not require a permit. If the desalination plant is required to address the TDS concentrations in the Dockum, an Underground Injection Control (UIC) Class V permit from the TCEQ would be required to authorize the use of deep well injection for disposal of reject water from the desalination plant.

5.13 Direct Potable Reuse from Northwest Water Reclamation Plant to North Water Treatment Plant

The Direct Potable Reuse (DPR) from Northwest Water Reclamation Plant (NWWRP) to North Water Treatment Plant (NWTP) project is included in the 2024 Lubbock Strategic Water Supply plan. This strategy includes conveying 6 mgd of reclaimed water from the NWWRP to an Advanced Treatment Plant for advanced treatment with multiple barriers before transporting and discharging into the raw water headworks at the NWTP. The project purifies reclaimed water from the NWWRP through advanced treatment (RO, UV disinfection and AOP) to create a water supply that will be of higher quality than the City's other raw water sources. The treated reclaimed water will be blended with other raw water from CRMWA at the North Water Treatment Plant (NWTP) and undergo conventional treatment for distribution to customers. Human health risks for direct potable reuse are equal or less than those of other water supply sources when full advanced treatment is used (RO, RO, UV disinfection and AOP). These processes are effective at removing identified ECCs and other contaminants, including pathogens, from treated wastewater.

The major design features of this strategy include:

- The NWTP has an existing capacity adequate to treat and distribute the additional 6 mgd of reclaimed water. Therefore, an expansion of the NWTP is not necessary;
- A 6 mgd ATP at the Lubbock NWTP;
- A new 280 hp pump station at the NWWRP to deliver the treated reclaimed water to the ATP via a new 24-in, 8.8-mile transmission pipeline; and
- RO concentrate will be discharged through a 10-in, 6-mile transmission line to the North Fork Double Mountain Fork of the Brazos River.

Figure 5-13 depicts the relative locations of the infrastructure needed for the Direct Potable Reuse from NWWRP to NWTP strategy.

5.13.1 Quantity of Available Water

This strategy is designed to treat and deliver an average of 6 mgd (6,720 ac-ft/yr) to the ATP; however, the efficiency of the RO is assumed 80 percent resulting in 1.2 mgd of reject and 4.8 mgd of treated reclaimed water to the NWTP each year.

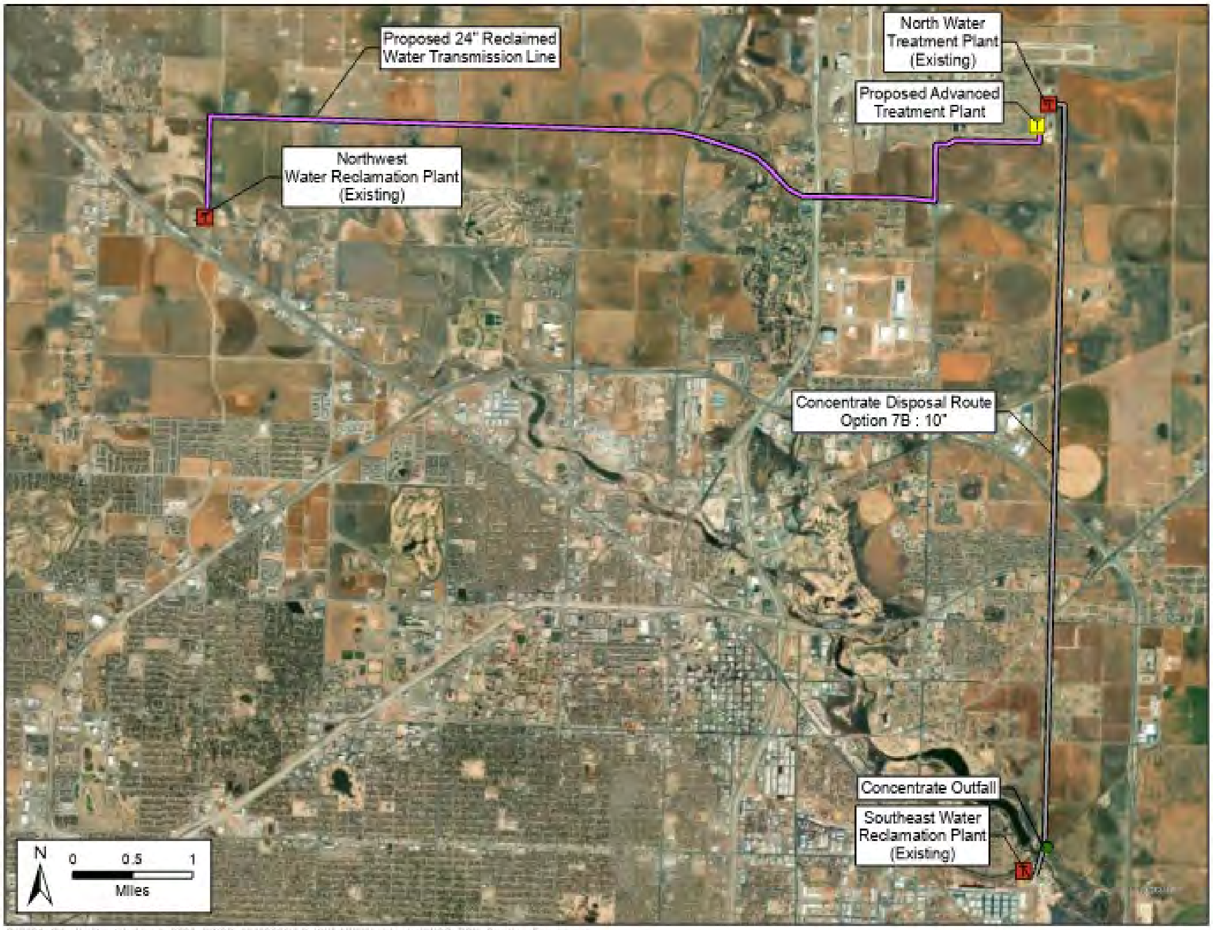

Figure 5-13. DPR from NWWRP to NWTP

5.13.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-13. Assumptions and conditions associated with these costs include:

- Facilities are sized with a 1.2 PF;
- Concentrate reject from the RO plant will be stream discharged;
- Engineering, legal, and contingency costs are 30 percent of pipeline construction and 35 percent of other facilities constructed;
- Power is available at $0.09 per kwh;
- Interest during construction is estimated at 3.5 percent, and a 0.5 percent return on investments over a 1-year period;
- The project will be financed for 20 years at a 3.5 percent annual interest rate; and
- The project is assumed to have a 1-year construction period.

As shown, the total cost is estimated to be $119,906,000. Annual debt service is $8,429,000; and, annual operational cost, including power, is $2,693,000. This results in a total annual cost of $11,122,000. Before debt service, the unit cost for 5,376 ac-ft/yr of supply at NWTP is estimated to be $2,069 per ac-ft, or $6.35 per 1,000 gallons. After debt service, the unit cost of water for the project is estimated to be $501 per ac-ft, or $1.54 per 1,000 gallons. This cost does not include the distribution of the potable water from the NWTP to potential customers.

Table 5-13. Cost Estimate Summary for DPR from NWWRP to NWTP (September 2023 Dollars)

Item	Estimated Costs for Facilities
Pump Stations (7.2 mgd)	$2,961,000
Transmission Pipeline (10-24 in dia., 15 miles)	$31,002,000
Water Treatment Plant (6 mgd)	$53,066,000
Integration, Relocations, Backup Generator & Other	$108,000
TOTAL COST OF FACILITIES	**$87,137,000**
	Engineering:
- Planning (3%)	$2,567,000
- Design (7%)	$5,989,000
- Construction Engineering (1%)	$856,000
Legal Assistance (2%)	$1,711,000
Fiscal Services (2%)	$1,711,000
Pipeline Contingency (15%)	$4,429,000
All Other Facilities Contingency (20%)	$11,207,000
Environmental & Archaeology Studies and Mitigation	$482,000
Land Acquisition and Surveying (13 acres)	$46,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$3,771,000
TOTAL COST OF PROJECT	**$119,906,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$8,429,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$295,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$74,000
Water Treatment Plant	$1,769,000
Pumping Energy Costs (0.09 $/kW-hr)	$555,000
TOTAL ANNUAL COST	**$11,122,000**
Available Project Yield (ac-ft/yr)	5,376
Annual Cost of Water ($ per ac-ft), based on PF=1.2	$2,069
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.2	$501
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.2	$6.35
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.2	$1.54

ac-ft = acre-feet; ac-ft/yr = acre-feet per year; mgd = million gallons per day; in = inch; dia. = diameter; ROI = return on investment; kW-hr = kilowatt-hours

5.13.3 Implementation Issues

5.13.3.1 Environmental Issues

The proposed project occurs within the High Plains physiographic regions of Texas and is within the Kansan biotic province.[164] The project components are within an area defined as mesquite shrub and crops vegetation types.[165] The mesquite shrub vegetation type is found on the High Plains, Rolling Plains, and northwestern Edwards Plateau. Commonly associated plants include narrow-leaf yucca, tasajillo (*Opuntia leptocaulis*), juniper, cholla, blue grama, hairy grama, purple three-awn (Aristida purpurea), buffalograss (*Bouteloua dactyloides*), sandlily (*Leucocrinum montanum*),

[164] Blair, W.F. 1950. "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117.

[165] McMahan, C.A., R.G. Frye, and K.L. Brown. 1984. "The Vegetation Types of Texas." Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ October 21, 2024.

sandsage, and wild buckwheat, among others. Crops include a variety of cultivated row or cover crops. EMST data and TPWD's more detailed and recently produced vegetation data[166], identify several different habitat types within the proposed including playa grassland, mesquite and sand sage shrubland, short and mixed grass prairie, herbaceous vegetation, and areas of urban high and low intensity. Vegetation impacts would include clearing areas for construction of approximately two new pipelines for reclaimed water transmission and wastewater disposal.

Areas of 100-year floodplain (Zone A) and special flood hazard areas (without a base flood elevation Zone AE) are located in areas along the Yellow House River northwest of the Northwest Water Reclamation Plant, and along Blackwater Creek and Bluefield Street, east of North Avenue P, and along North Guava Avenue, north of East Regis Street, and along the Yellow House River (also referred to as the North Fork Double Mountain Fork Brazos River), south of the Dunbar Lake Dam, near the Lubbock Wastewater Treatment facility, with the areas of the proposed pipelines. [167] Portions of the pipeline could be located within these floodplains. Several freshwater emergent wetlands or ponds were identified on the NWI maps adjacent to and within the potential pipeline routes. An NWP or coordination with the USACE may be required for impacts to waters of the U.S. One TCEQ surface water segment, the North Fork Double Mountain Fork Brazos River (Segment ID 1241A) was identified within the proposed project area, located immediately north of the Lubbock Wastewater Treatment facility. Segment ID 1241A is considered impaired for as noted on the and TCEQ Surface Water Quality Viewer[168].

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (P196-515), and the Archeological and Historic Preservation Act (PL93-291). The owner of the project would be required to comply with the antiquities code. Based on the review of available GIS datasets, the City of Lubbock Cemetery and 1 historical marker (12680) were identified in the datasets within a one-mile buffer of the proposed project area. No state historic sites or National Register of Historic Places-listed sites were located within a one-mile buffer of the proposed project area. A review of archeological resources in the proposed project area should be conducted during project planning.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies and projects requiring federal approvals, are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Lubbock County are shown in Appendix D under Lubbock County, Texas.

According to the IPaC website maintained by USFWS, several birds, including the Bald Eagle and Golden Eagle, could be a migrant through the project area, but no adverse impacts to the migratory

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[166] TPWD. 2025. Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

[167] FEMA. 2025. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online: https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd

February 21, 2025.

[168] TCEQ. 2024. Surface Water Quality Viewer. Accessed online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed February 21, 2025.

birds would be expected.[169] Two birds, the piping plove and rufa red knot, listed as threatened species, could occur in the project area; however, they only need to be considered for wind energy projects. Two fishes, the sharpnose shiner and the smalleye shiner, federal species, could potentially occur in the project area. These fish species need to be considered for all reservoir projects; in-channel projects such as interbasin transfers, water diversions, small impoundments, etc. that may reduce flows of major tributaties eventually flowing into occupied habitat. One insect, the monarch butterfly, a proposed threatened species, could potentially occur in the project area; however, this species is not currently listed. There are no critical habitats in the project area. TPWD's TXNDD documents the occurrences of rare species in Texas. Occurrences of the Texas horned lizard, state listed as threatened, is documented within the project area. No other documented occurrences of threatened, endangered or rare species or natural communities were reported within 5 miles of the project area.

A biological survey of the project area should be conducted to determine whether populations of threatened or endangered species, or potential habitats used by listed species occur in the area to be affected, if this strategy is selected. A determination on whether any impacts or effects to listed species may occur would then be made. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

The installation of wells and collection pipelines should be planned and installed so that sensitive habitats, cultural resources, and other sensitive areas are avoided.

Summary

Since the advanced treatment facilities are being constructed on property owned by Lubbock that is currently being used for similar purposes, environmental issues should be minimal. The transmission line corridor that will convey the reclaimed water should be selected to avoid potentially sensitive areas.

5.13.3.2 Permitting Issues

The drinking water produced for the project will meet or exceed all state and federal drinking water standards. The TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. TCEQ will require a pilot study prior to regulatory approval and for determining design values for the treatment technologies. Treatment requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, results of effluent quality sampling/monitoring data, and wastewater treatment process.

Disposal of residuals from the project would meet all state and federal requirements for discharge of waste. A TPDES permit will be required to discharge RO concentrate. The water quality for RO concentrate discharged into the NFDMF of the Brazos River will meet or exceed the stream standards for that segment[170].

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[169] USFWS. 2025. Information for Planning and Consultation. Accessed online https://ecos.fws.gov/ipac/location/2CDHNRFRWZBEFN2BCFV527IIXM/resources November 13, 2024.

[170] City of Lubbock, "Potable Water Reuse Implementation Feasibility Study". March 2017. 7-9.

Stream crossings, if any, may be subject to Section 404 of the Clean Water Act. Due to the minimal and temporary impacts associated with the pipeline installation, it is likely that most of the proposed project would be authorized by Nationwide Permit 58. Cultural resource surveys requiring a Texas Antiquities Permit will likely be required, but extensive archeological testing should be avoided or mitigated through route selection.

Monitoring is likely to include Cryptosporidium (or a surrogate organism), other regulated contaminants, and may include contaminants on the U.S. Environmental Protection Agency (USEPA) Candidate Contaminate List (CCL), including Emerging Constituents of Concern (ECCs) and pharmaceuticals and personal care products (PPCPs).

5.13.3.3 Other Issues

Due to the nature of the project, a public outreach plan will be essential for successful implementation of the proposed reuse project.

Advanced treatment design considerations should include:

- multiple process barriers;
- redundancy and backup power sources;
- alternate storage or discharge locations to divert reclaimed water from the potable distribution system during an acute episode; and
- real time monitoring and regular sampling to ensure process performance and avoid any acute episode of pathogens in the reclaimed water.

5.14 Direct Potable Reuse from Northwest Water Reclamation Plant to Pump Station 9

The Direct Potable Reuse (DPR) from Northwest Water Reclamation Plant (NWWRP) to Pump Station (PS) 9 project is included in the 2024 Lubbock Strategic Water Supply plan. This strategy includes treating 6 mgd of reclaimed water from the NWWRP at an adjacent ATP for advanced treatment with multiple barriers before transporting and discharging into the potable water line from the Bailey County Well Field near Pump Station 9. The project purifies reclaimed water from the NWWRP through advanced treatment (RO, ultrafiltration, granular activated carbon [GAC] contactor and UV disinfection and AOP). This advanced treatment process is more robust than the other DPR options since it is not blended and retreated through other water treatment plants but introduced directly into the distribution system after advanced treatment.

The major design features of this strategy include:

- A 6 mgd ATP at the Lubbock NWWRP;
- A new 82 hp pump station at the NWWRP to deliver the treated reclaimed water to the ATP via a new 20-in, ½ mile transmission pipeline; and
- 1.2 mgd of RO concentrate will be discharged through the existing NWWRP effluent pipeline and discharged at the NWWRP outfall.

Figure 5-14 depicts the relative locations of the infrastructure needed for the Direct Potable Reuse from the NWWRP to PS9.

5.14.1 Quantity of Available Water

This strategy is designed to treat and deliver an average of 6 mgd (6,720 ac-ft/yr) to the ATP; however, the efficiency of the RO is assumed 80 percent resulting in 1.2 mgd of reject and 4.8 mgd of treated reclaimed water to PS9 each year.

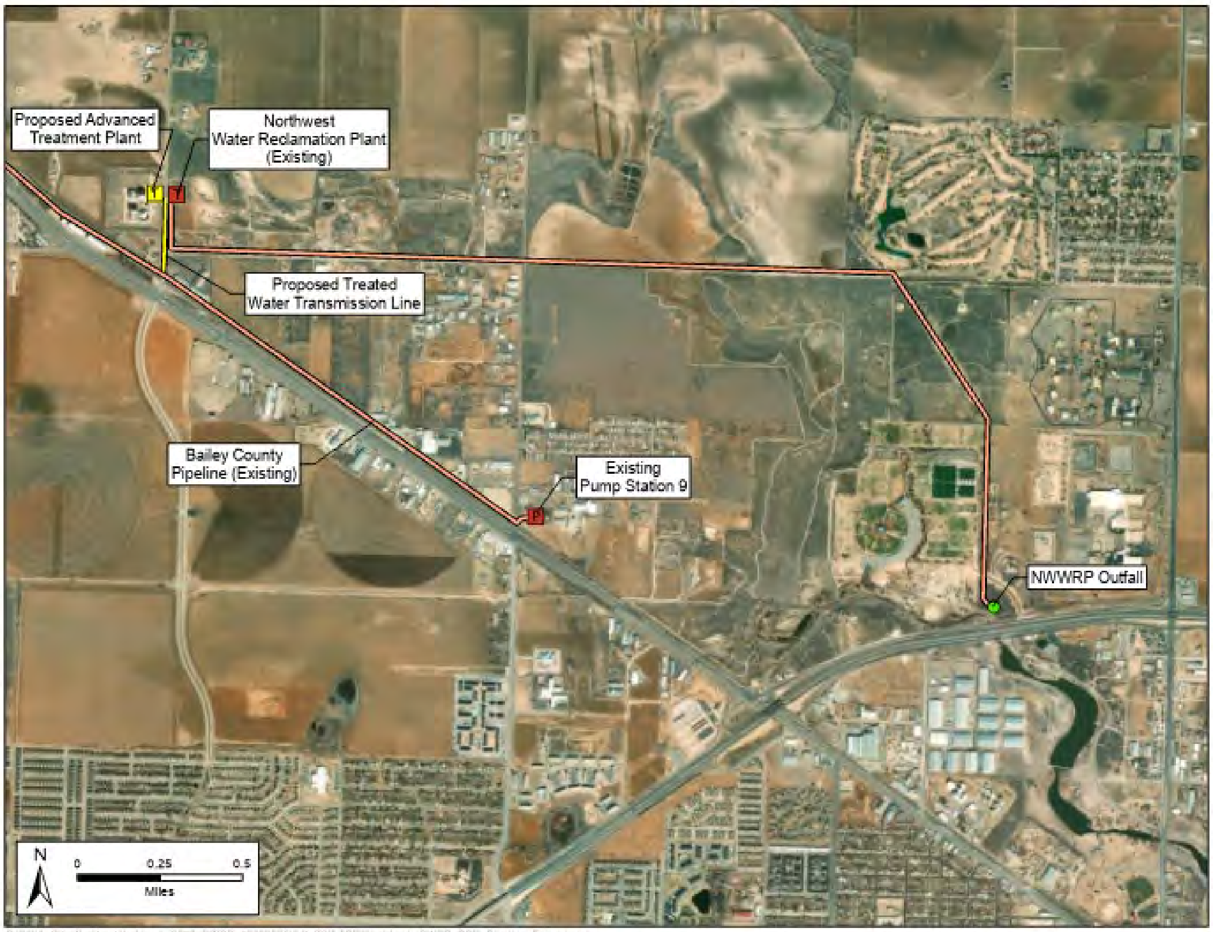

Figure 5-14. DPR from NWWRP to PS9

5.14.2 Strategy Costs

As shown, the total cost is estimated to be $103,992,000. Annual debt service is $7,316,000; and, annual operational cost, including power, is $2,816,000. This results in a total annual cost of $10,132,000. Before debt service, the unit cost for 5,376 ac-ft/yr of supply at PS9 is estimated to be $1,885 per ac-ft, or $5.78 per 1,000 gallons. After debt service, the unit cost of water is $524 per ac-ft, or $1.61 per 1,000 gallons. This cost does not include the distribution of the potable water from the PS9 to potential customers.

Table 5-14. Cost Estimate Summary for DPR from NWWRP to PS9 (September 2023 Dollars)

Item	Estimated Costs for Facilities
Intake Pump Stations (6 mgd)	$1,294,000
Transmission Pipeline (20 in dia., 0.5 miles)	$701,000
Water Treatment Plant (6 mgd)	$72,568,000
Integration, Relocations, Backup Generator & Other	$19,000
TOTAL COST OF FACILITIES	**$74,582,000**
Engineering:	
- Planning (3%)	$2,237,000
- Design (7%)	$5,219,000
- Construction Engineering (1%)	$746,000
Legal Assistance (2%)	$1,491,000
Fiscal Services (2%)	$1,491,000
Pipeline Contingency (15%)	$104,000
All Other Facilities Contingency (20%)	$14,774,000
Environmental & Archaeology Studies and Mitigation	$38,000
Land Acquisition and Surveying (9 acres)	$37,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$3,273,000
TOTAL COST OF PROJECT	**$103,992,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$7,316,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$7,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$32,000
Water Treatment Plant	$2,218,000
Pumping Energy Costs (0.09 $/kW-hr)	$559,000
TOTAL ANNUAL COST	**$10,132,000**
Available Project Yield (ac-ft/yr)	5,376
Annual Cost of Water ($ per ac-ft), based on PF=1.2	$1,885
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.2	$524
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.2	$5.78
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.2	$1.61

ac-ft = acre-feet; ac-ft/yr = acre-feet per year; mgd = million gallons per day; in = inch; dia. = diameter; ROI = return on investment; kW-hr = kilowatt-hours

5.14.3 Implementation Issues

5.14.3.1 Environmental Issues

The proposed project occurs within the High Plains physiographic regions of Texas and is within the Kansan biotic province.[171] The project components are within an area defined as mesquite shrub and crops vegetation types.[172] The mesquite shrub vegetation type is found on the High Plains, Rolling Plains, and northwestern Edwards Plateau. Commonly associated plants include narrow-leaf yucca, tasajillo (*Opuntia leptocaulis*), juniper, cholla, blue grama, hairy grama, purple three-awn (Aristida purpurea), buffalograss (*Bouteloua dactyloides*), sandlily (*Leucocrinum montanum*), sandsage, and wild buckwheat, among others. Crops include a variety of cultivated row or cover

[171] Blair, W.F. 1950. “The Biotic Provinces of Texas, “Tex. J. Sci. 2:93-117.

[172] McMahan, C.A., R.G. Frye, and K.L. Brown. 1984. “The Vegetation Types of Texas.” Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ October 21, 2024.

crops. EMST data and TPWD's more detailed and recently produced vegetation data[173], identify several different habitat types within the proposed including playa grassland, mesquite and sand sage shrubland, short and mixed grass prairie, herbaceous vegetation, and areas of urban high and low intensity. Vegetation impacts would include clearing areas for construction of approximately 2 new pipelines for reclaimed water transmission and wastewater disposal.

Areas of 100-year floodplain (Zone A) are located immediately northwest of Highway 84 in areas along the Yellow House River north of CR 6300 within the areas of the existing pipelines. Areas of 100-year floodplain (Zone A) and special flood hazard areas (without a base flood elevation Zone AE) are located in areas along the Yellow House River immediately north of N Loop 289 within the areas of the proposed pipeline. [174] Portions of the pipelines could be located within these floodplains. Several freshwater emergent wetlands or ponds were identified on the NWI maps adjacent to and potentially within the potential pipeline routes. An NWP or coordination with the USACE may be required for impacts to waters of the U.S. No TCEQ surface water segments were identified, and no surface water quality concerns were noted on the TCEQ Surface Water Quality Viewer[175] within the proposed project area. The nearest TCEQ surface water segment, North Fork Double Mountain Fork Brazos River (Segment ID 1241A) is located approximately 3.2 miles to the southeast.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (P196-515), and the Archeological and Historic Preservation Act (PL93-291). The owner of the project would be required to comply with the antiquities code. Based on the review of available GIS datasets, a museum, the Lubbock Lake Landmark, (12680) were identified in the datasets within a one-mile buffer of the proposed project area, located immediately north of the intersection of N Loop 289 and Clovis Road (Highway 84). The Lubbock Lake Landmark is a National Historic Landmark and a State Archeological Landmark. No state other historic sites or National Register of Historic Places-listed sites were located within a one-mile buffer of the proposed project area. A review of archeological resources in the proposed project area should be conducted during project planning.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies and projects requiring federal approvals, are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Lubbock County are shown in Appendix D under Lubbock County, Texas.

According to the IPaC website maintained by USFWS, several birds, including the Bald Eagle and Golden Eagle, could be a migrant through the project area, but no adverse impacts to the migratory

[173] TPWD. 2025. Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

[174] FEMA. 2025. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online

https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd February 21, 2025.

[175] TCEQ. 2025. Surface Water Quality Viewer. Accessed online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778

February 21, 2025.

birds would be expected.[176] There are no critical habitats in the project area. TPWD's TXNDD documents the occurrences of rare species in Texas. Occurrences of the Texas horned lizard, state listed as threatened, is documented within the project area. No other documented occurrences of threatened, endangered or rare species or natural communities were reported within 5 miles of the project area.

A biological survey of the project area should be conducted to determine whether populations of threatened or endangered species, or potential habitats used by listed species occur in the area to be affected, if this strategy is selected. A determination on whether any impacts or effects to listed species may occur would then be made. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

The installation of wells and collection pipelines should be planned and installed so that sensitive habitats, cultural resources, and other sensitive areas are avoided.

Summary

Since the advanced treatment facilities are being constructed on property owned by Lubbock that is currently being used for similar purposes, environmental issues should be minimal. The transmission line corridor that will convey the reclaimed water should be selected to avoid potentially sensitive areas.

5.14.3.2 Permitting Issues

The drinking water produced for the project will meet or exceed all state and federal drinking water standards. The TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. TCEQ will require a pilot study prior to regulatory approval and for determining design values for the treatment technologies. Treatment requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, results of effluent quality sampling/monitoring data, and wastewater treatment process.

Disposal of residuals from the project would meet all state and federal requirements for discharge of waste. A TPDES permit will be required to discharge RO concentrate. The water quality for RO concentrate discharged into the NFDMF of the Brazos River will meet or exceed the stream standards for that segment.[177]

Stream crossings, if any, may be subject to Section 404 of the Clean Water Act depending on flow conditions and construction methods. Due to the minimal and temporary impacts associated with the pipeline installation, it is likely that most of the proposed project would be authorized by Nationwide Permit 58. Cultural resource surveys requiring a Texas Antiquities Permit will likely be required, but extensive archeological testing should be avoided or mitigated through route selection.

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[176] USFWS. 2025. Information for Planning and Consultation. Accessed online https://ecos.fws.gov/ipac/location/2CDHNRFRWZBEFN2BCFV527IIXM/resources

February 21, 2025.

[177] City of Lubbock, "Potable Water Reuse Implementation Feasibility Study". March 2017. 7-9.

Monitoring is likely to include Cryptosporidium (or a surrogate organism), other regulated contaminants, and may include contaminants on the USEPA CCL, including ECCs and PPCPs.

5.14.3.3 Other Issues

Due to the nature of the project, a public outreach plan will be essential for successful implementation of the proposed reuse project.

Advanced treatment design considerations should include:

- multiple process barriers;
- redundancy and backup power sources;
- alternate storage or discharge locations to divert reclaimed water from the potable distribution system during an acute episode; and
- real-time monitoring and regular sampling to ensure process performance and avoid any acute episode of pathogens in the reclaimed water.

5.15 Lubbock Land Application Site Groundwater Potable Reuse

The Lubbock Land Application Site (LLAS) Groundwater Potable Reuse project is included in the 2024 Lubbock Strategic Water Supply plan. The City of Lubbock currently land applies reclaimed water from Plant 3 of the SEWRP at the LLAS. Lubbock has constructed a number of groundwater wells in the LLAS as part of a nitrate mitigation project associated with the SEWRP TPDES permit. Currently, the City withdraws approximately 2 mgd of groundwater from the LLAS and discharges it into the Jim Bertram Lake System (JBLS). Rather than discharging this supply into the JBLS, this strategy will deliver 2 mgd of groundwater from an existing storage tank to an ATP for treatment prior to blending with other raw water sources at the NWTP. Raw water supplies at the NWTP will be blended with the treated groundwater at a ratio of 10:1 to provide an adequate total dissolved solids (TDS) concentration.

The major design features of this strategy include:

- Expand existing pump station to deliver the reclaimed water from the existing ground storage tank to the advanced water treatment facility;
- A new 16-in, 7.2 mile pipeline to deliver the recovered water to the NWTP; and
- A 2 mgd ATP at the NWTP.

Figure 5-15 depicts the relative locations of the Lubbock Land Application Groundwater Potable Reuse and associated infrastructure.

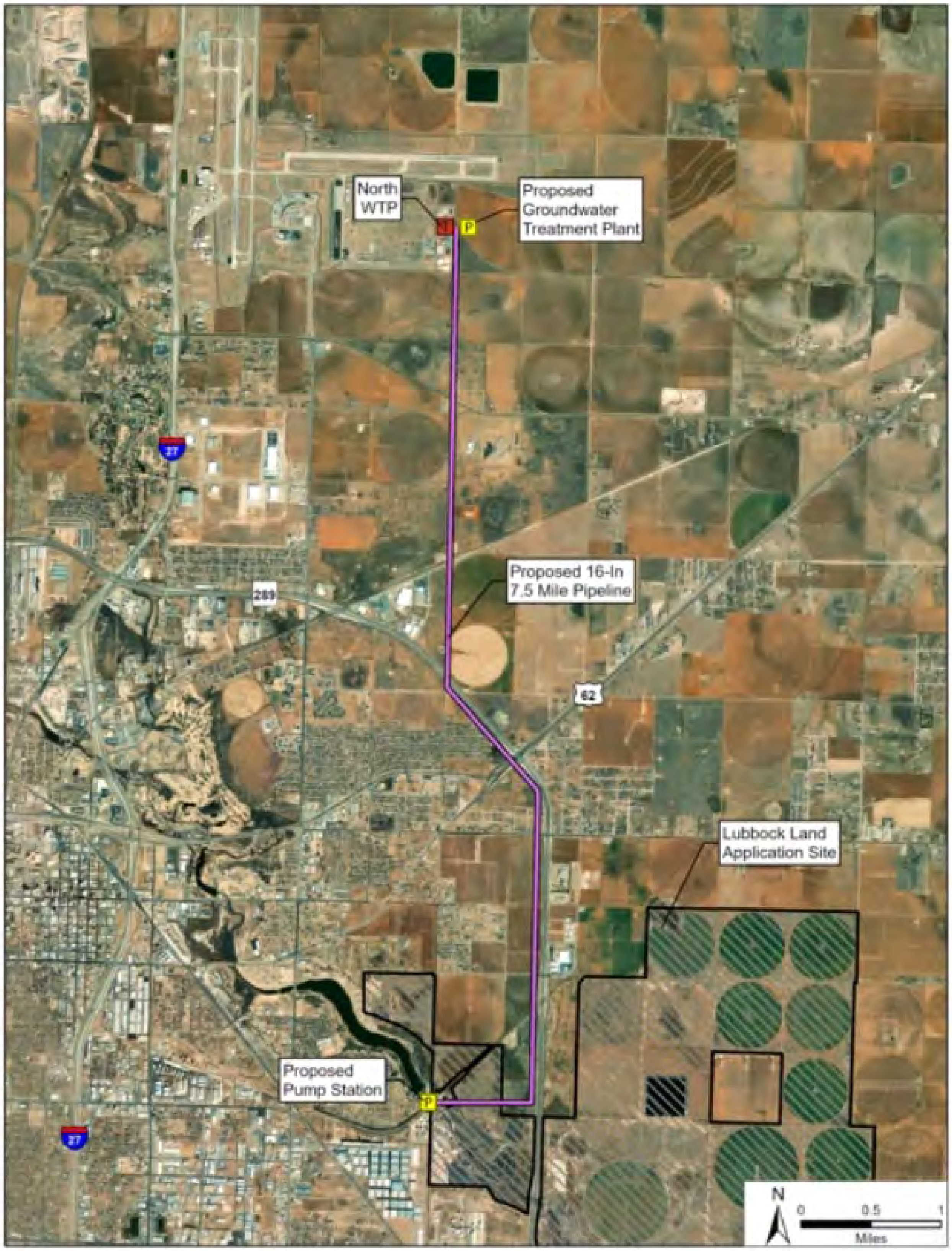

Figure 5-15. Land Application Groundwater Potable Reuse Infrastructure

5.15.1 Quantity of Available Water

This groundwater reuse strategy assumes that up to 2 mgd of reclaimed water will be sent to the NWTP.

5.15.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-15. Assumptions and conditions associated with these costs include:

- The costs are based on information provided by Alan Plummer Associates, Inc. (APAI);
- Engineering, legal, and contingency costs is 30 percent of pipelines and 35 percent for other facilities;
- Power is available at $0.09 per kwh;
- Interest during construction is 3.5 percent, and a 0.5 percent return on investments;
- The project will be financed for 20-years at a 3.5 percent interest rate; and
- The project is assumed to have a 1-year construction period.

Table 5-15. LLAS Groundwater Reuse Costs (September 2023 Dollars)[1]

Item	Estimated Costs for Facilities
Pump Station Expansion (2 mgd)	$1,636,000
Transmission Pipeline (16 in dia., 7.5 miles)	$16,468,000
Advanced Groundwater Treatment Plant (2 mgd)	$6,255,000
Integration, Relocations, Backup Generator & Other	$42,000
TOTAL COST OF FACILITIES	**$24,401,000**
Engineering:	
- Planning (3%)	$731,000
- Design (7%)	$1,705,000
- Construction Engineering (1%)	$244,000
Legal Assistance (2%)	$487,000
Fiscal Services (2%)	$487,000
Pipeline Contingency (15%)	$2,470,000
All Other Facilities Contingency (20%)	$1,578,000
Environmental & Archaeology Studies and Mitigation	$235,000
Land Acquisition and Surveying (50 acres)	$175,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,056,000
TOTAL COST OF PROJECT	**$33,569,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,359,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$165,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$41,000
Water Treatment Plant	$447,000
Pumping Energy Costs (0.09 $/kW-hr)	$40,000
TOTAL ANNUAL COST	**$3,052,000**
Available Project Yield (ac-ft/yr)	2,240
Annual Cost of Water ($ per ac-ft), based on PF=1	$1,363
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$309
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$4.18
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.95

Note: Costs based on 11/13/17 Land Application Groundwater Potable Reuse Evaluation.
ac-ft = acre-feet; ac-ft/yr = acre-feet per year; mgd = million gallons per day; in = inch; dia. = diameter; ROI = return on investment; kW-hr = kilowatt-hours

As shown, the total cost is estimated to be $33,569,000. Annual debt service is $2,359,000; and, annual operational cost, including power, is $693,000. This results in a total annual cost of $3,052,000. During the debt service period, the unit cost for 2,240 ac-ft/yr of supply at the SWTP is estimated to be $1,363 per ac-ft, or $4.18 per 1,000 gallons. After debt service, the unit cost of water is estimated to be $309 ac-ft, or $0.95 per 1,000 gallons. This cost does not include the distribution of the potable water from the NWTP to potential customers.

5.15.3 Implementation Issues

5.15.3.1 Environmental Issues

Since the advanced treatment facilities are being constructed on property owned by Lubbock that is currently being used for similar purposes, environmental issues should be minimal. The transmission line corridor that will convey the reclaimed water should be selected to avoid potentially sensitive areas.

5.15.3.2 Permitting Issues

The water produced for the project will meet or exceed all state and federal drinking water standards. The TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. TCEQ will require a pilot study prior to regulatory approval and for determining design values for the treatment technologies. Treatment requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, results of effluent quality sampling/monitoring data, and wastewater treatment process.

Stream crossings may be subject to Section 404 of the Clean Water Act depending on flow conditions and construction methods. Due to the minimal and temporary impacts associated with the pipeline installation, it is likely that any such crossings would be authorized by Nationwide Permit 58. Cultural resource surveys requiring a Texas Antiquities Permit will likely be required, but extensive archeological testing should be avoided or mitigated through route selection.

Monitoring is likely to include Cryptosporidium (or a surrogate organism), other regulated contaminants, and may include contaminants on the USEPA CCL, including ECCs and PPCPs.

5.15.3.3 Other Issues

Due to the nature of the project, a public outreach plan will be essential for successful implementation of the proposed reuse project.

Advanced treatment design considerations should include:

- multiple process barriers;
- redundancy and backup power sources;
- alternate storage or discharge locations to divert reclaimed water from the potable distribution system during an acute episode; and
- real-time monitoring and regular sampling to ensure process performance and avoid any acute episode of pathogens in the reclaimed water.

B. Potentially Feasible Water Management Strategies: Groundwater

5.16 Groundwater Sources

The principal aquifer in the Llano Estacado Region is the Edwards-Trinity High Plains (ETHP) Aquifer[178]. The Ogallala Aquifer, part of the High Plains Aquifer, consists of the saturated section of the Ogallala Formation, as well as those underlying and overlying geologic units that are in hydraulic continuity. The Seymour Aquifer is a major aquifer in the region, although it does not provide much supply for the Llano Estacado Region. The Dockum Aquifer and Blaine Aquifer, considered minor aquifers by the state, are also located in the Llano Estacado Region. Chapter 1 discusses the groundwater sources of the Llano Estacado Region in further detail.

To address House Bill 807 (HB 807) requirements codified in TWC §16.053(e)(10) and related to the specific assessment of aquifer storage and recovery (ASR) potential if significant identified needs exist, the LERWPG assessed the feasibility of ASR projects. As part of the established TWDB planning process, existing demands and supplies and the resulting needs are calculated. The threshold of significant water needs and the potential for an ASR project to meet those needs was determined as any non-irrigation WUG that exhibited needs in the region. Because most, if not all, of the region exhibits suitable geology at least near a documented water need, the next step included identifying sponsors for ASR projects. Several ASR WMS are documented in this section.

5.17 Brackish Supplemental Water Supply for Bailey County Well Field

The Bailey County Well Field (BCWF) produces water from the Ogallala Aquifer for the City of Lubbock. The well field's well capacity has decreased sharply the last few years because the City of Lubbock has needed to produce more from the BCWF than desired in order to compensate for a reduction in supply originating through the CRMWA system. In 2010, the BCWF's production capacity was 50 mgd. By 2017, the well field's production capacity had dropped to approximately 30 mgd. The transmission line from the BCWF to the City of Lubbock's distribution system can deliver a peak flow of 40 mgd.

The City of Lubbock has two goals for the BCWF. The first goal is to maintain the 2017 BCWF capacity of 30 mgd. The City of Lubbock's second goal is to reserve the BCWF for meeting peak demand during summer months. In order to effectively meet these goals, it is recommended that the City of Lubbock produce no more than 5,000 ac-ft/yr on a long-term average. The City of Lubbock plans to continually produce 2 mgd from the BCWF to keep the transmission line operational.

A potential WMS to either extend the life of the BCWF or increase its capacity is to develop brackish groundwater in the underlying Dockum Aquifer. In this part of the Panhandle of Texas, the Dockum Aquifer has not been explored as a water supply, partly because of the plentiful supply of fresh water from the shallow Ogallala Aquifer. The TWDB Regional Groundwater Availability Modeling Program completed the most comprehensive and recent data compilation and study. The Dockum

[178] McGuire, V.L., M.R. Johnson, R.L., Schieffer, J.S. Stanton, S.K. Sebree, and I.M. Verstraeten. 2003. Water in storage and approaches to ground-water management, High Plains Aquifer, 2000: U.S. Geological Survey Circular 1243, U.S. Department of the Interior, Reston, Virginia, 51p.

groundwater availability model (GAM)[179] was published in 2008. A follow-up GAM of the High Plains Aquifer System (HPAS)[180], [181] included the ETHP, Pecos Valley, Rita Blanca, and the Dockum aquifers. The most productive formation of Dockum is the Santa Rosa, which occurs at the base of the Lower Dockum. The bottom part of the Lower Dockum Aquifer is consider the target zone for Dockum water wells. Figure 5-16 shows the relative locations of the well field and the BCWF infrastructure. The Dockum Aquifer and Permian wells can overlap with the Ogallala Aquifer wells because they are in a separate formations.

For purposes of this WMS, selected aquifer features have been exported from the HPAS conceptual model report. The selected features are regional in scale and include the following.

- Base of the Ogallala Aquifer and Pecos River Alluvium Approximate, which is approximately the top of the Dockum Aquifer (Figure 5-17). Top of the Dockum Aquifer is in contact with the Ogallala approximated north of the center of Bailey County and up to 200 feet below in the southern part of our study area. The regional maps suggest that the top of the Dockum dips to the east-southeast at approximately 20 feet per mile (fpm).
- Base of the Upper Dockum Aquifer and top of Lower Dockum Aquifer (Figure 5-18). Across Bailey County, the regional data show that the contact between the Upper and Lower Dockum dips almost due south at approximately 10 fpm.
- Base of the Dockum Aquifer (Figure 5-19). The regional dip of the Dockum Aquifer is south-southeast at slightly more than 15 fpm.
- Thickness of Lower Dockum Aquifer (Figure 5-20). The total thickness tends to increase toward the south-southeast of the study area and is approximately 800 to 1,000 feet in Bailey County.
- Net sand thickness in the Lower Dockum Aquifer (Figure 5-21). In Bailey County, the cumulative thickness of sand layers ranges from approximately 150 to 250 feet.
- TDS in the Dockum Aquifer (Figure 5-22). Water quality characteristics are poorly defined. Most of the estimates are based on regional trends.

For regional water supply planning purposes, the following project estimates and facility features include the following.

- The target Dockum Aquifer well field is to be located a few miles west of the terminal ground storage and pump station for the BCWF. This location is near the pump station but removed from the tight cluster of Ogallala Aquifer wells in the BCWF.
- The water treatment plant is to be located near the BCWF ground storage and pump station.

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[179] INTERA. October 2008, Groundwater Availability Model for the Dockum Aquifer, prepared for the TWDB. http://www.twdb.texas.gov/groundwater/models/gam/dckm/DCKM_Model_Report.pdf?d=1551893029690

[180] INTERA. August 2015, Final Conceptual Model Report for the High Plains Aquifer System Groundwater Availability Model, Prepared for the TWDB; http://www.twdb.texas.gov/groundwater/models/gam/hpas/HPAS_GAM_Conceptual_Report.pdf?d=1551893212942

[181] INTERA. August 2015, Numerical Model Report for the High Plains Aquifer System Groundwater Availability Model, Prepared for the TWDB; http://www.twdb.texas.gov/groundwater/models/gam/hpas/HPAS_GAM_Numerical_Report.pdf?d=1551893583360

- Dockum Aquifer wells are to be designed to draw water from the Santa Rosa Formation, which is at the bottom of the Lower Dockum Aquifer. Estimated well yields are based on (1) estimated sand thickness maps and horizontal hydraulic conductivity values in the most recent GAM, (2) calculation of an estimated transmissivity of the Lower Dockum, (3) conversion of the transmissivity to a specific well capacity, and (4) assuming an allowable drawdown of 100 feet. The potential well capacity is calculated to be approximately 200 gallons per minute (gpm). Considering not all the sand layers across the entire thickness of the Lower Dockum would be screened, the estimated well yield for a Dockum well is 150 gpm. Wells are estimated to be 1,700 feet deep.
- Concentrate disposal wells are to tap into a formation in the Permian System. According to the Texas Railroad Commission online database, the nearest injection wells for oil and gas operations are in a field in east-central Cochran County and disposal wells are at depths of approximately 5,000 feet. Considering the dip of the Permian System, the wells may be slightly shallower in the vicinity of the Lubbock BCWF terminal. For purposes of this strategy, the estimated depth is 5,000 feet. Injection rates are estimated to be approximately 50 gpm.
- As stated earlier, the salinity of water from the Dockum Aquifer in Bailey County is poorly defined. Based on a regional TDS map in the Dockum GAM, the TDS concentration is estimated to be 10,000 milligrams per liter (mg/L).

The proposed Brackish Supplemental Water Supply for Bailey County Well Field strategy is sized to provide 2 mgd for continual use of the Bailey County pipeline. The Dockum Aquifer wells would be operated year round and produce approximately 2,240 ac-ft/yr of potable water, which is approximately 45 percent of the long-term 5,000 ac-ft/yr limitation. On a peaking day basis during summer high demands, 2 mgd is only a small portion of the 30-mgd target capacity or 40 mgd for full pipeline capacity. On a long-term basis, the Dockum Aquifer wells could provide the City of Lubbock with much greater short-term capacity from the BCWF during high summer demands and still stay within the 5,000 ac-ft/yr limitation.

Major design features and assumptions of this strategy include the following.

- Construct 15 150-gpm wells in the Santa Rosa Formation, which is within the Lower Dockum Aquifer;
- Install the Dockum wells at approximately 1,700 feet deep;
- Locate wells on properties where the City of Lubbock holds existing water rights;
- Use RO technology at the water treatment plant and operate at 75 percent efficiency;
- Produce water with a TDS concentration of approximately 450 mg/L that requires approximately 96 percent of the raw Dockum water to go through the RO process;
- Produce 2.0 mgd of product water, requiring approximately 2.64 mgd of raw water, and the concentrate discharge is approximately 0.33 mgd and has a TDS concentration of approximately 40,000 mg/L;
- Install an estimated five disposal wells discharging into the Permian Formation, assuming the injection rates are 100 gpm and that these wells would be approximately 5,000 feet deep;
- Install approximately 15 miles of 6- to 18-inch diameter well collection and transmission pipes;

- Size Dockum Aquifer well pumps to deliver the water to the water treatment plant;
- Discharge product water into an existing ground storage tank at the BCWF terminal; and
- Discharge concentrate into a ground storage tank and then pump to the disposal wells.

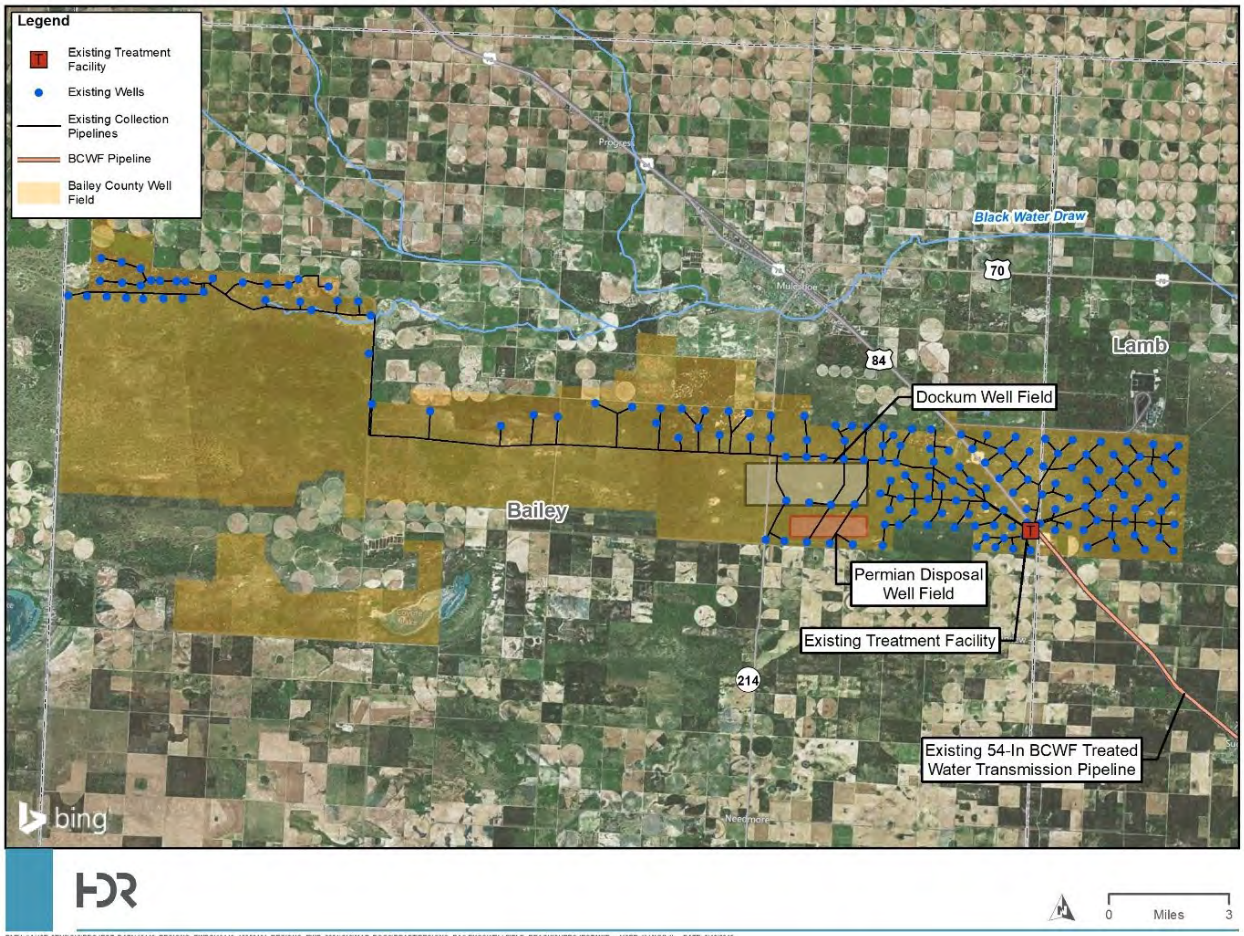


Figure 5-16. Area of Potential New Well Locations for BCWF Brackish Water Strategy

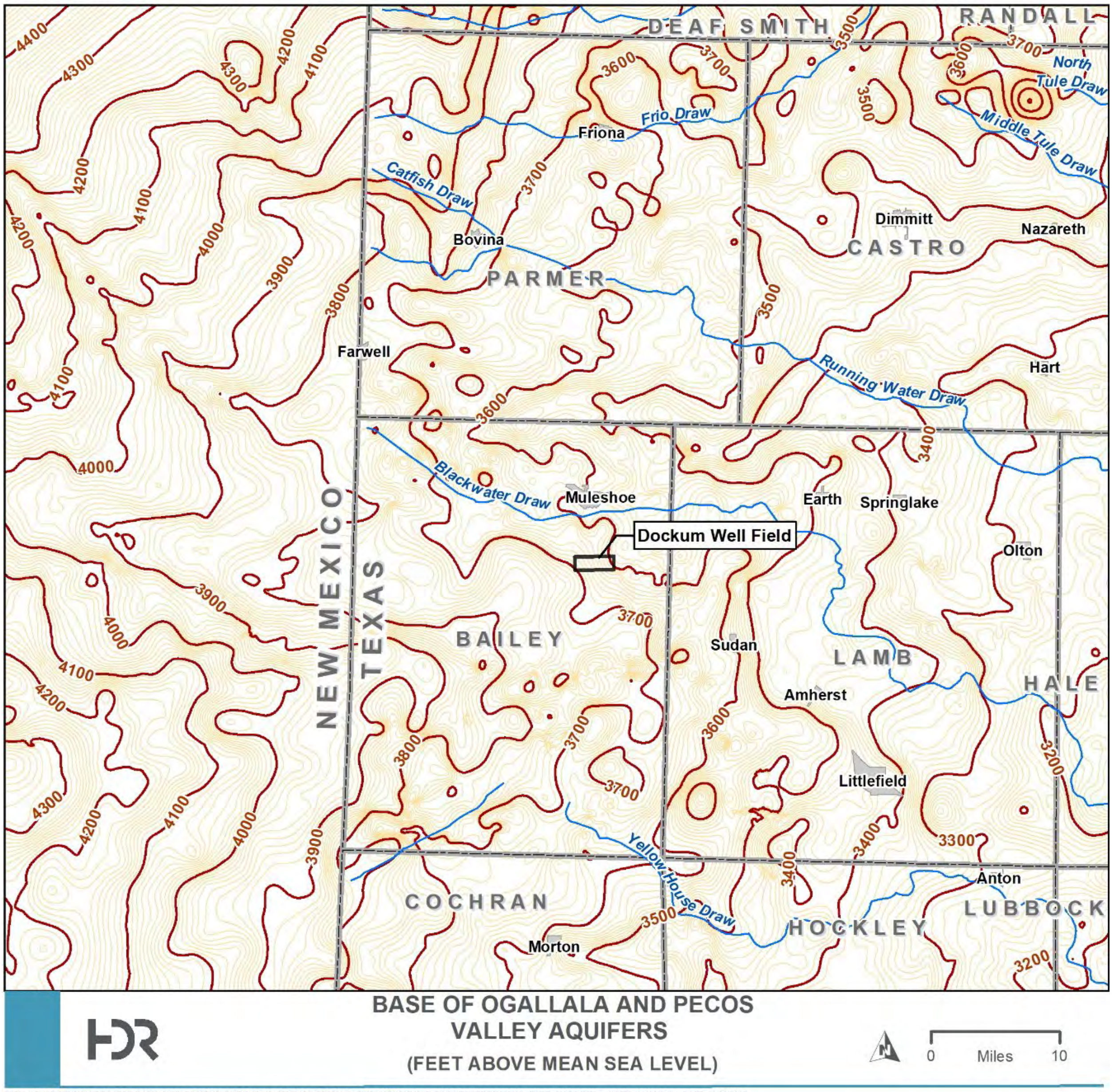


Figure 5-17. Base of the Ogallala Aquifer, which is approximate top of Dockum Aquifer in Project Area

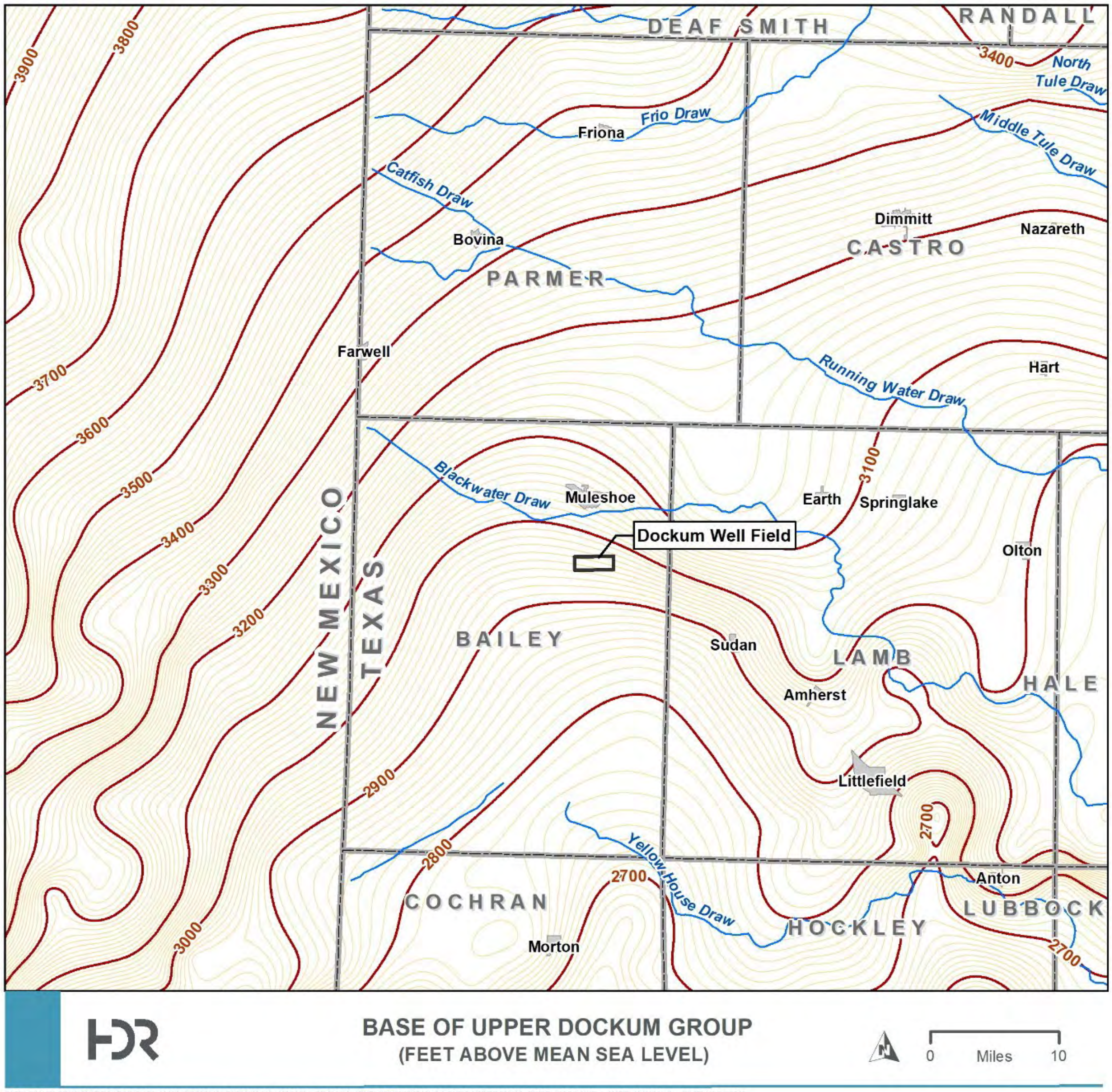
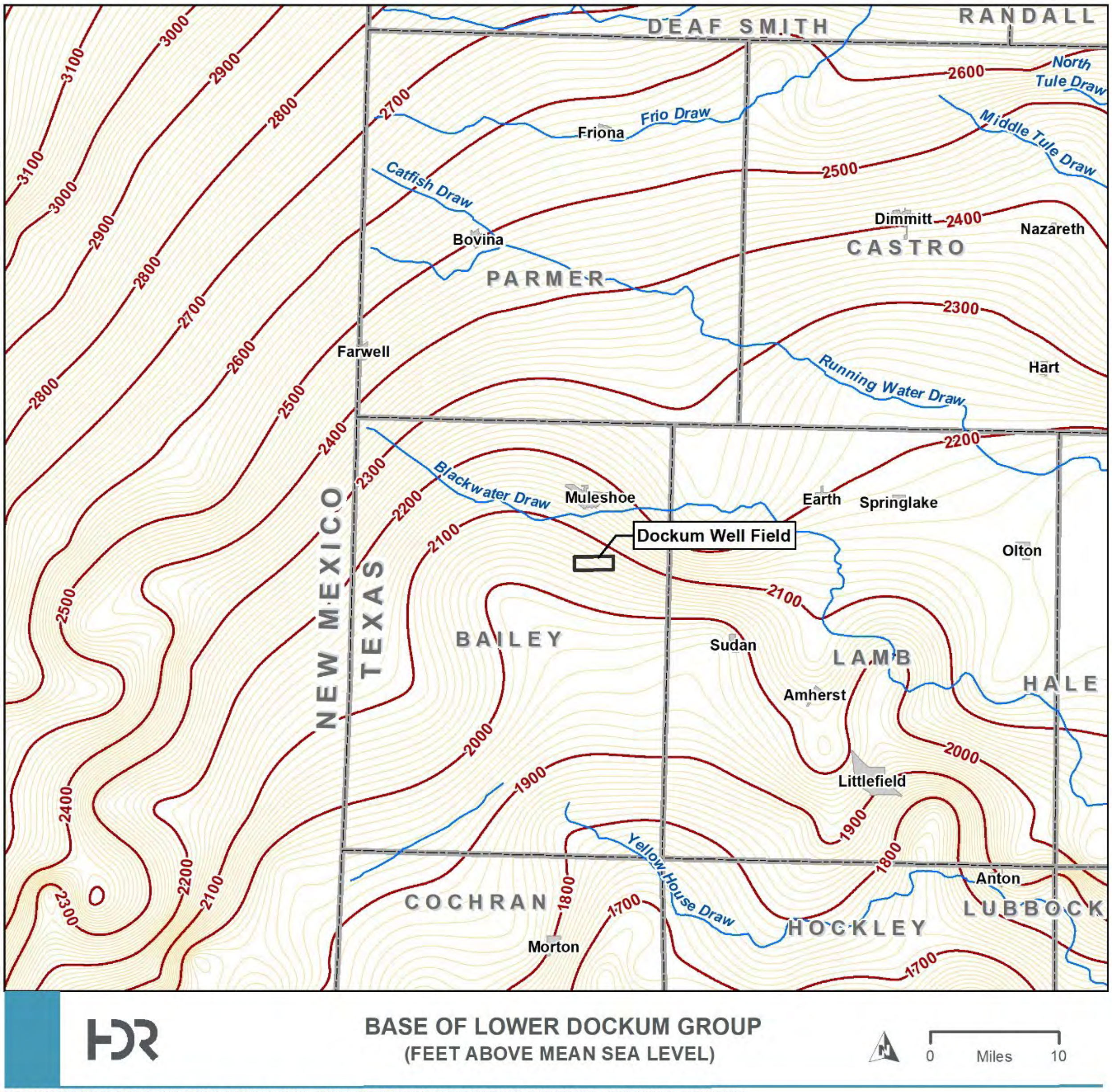


Figure 5-18. Base of the Upper Dockum Aquifer



PATH: \\AUSE-SRV2\GIS\PROJECT_DATA\18148_REGIONO_RWPG\18148_10050191_REGIONO_RWP_2021\GIS\MAP_DOCS\DRAFT\REGIONO_TWDB_MAPS.MXD - USER: KJAVVAJI - DATE: 10/22/2019

Figure 5-19. Base of the Dockum Aquifer

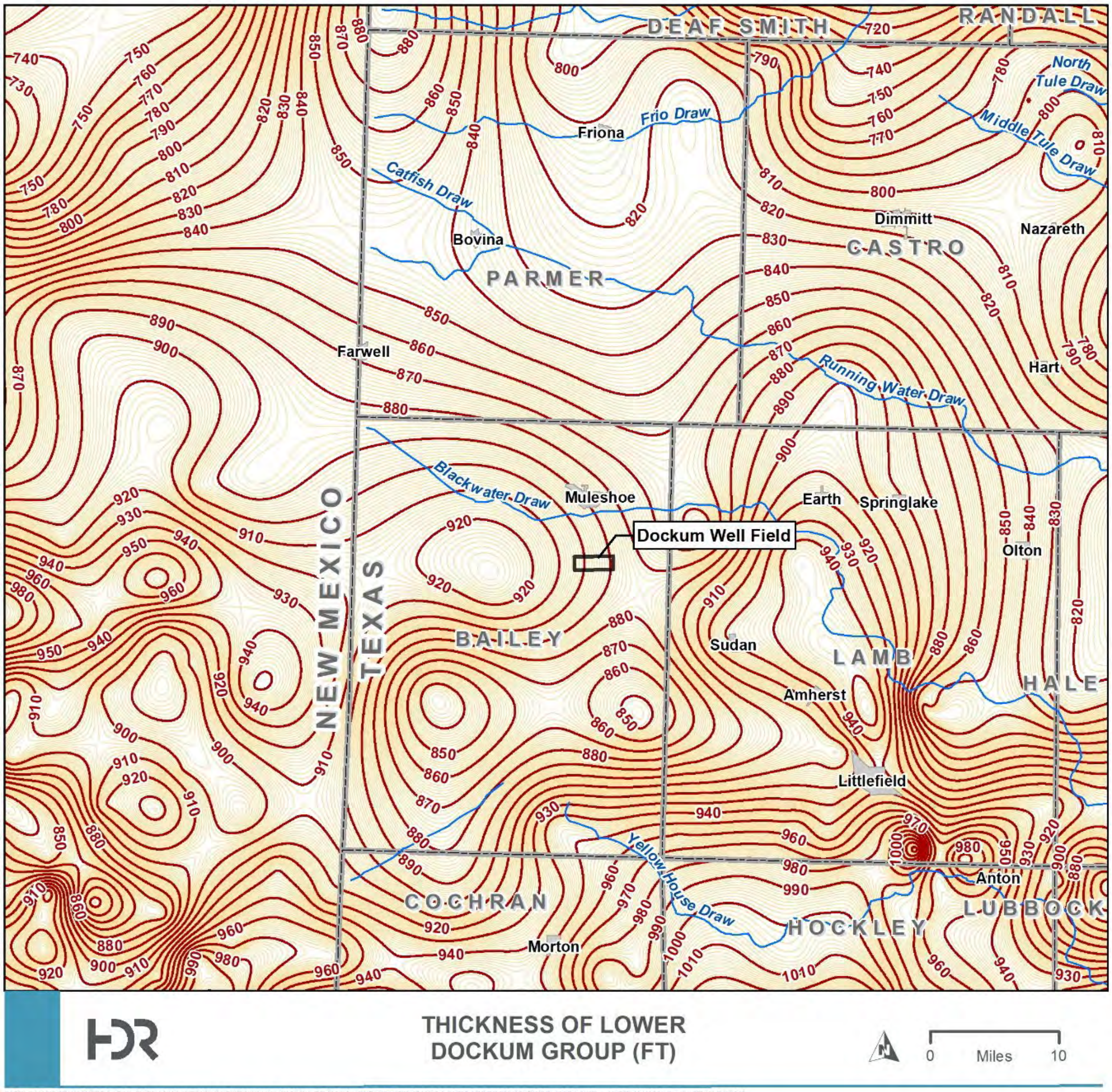


Figure 5-20. Thickness of Lower Dockum Aquifer

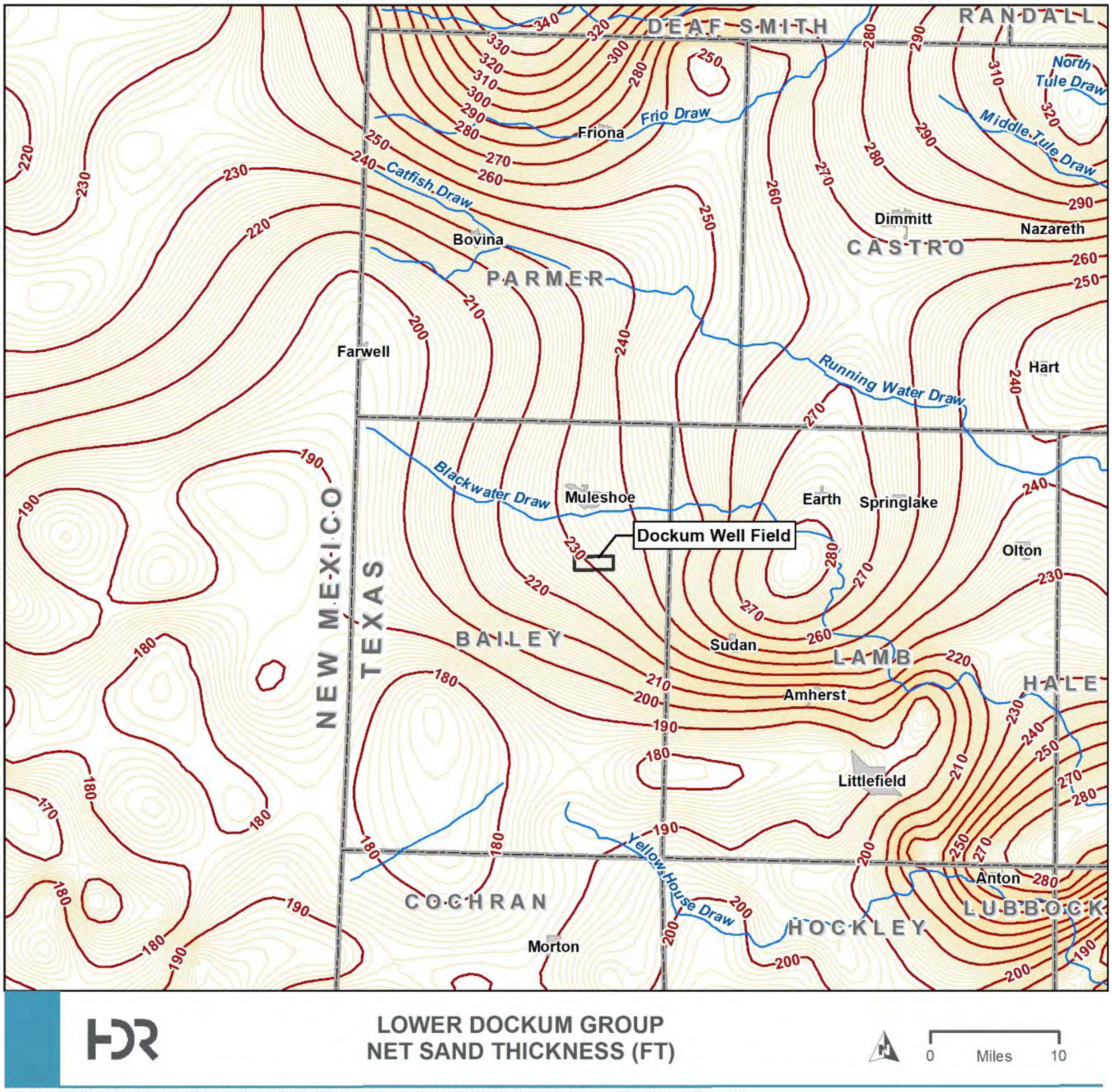


Figure 5-21. Net Sand Thickness of Lower Dockum Aquifer

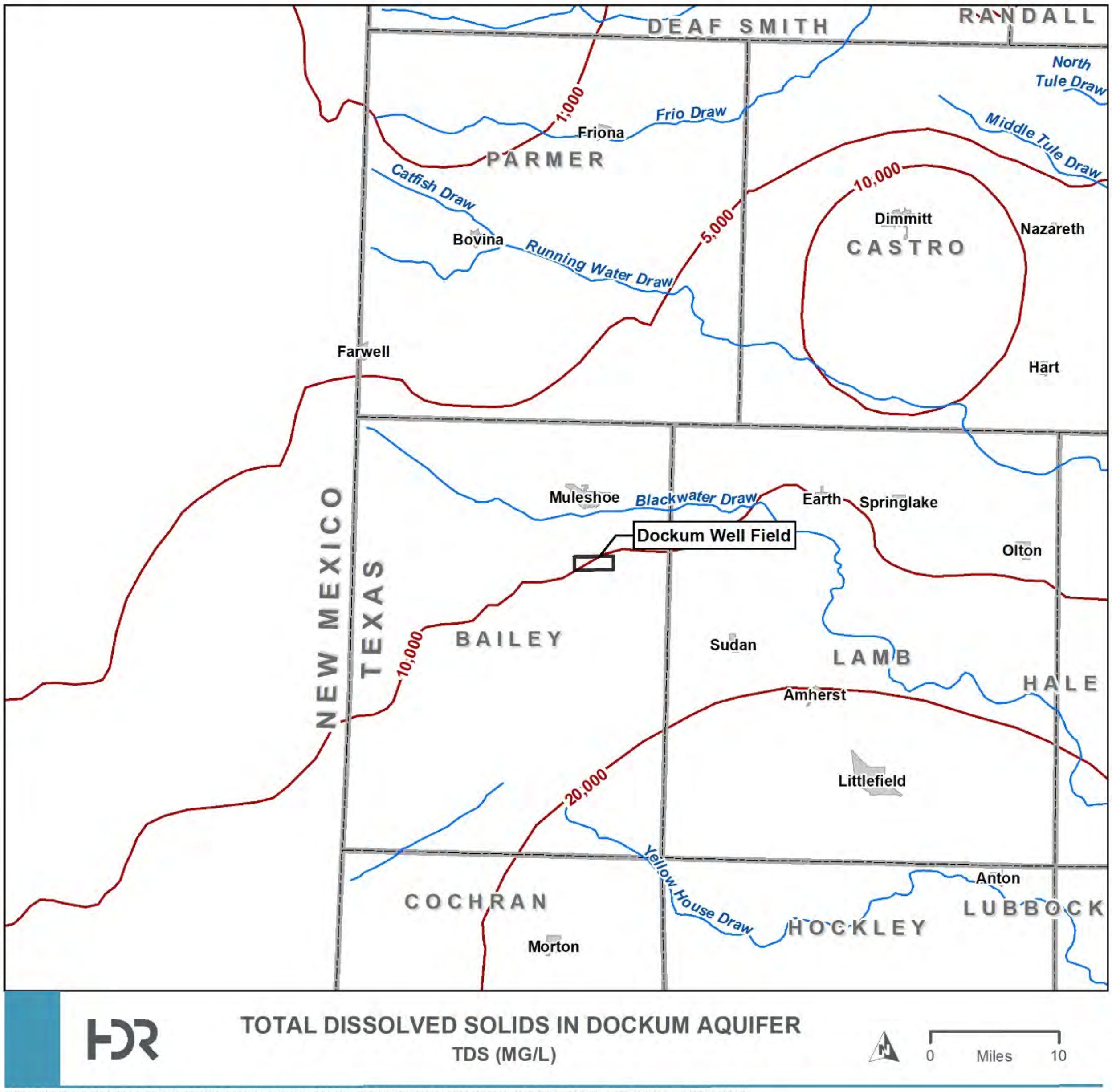


Figure 5-22. Approximate Salinity of Water in Dockum Aquifer

5.17.1 Quantity of Available Water

Brackish Supplemental Water Supply for Bailey County Well Field strategy is sized to provide a 2.0-mgd base load supply of water that is available year-round. It would replace the pumping of Ogallala Aquifer wells to maintain a target production during seasons of low demand and supplement Ogallala Aquifer water during seasons of high demand.

5.17.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-16. Assumptions and conditions associated with these costs include the following.

- Capital cost for wells and collector and transmission pipelines is calculated by the unified costing model that is used for strategies in the regional water plans;
- Engineering, legal, and contingency costs are 35 percent for facilities constructed for this strategy;
- A test drilling program into the Dockum Aquifer and Permian Formation is included;
- Power is available at $0.09 per kW-hr (kilowatt-hour);
- Interest during construction is estimated at 3.0 percent, and a 0.5 percent return on investments over a 1-year period; and
- The project would be financed for 20 years at a 3.5 percent annual interest rate.

As shown in Table 5-16, the total project costs for the 50-year plan are estimated at $35,253,000. Annual debt service is $3,653,000; and, annual operational cost, including power, is $2,476,000, resulting in a total annual cost of $6,129,000. The unit cost for the 2.00 mgd capacity and 2,240 ac-ft/yr supply is estimated to be $2,736 per ac-ft, or $8.40 per 1,000 gallons.

Table 5-16. BCWF Brackish Supplemental Water Supply Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Pump Station (0.35 mgd)	$815,000
Transmission Pipeline - WTP to Concentrate Disposal Well Field (6-in dia., 4 miles)	$804,000
Well Fields (Wells, Pumps, and Piping)	$23,799,000
Storage Tanks (Other Than at Booster Pump Stations)	$519,000
Water Treatment Plant (2.2 mgd)	$9,316,000
TOTAL COST OF FACILITIES	**$35,253,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$12,298,000
Environmental & Archaeology Studies and Mitigation (Includes Test Drilling Program)	$2,970,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$1,390,000
TOTAL COST OF PROJECT	**$51,911,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,653,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Facilities)	$251,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$20,000
Water Treatment Plant	$2,041,000
Pumping Energy Costs (0.08 $/kW-hr)	$164,000
TOTAL ANNUAL COST	**$6,129,000**
Available Project Yield (ac-ft/yr)	2,240
Annual Cost of Water ($ per ac-ft), based on PF=1	$2,736
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$1,105
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$8.40
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$3.39

Acronyms: WTP = water treatment plant; WF = well field; mgd = million gallons per day; ROI = return on investment; ac-ft/yr = acre-feet per year; kW-hr = kilowatt-hour; PF = peak factor

5.17.3 Implementation Issues

5.17.3.1 Environmental Issues

The proposed project occurs within the High Plains physiographic region of Texas and is within the Kansan biotic province[182]. According to the EMST, the project components are within an area defined as Sandsage-Havard Shin oak brush vegetation type[183]. The Sandsage-Havard Shin oak vegetation type is found on sandy soils of the northwestern High Plains and Rolling Plains ecological regions. Species, including skunkbush sumac, Chickasaw plum (*Prunus angustifolia*), indiangrass (*Sorghastrum sp.*), switchgrass (*Panicum virgatum*), sand lovegrass (*Eragrostis trichodes*), sideoats grama, scurfpea (*Psoralidium* sp.), and wild buckwheat (*Eriogonum sp.*), are commonly associated plants. EMST data and TPWD's more detailed and recently produced vegetation data[184], show primarily High Plains sandy deciduous shrubland and sand prairie. Vegetation impacts would include clearing small areas for construction of approximately 20 new wells (15 in the Dockum Well Field

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[182] Blair, W.F. 1950. "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117.

[183] McMahan, C.A., R.G. Frye, and K.L. Brown, 1984. The Vegetation Types of Texas. Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ February 21, 2025.

[184] TPWD. 2025. Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

and 5 in the Permian Well Field), and for the installation of approximately 15 miles of 6-inch to 16-inch diameter collection pipe in each capacity maintenance (CM) phase.

FEMA has not mapped the project area for 100-year floodplains.[185] No wetlands, rivers, streams, or surface water features were identified in the project area based on NWI, topographic maps, aerial photographs, or National Hydrography Data (NHD). Coordination with USACE would be required for construction within waters of the U.S. Impacts from this proposed project resulting in a loss of less than 0.5 acres of waters of the U.S. could be covered under NWP 58 for Utility Line Activities. The TCEQ Surface Water Quality Viewer[186] identifies no stream or reservoir segments within 5 miles of the proposed well field.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (P196-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets, there are no state historic sites, National Register of Historic Places-listed sites, historical markers, national register properties, national register districts, or cemeteries located within a one-mile buffer of the proposed project area.

A review of archeological resources in the proposed project area should be conducted during project planning. The owner or controller of the project would be required to coordinate with the Texas Historical Commission regarding impacts to cultural resources.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Bailey County are listed in Appendix D under Bailey County, Texas.

According to IPaC, provided by USFWS on February 21, 2025, the lesser prairie chicken, listed as endangered, that could potentially occur in the project area. The piping plover and the rufa red knot are federal species listed as threatened that could potentially be in the project area; however, these species only need to be considered if for wind energy projects. Two fishes, the sharpnose shiner and the smalleye shiner, federal species, could potentially occur in the project area. These fish species need to be considered for all reservoir projects; in-channel projects such as interbasin transfers, water diversions, small impoundments, etc. that may reduce flows of major tributaties eventually flowing into occupied habitat. The IPaC lists the monarch butterfly, proposed threatened species, as potentially occurring in the project area. There are no critical habitats for these or any other species within the project area. TPWD's TXNDD showed the occurrence of the western box turtle, state species listed as threatened, and the presence of two prairie dog towns, located within the project area. No other occurrences of threatened, endangered, candidate or SGCN-listed species were documented within one mile of the proposed project area.

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[185] FEMA. 2025. FEMA Flood Map Service Center: Search by Address. Accessed online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 February 21, 2025.

[186] TCEQ. 2025. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed February 21, 2025.

A biological survey of the project area, to determine whether populations of threatened or endangered species, or potential habitats used by listed species occur in the area to be affected, should be conducted if this strategy is selected. A determination on whether any impacts or effects to listed species may occur would then be made. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning. The installation of wells and collection pipelines should be planned and installed so that sensitive habitats, cultural resources, and other environmentally sensitive areas are avoided.

Summary

The project is proposed to help maintain the capacity of the BCWF and the existing water supply and is not anticipated to impact land use, density, or type of development beyond that already planned within the project area. Permanent land use impacts in the project area would be limited to the new wells and collector lines and the new water treatment plant and pump station at the well field. Disturbance to area land use would depend upon the type of construction used to install the pipelines (open cut, boring, etc.).

5.17.3.2 Permitting Issues

The City of Lubbock already owns groundwater rights on 83,305 acres of contiguous property and wells would be drilled within this area. The City of Lubbock would need to acquire permits from the High Plains Underground Conservation District No. 1 (HPWD), and TCEQ must approve the design and construction of public water supply wells, water transmission facilities, and disposal of concentrate.

5.17.3.3 Other

Wells would be placed on properties where the City of Lubbock owns the water rights, which includes the rights to surface improvements to extract and convey the groundwater. The City of Lubbock would need to negotiate work with surface owners to accommodate the surface operations and plans.

Before designing the Brackish Supplemental Water Supply for Baily County Well Field strategy, a test drilling program in the Dockum and Permian is needed to adjust the regional estimates to local conditions.

5.18 Bailey County Well Field Capacity Maintenance

The BCWF produces water from the Ogallala Aquifer for the City of Lubbock. Production capacity has decreased sharply since 2010 because the City of Lubbock has needed to produce more from the BCWF than desired in order to compensate for a reduction in supply originating through the CRMWA system. In 2010, the BCWF's production capacity was 50 mgd. By 2017, the well field's production capacity had dropped to approximately 30 mgd. The transmission line from the BCWF to the City of Lubbock's distribution system can deliver a peak flow of 40 mgd. To avoid pipeline failures due to aging pipeline materials, the City limits deliveries to less than 30 mgd.

The City of Lubbock has two goals for the BCWF. The first goal is to maintain the 2017 BCWF capacity of 30 mgd. The City of Lubbock's second goal is to reserve the BCWF for meeting peak demand during summer months. In order to effectively meet these goals, it is recommended that the

City of Lubbock produce no more than 5,000 ac-ft/yr on a long-term average.[187] The City of Lubbock plans to continually produce 2 mgd from the BCWF to keep the transmission line operational. Under this base load production amount, the City of Lubbock is able to use the BCWF full capacity of 30 mgd for 32 days to meet peaking demands during the summer without exceeding the annual maximum production target of 5,000 ac-ft.

The proposed BCWF Capacity Maintenance strategy is intended to replace capacity that is expected to be lost in the future and assist the City of Lubbock in achieving its BCWF goals. It is anticipated that each capacity maintenance phase would maintain the 30 mgd capacity for 6 to 10 years, after which time additional well field maintenance would be needed. The capacity maintenance phase is based on an HDR Engineering, Inc. (HDR) analysis completed in 2017, which updated the results from a Daniel B. Stephens & Associates' (DBS&A) October 2012 modeling report.[188] Assuming that new wells have a production capacity of 200 to 250 gpm, and based on the expected production decline curve from the DBS&A and HDR analyses, 20 replacement wells would be required every 6 to 10 years to maintain the production capacity in the BCWF, while continually producing approximately 5,000 ac-ft/yr. Following the projected pattern of decline for the existing wells, a program of 80 supplemental wells would be required during the planning period, with 20 wells to be constructed in 2034, 2043, 2051, and 2057.

The major design features and assumptions of this strategy include the following.

- Construct 20 200-gpm wells every 6 to 10 years, for a total of 80 wells over the 50-year planning period;
- Construct wells to an average depth of 220 feet and operate at an average of 200 gpm;
- Locate wells on properties where the City of Lubbock holds existing water rights;
- No additional treatment is required;
- Install approximately 27 miles of 6- to 12-inch diameter well collection pipe and approximately 15 miles of 16-inch transmission pipe; and
- Size well pumps to deliver the water to terminal storage at the east end of the BCWF in a new pipeline, with a delivery pressure of 30 pounds per square inch (psi) at the terminal storage connection to the original well field.

Figure 5-23 shows the relative locations of the well field and associated infrastructure needed.

[187] Daniel B. Stephens & Associates. 2012. Updated Bailey County Well Field Modeling Report, September 2012: 6.

[188] Daniel B. Stephens & Associates. 2012. Updated Bailey County Well Field Modeling Report, September 2012: 7.

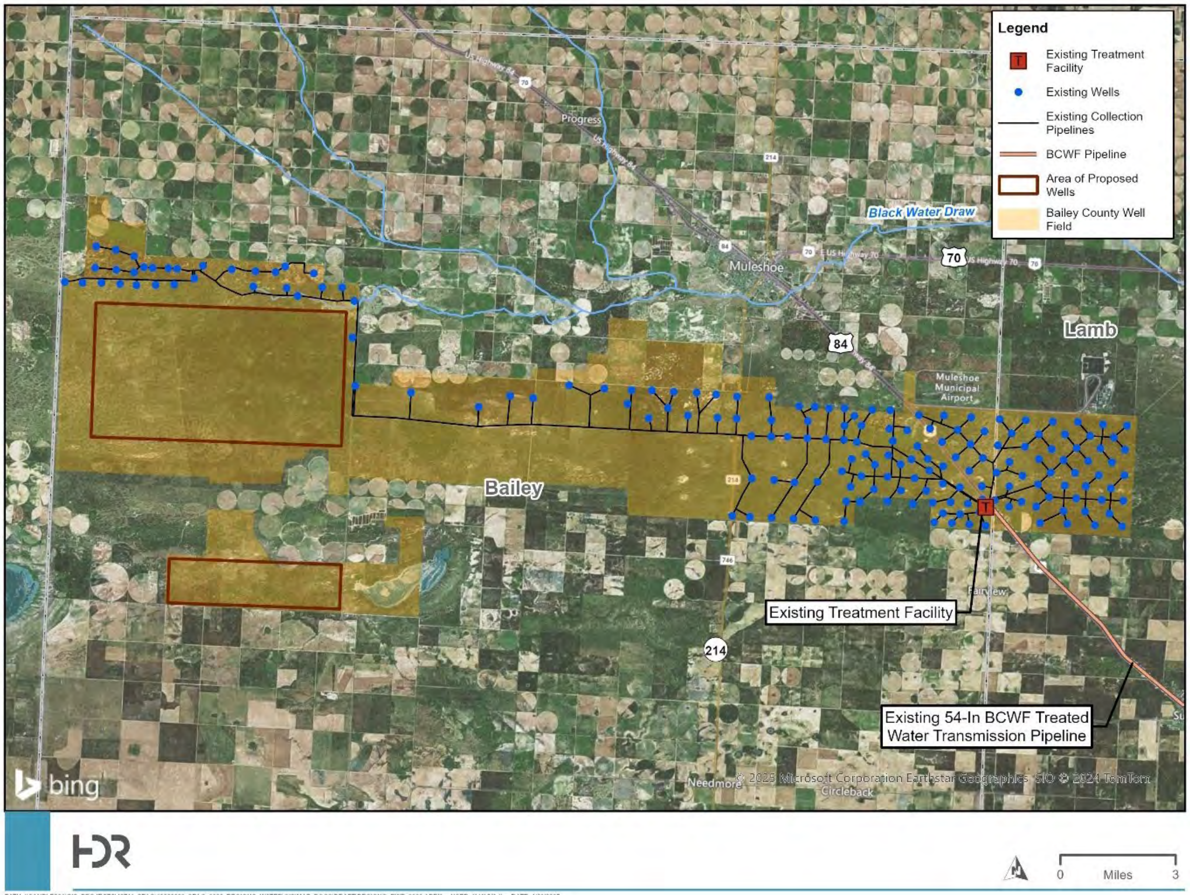

Figure 5-23. Area of Potential New Well Locations for BCWF Capacity Maintenance Strategy

5.18.1 Quantity of Available Water

The Bailey County Well Field Capacity Maintenance for the City of Lubbock strategy is designed to maintain the current BCWF production capacity of 30 mgd. Under this strategy, the City of Lubbock would produce an average of 5,000 ac-ft/yr of water from the BCWF, consisting of a 2-mgd base load throughout the year, and peaking supply of 30 mgd for approximately 32 days each year. The CM is to be staged with the installation of 20 new wells and associated pipeline every 6 to 10 years, providing 5.76 mgd (20 wells at approximately 200 gpm each) of capacity to offset overall capacity declines from the system.

The current well field consists of 175 active wells. Some of the new wells would replace existing wells and the remainder would augment the decline in flow from the active wells. For purposes of this strategy, all the new wells would be located in the northwest part of the leases, away from the intensity of existing pumping. By cycling the wells and not overpumping any single well, each new well could supply an average of 28.6 ac-ft/yr. Therefore, each set of 20 new wells will provide an average supply of approximately 572 ac-ft/yr.

5.18.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-17. Assumptions and conditions associated with these costs include the following.

- Capital cost for wells and collector and transmission pipelines is calculated by the unified costing model that is used for strategies in the regional water plans;
- Engineering, legal, and contingency costs are 35 percent for facilities constructed for this strategy;
- Power is available at $0.09 per kW-hr;
- Interest during construction is estimated at 3.5 percent, and a 0.5 percent return on investments over a 1-year period; and
- The project would be financed for 20 years at a 3.5 percent annual interest rate.

As shown in Table 5-17, the total construction costs for the 50-year plan are estimated at $47,584,000. Annual debt service is $4,768,000; and, annual operational cost, including power, is $552,000, resulting in a total annual cost of $5,320,000. With debt service, the unit cost for the 30 mgd peak capacity and 2,288 ac-ft/yr supply is estimated to be $2,325 per ac-ft, or $7.13 per 1,000 gallons. After debt service, the unit cost of water is estimated to be $241 per ac-ft, or $0.74 per 1,000 gallons. Annual costs represent the average costs over the implementation period. Annual costs in the early years would be greater than in later years because the larger diameter transmission main would be constructed in the first phase of the projects. The calculated capital costs do not include any costs for maintenance, upgrades, or rehabilitation to existing equipment. The capital costs shown are only for project components that directly increase the volumetric water supply.

Table 5-17. BCWF Capacity Maintenance Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Well Fields (4 Phases of 20 Wells at 200 gpm)[1]	$1,840,000
Well Collection System (10.6 mi - 6, 8, 12, 16-in dia)	$45,744,000
TOTAL COST OF FACILITIES	**$47,584,000**
Engineering:	
- Planning (3%)	$1,424,000
- Design (7%)	$3,328,000
- Construction Engineering (1%)	$472,000
Legal Assistance (2%)	$952,000
Fiscal Services (2%)	$952,000
Facilities Contingency (20%)	$9,520,000
Environmental & Archaeology Studies and Mitigation	$1,272,000
Land Acquisition and Surveying (74 acres for each 20 well package. 297 total acres)	$152,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$2,136,000
TOTAL COST OF PROJECT	**$67,792,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$4,768,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$472,000
Pumping Energy Costs (0.09 $/kW-hr)	$80,000
TOTAL ANNUAL COST	**$5,320,000**
Available Project Yield (ac-ft/yr)	2,288
Annual Cost of Water ($ per ac-ft), based on PF=1	$2,325
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$241
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$7.13
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.74

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor
1. Unit cost for wells and related infrastructure is based on estimate provided by Parkhill, Smith and Cooper, Inc.

5.18.3 Implementation Issues

5.18.3.1 Environmental Issues

The proposed project occurs within the High Plains physiographic region of Texas and is within the Kansan biotic province[189]. The project components are within an area defined as Sandsage-Havard Shin oak brush vegetation type[190]. The Sandsage-Havard Shin oak vegetation type is found on sandy soils of the northwestern High Plains and Rolling Plains ecological regions. Species, including skunkbush sumac, Chickawaw plum, Indiangrass, switchgrass, sand lovegrass, sideoats grama, scurfpea, and wild buckwheat, are commonly associated plants. EMST data and TPWD's more detailed and recently produced vegetation data[191], show there are several different habitat types within the proposed well field area with sandhill shinnery duneland and High Plains sandy deciduous shrubland occupying the largest areas, followed by native invasive deciduous shrubland, High Plains sandhill shinnery shrubland, and native invasive mesquite shrubland. Vegetation impacts would

[189] Blair, W.F. 1950. "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117.

[190] McMahan, C.A., R.G. Frye, and K.L. Brown, 1984. "The Vegetation Types of Texas." Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ February 21, 2025.

[191] TPWD. 2025. Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

include clearing small areas for construction of approximately 10 new wells every 6 years and installing approximately 5 miles of collection pipe in each CM phase.

FEMA has not mapped the project area for 100-year floodplains. One isolated freshwater emergent wetland, approximately 2.5 acres in size, was located near the northeast corner of the proposed well field, based on NWI data. No other wetlands, rivers, streams, or surface water features were identified in the project area based on NWI, topographic maps, aerial photographs, or NHD. Coordination with USACE would be required for construction within waters of the U.S. Impacts from this proposed project resulting in a loss of less than 0.5 acres of waters of the U.S. could be covered under NWP 58 for utility line activities. TCEQ's Surface Water Quality Viewer[192] identifies no stream or reservoir segments within 5 miles of the proposed well field.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (P196-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets, there are no state historic sites, National Register of Historic Places-listed sites, historical markers, national register properties, national register districts, or cemeteries located within a one-mile buffer of the proposed project area.

A review of archeological resources in the proposed project area should be conducted during project planning. The owner or controller of the project would be required to coordinate with the Texas Historical Commission regarding impacts to cultural resources.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Bailey County are listed in Appendix D under Bailey County, Texas.

According to IPaC, provided by USFWS on February 21, 2025, the piping plover and red knot are listed on the IPaC database for the project area, but only need to be considered for wind energy projects. There are no critical habitats for these or any other species within the project area. TPWD's TXNDD showed the presence of a prairie dog town, part of which is on the northeastern corner of the proposed well field. TPWD's TXNDD showed the occurrence of the lesser prairie chicken, federal species listed as endangered, within the project area. TXNDD identified an occurrence of the Cienega false clappia bush, a species of greatest conservation need (SGCN) within the project area. No other occurrences of threatened, endangered, candidate, or SGCN-listed species were documented within one mile of the proposed well field.

A biological survey of the project area, to determine whether populations of threatened or endangered species, or potential habitats used by listed species occur in the area to be affected, should be conducted if this strategy is selected. A determination on whether any impacts or effects to listed species may occur would then be made. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning. The installation of wells and collection pipelines should be planned and

[192] TCEQ. 2025. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed February 21, 2025.

installed so that sensitive habitats, cultural resources, and other environmentally sensitive areas are avoided.

Summary

The project is proposed for CM of existing water supply and is not anticipated to impact land use, density, or type of development beyond that already planned within the project area. Permanent land use impacts in the project area would be limited to the new wells and collector lines. The proposed project would not require additional treatment. Disturbance to area land use would depend upon the type of construction used to install the pipelines (open cut, boring, etc.).

5.18.3.2 Permitting Issues

The City of Lubbock already owns groundwater rights on 83,305 acres of contiguous property, and wells would be drilled within this area. The City of Lubbock would need to acquire permits from the HPWD, and TCEQ must approve the design and construction of public water supply wells and water transmission facilities.

5.18.3.3 Other

Wells would be placed on properties where the City of Lubbock owns the water rights, which include the rights to surface improvements to extract and convey the groundwater. The City of Lubbock would need to negotiate work with surface owners to accommodate the surface operations and plans.

5.19 CRMWA to Lubbock Aquifer Storage and Recovery

This ASR strategy for the City of Lubbock would store water purchased from CRMWA during the fall, winter, and spring in the Ogallala Aquifer and recover the water during summer months. The ASR project aids in balancing the CRMWA deliveries by increasing the deliveries during periods of relatively low winter demands and decreasing demands on the CRMWA system during the summer. The raw CRMWA water would be delivered to the City of Lubbock's NWTP and treated. Some of the treated water would be delivered and injected into a new ASR well field approximately 2 miles east of the NWTP. Later, this water would be recovered and delivered back to the NWTP site, disinfected, and blended with other treated water from CRMWA for delivery to the distribution system. The goal of the strategy is to supplement the City of Lubbock's peak-day supplies and to more fully use the aqueduct.

The framework for this strategy follows a 2011 CDM Smith report titled *Canadian River Municipal Water Authority Aquifer Storage and Recovery Facility: Project Delivery Plan.*[193] The strategy is also discussed in detail in the City of Lubbock's 2015 *Aquifer Storage and Recovery (ASR) Evaluation*[194] report prepared by HDR.

The major design features and assumptions of this strategy include the following.

- Treat raw water from CRMWA sources at NWTP;

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[193] CDM Smith. 2011. Canadian River Municipal Water Authority Aquifer Storage and Recovery Facility: Project Delivery Plan.

[194] HDR Engineering. 2015. Aquifer Storage and Recovery (ASR) Evaluation, Engineering Report for City of Lubbock.

- Construct a new pump station at the NTWP to deliver treated water directly to ASR wells in the well field for injection;
- Install 45 Ogallala Aquifer ASR wells with an injection capacity of approximately 350 gpm and a recovery capacity of 500 gpm, noting six of the ASR wells are considered to be contingency or standby wells;
- Install 34 Ogallala Aquifer production wells with a capacity of approximately 500 gpm, while five of the production wells are considered to be contingency or standby wells;
- Use ASR wells for injection and recovery and use production wells for only for recovery;
- Space wells approximately 0.25 mile apart or greater;
- Distribute ASR wells more on the west side of the well field to compensate for the slight easterly downdip in the Ogallala Aquifer storage zone;
- Design well pumps to deliver recovered water directly to the NWTP; and
- Disinfect and blend recovered water with treated water from the CRMWA and then pump into the distribution system.

Figure 5-24 shows the relative locations of the ASR and production wells and associated infrastructure. Figure 5-25 shows a schematic of the ASR system.

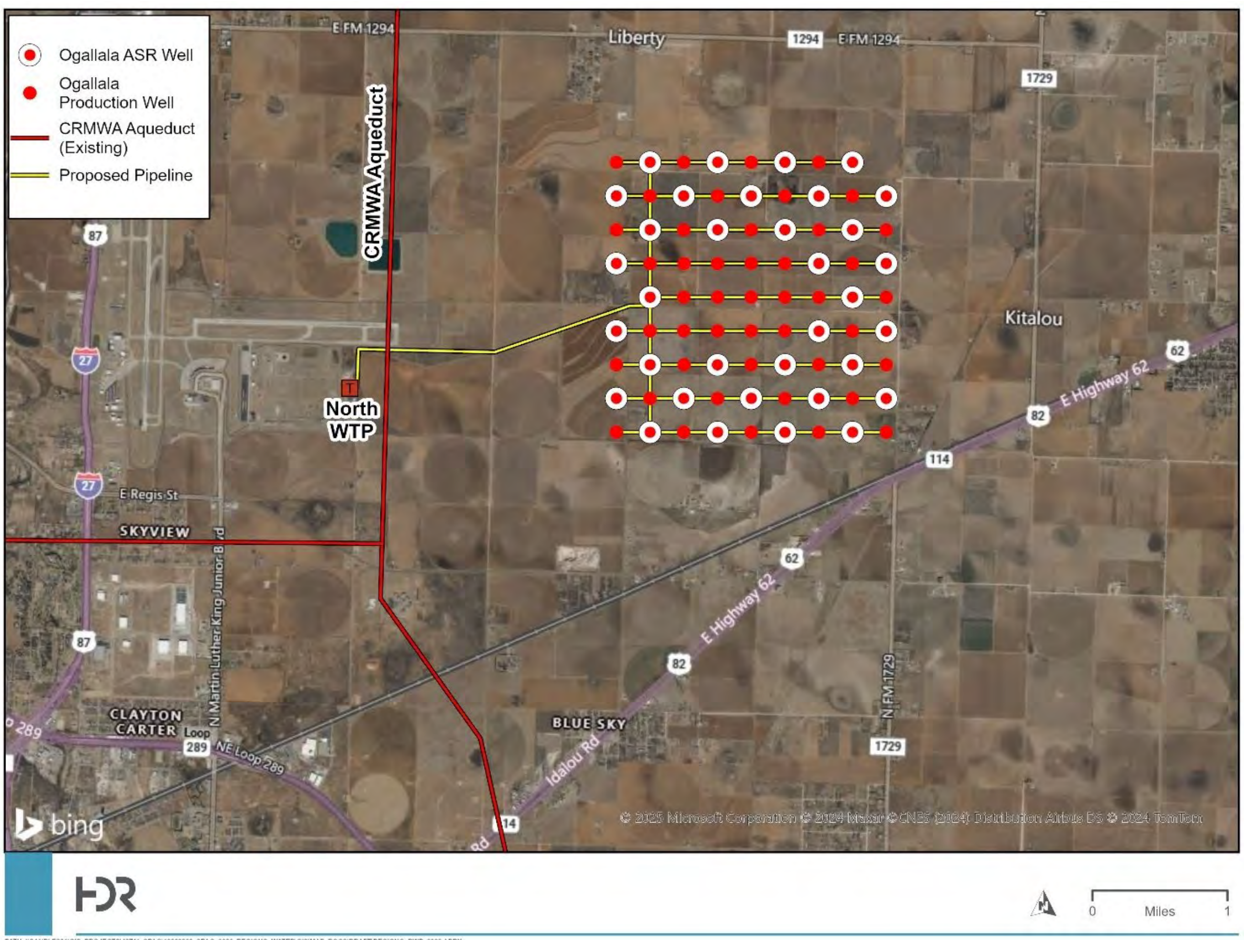

Figure 5-24. CRMWA to Aquifer Storage and Recovery Infrastructure

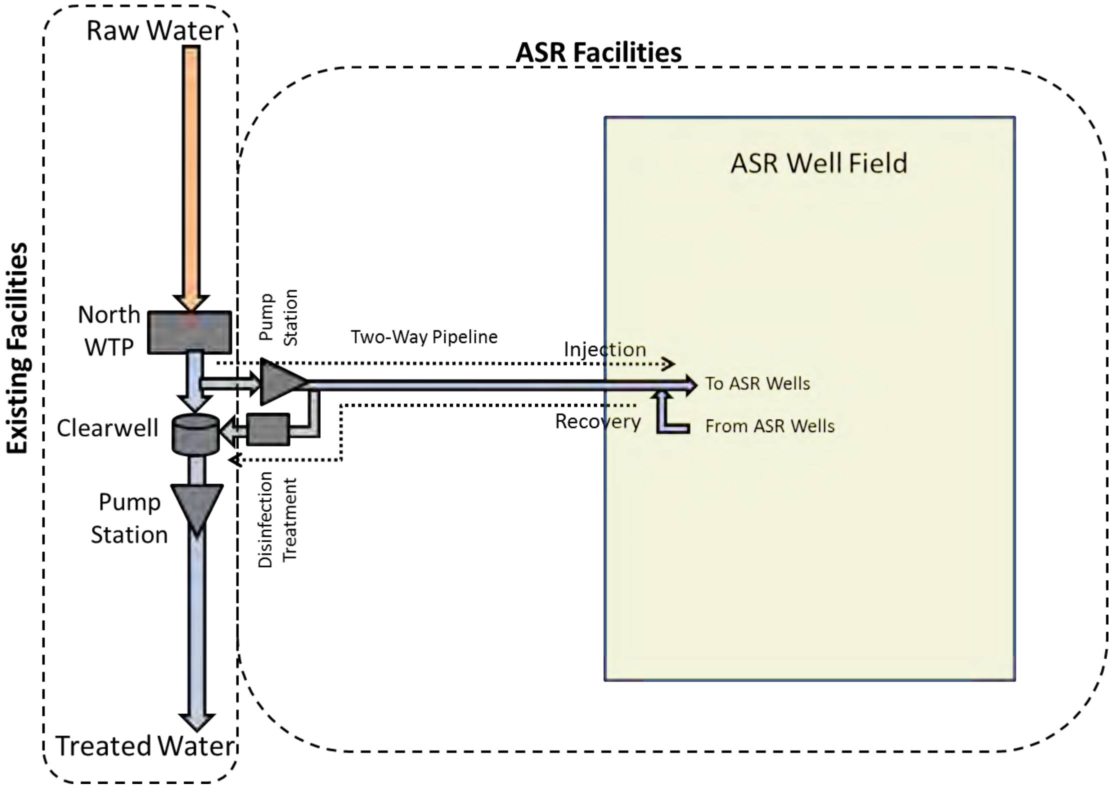

Figure 5-25. ASR System Schematic

5.19.1 Quantity of Available Water

The ASR strategy assumes that the new transmission line from the Roberts County Well Field (RCWF) to the CRMWA Aqueduct will be built. It also assumes that the City of Lubbock's average unused seasonal capacity in the CRMWA aqueduct is 19.5 mgd. For evaluation purposes, the system is assumed to operate under recharge conditions for 6 months of the year (November through April), recovery conditions for 2.5 months (mid-June through August) and remain idle for the remaining time (May to mid-June, September, and October). This results in an average of 10,920 ac-ft/yr of water available for ASR storage. To recover this same amount in 2.5 months, a 48.8-mgd system would be designed and built.

Depending on groundwater levels, nearby pumping, and stored volume, some of this stored supply may be lost to other wells; however, the strategy assumes recovery operations would pump the same total volume as recharge. As a result, there would be a minor blend of native and injected water, assuming native groundwater is suitable for a public supply.

At many ASR sites, forming and maintaining a buffer zone around an ASR well or well field has been found effective at controlling subsurface geochemical reactions so that recovered water quality is similar to injected water quality. Initial ASR well testing in the Lubbock area would determine whether the same beneficial results would be achieved locally, minimizing or avoiding the need for pre- or post-treatment of the water in ASR storage.

5.19.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-18. Assumptions and conditions associated with these costs include the following.

- On average a high-capacity Ogallala Aquifer production well for the target area is expected to be able to produce approximately 500 gpm and have an injection capacity of approximately 350 gpm;
- The depth to the base of the Ogallala Aquifer is approximately 160 feet;
- CRMWA raw water treatment prior to ASR would occur during November to April when there is unused capacity in the NWTP;
- Property acquisition for the ASR well field would be approximately 3,200 acres;
- A new pump station at the NWTP would deliver the treated water to the ASR well field through a two-way transmission pipeline;
- The well field would include 45 Ogallala Aquifer ASR wells, and six of the wells would be considered to be contingency or standby wells;
- The well field would include 34 Ogallala Aquifer production wells, and five of the production wells would be considered to be contingency or standby wells;
- The well spacing would be 1,320 feet or greater;
- Well pumps would deliver recovered water back to the NWTP through the two-way transmission pipeline;
- The recovered water would be disinfected and delivered to the NWTP clearwell for blending with treated water from the CRMWA supply, and the blended water would be pumped into the distribution system through the NWTP high service pump station;
- The ASR system would be operated with advanced Supervisory Control and Data Acquisition (SCADA) and variable speed well pumps, noting that during peak recovery period, wells may be operated in rotation to maintain target groundwater levels in the well field;
- The well field would include 15 monitoring wells;
- The migration of the injected water would be minimal;
- Costs for raw water treatment at the existing NWTP were not considered, and water would be treated and delivered from November through April when there is unused capacity in the NWTP;
- Property for the ASR well field is estimated to be purchased at $3,200 per acre (inclusive of water rights), based on a blend of agricultural and residential land cost data from the Lubbock Central Appraisal District;
- Engineering, legal, and contingency costs is 30 percent of pipelines and 35 percent for other facilities;
- Power is available at $0.09 per kW-hr;
- Interest during construction is 3.0 percent, and a 0.5 percent return on investments; and
- The project would be financed for 20-years at a 3.5 percent interest rate.

Table 5-18. CRMWA to Aquifer Storage and Recovery Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Pump Station (19.5 mgd)	$2,747,000
Transmission Pipeline (54-in dia., 2 miles)	$11,669,000
Well Fields (Wells, Pumps, and Piping)	$97,890,000
Water Treatment Plant (49 mgd)	$3,337,000
Integration, Relocations, Backup Generator & Other	$3,532,000
TOTAL COST OF FACILITIES	**$119,175,000**
Engineering:	
- Planning (3%)	$3,575,000
- Design (7%)	$8,342,000
- Construction Engineering (1%)	$1,192,000
Legal Assistance (2%)	$2,384,000
Fiscal Services (2%)	$2,384,000
Pipeline Contingency (15%)	$1,750,000
All Other Facilities Contingency (20%)	$21,501,000
Environmental & Archaeology Studies and Mitigation	$11,084,000
Land Acquisition and Surveying (3237 acres)	$11,393,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$11,879,000
TOTAL COST OF PROJECT	**$194,659,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$13,694,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,131,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$69,000
Water Treatment Plant	$2,002,000
Pumping Energy Costs (0.09 $/kW-hr)	$1,112,000
TOTAL ANNUAL COST	**$18,008,000**
Available Project Yield (ac-ft/yr)	10,920
Annual Cost of Water ($ per ac-ft), based on PF=2	$1,649
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=2	$395
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$5.06
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$1.21

Notes: mgd = million gallons per day; ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

As shown, the total project cost is estimated to be $194,659,000. Annual debt service is $13,694,000; and, annual operational cost, including power, is $4,314,000. This results in a total annual cost of $18,008,000. With debt service, the unit cost for a 10,920 ac-ft/yr peaking supply is estimated to be $1,649 per ac-ft, or $5.06 per 1,000 gallons. After debt service, the unit cost of water is estimated to be $395 per ac-ft, or $1.21 per 1,000 gallons. This cost does not include the cost of water from CRMWA nor the water treatment prior to storage in the ASR well field, because the NTWP would require no expansion to provide this treatment.

5.19.3 Implementation Issues

5.19.3.1 Environmental Issues

The proposed project occurs within the High Plains physiographic region of Texas and is within the Kansan biotic province[195.] The project components are within an area defined as crops vegetation type[196]. Crops include cultivated cover or row crops providing food or fiber and also may include grassland associated with crop rotations. EMST data and TPWD's more detailed and recently produced vegetation data[197], show the area containing primarily row crops, with areas of native invasive shrubland (mesquite, juniper, elm-olive), improved grasslands, short and mixed grass prairie, and high and low intensity urban areas. Vegetation impacts would include clearing areas for construction of the injection and production wells, pump station, and collector pipelines.

Special flood hazard areas are located in areas of playas within the proposed project area.[198] There are several of these special flood hazard areas located within the area of the proposed well field. Project components, including pipelines and wells may be located within these floodplains. Several features were identified on NWI maps where injection/recovery wells or pipelines are proposed. These included features identified as lakes, freshwater emergent wetlands, freshwater forested/shrub wetland, freshwater pond, and three features identified in the NWI set as "other" palustrine wetland type. Depending upon regulations at the time of development, these features may or may not be considered waters of the U.S. and a wetland delineation would need to be completed. Coordination with USACE is required for construction within waters of the U.S. Impacts from this proposed project resulting in a loss of less than 0.5 acres of waters of the U.S. could be covered under NWP 58 for utility line activities for water and other substances. TCEQ's Surface Water Quality Viewer[199] shows proposed project components are within approximately 5 miles of North Fork (Segment 1241A), which is listed as impaired for bacteria in water (recreation use).

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (P196-515), and the Archeological and Historic Preservation Act (PL93-291).

A review of archeological and historic resources in the proposed project area should be conducted during project planning. The owner or controller of the project is required to coordinate with the Texas Historical Commission regarding impacts to cultural resources.

Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Lubbock County are shown in Appendix D under Lubbock County, Texas.

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[195] Blair, W.F. 1950. "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117.

[196] McMahan, C.A., R.G. Frye, and K.L. Brown, 1984. "The Vegetation Types of Texas." Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ March 22, 2019.

[197] TPWD. 2019. Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

[198] FEMA. 2025. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online FEMA's National Flood Hazard Layer (NFHL) Viewer February 21, 2025.

[199] TCEQ. 2025. Surface Water Quality Viewer. Accessible online Surface Water Quality Vieweraccessed February 21, 2025.

According to IPaC, provided by USFWS for the project area on February 21, 2025, two threatened or endangered species, the sharpnose shiner and smalleye shiner, could potentially be affected by the project. Additionally, the monarch butterfly is listed as proposed threatened within the project area. The piping plover, and red knot are also mentioned, but only need to be considered for wind energy projects. There are no critical habitats in the project area.

In areas of proposed improvements, there are no documented occurrences of threatened, endangered or rare species, based on TPWD's TXNDD. The swift fox, a SGCN-designated species has been documented within one mile of the project area. No other documented occurrences were noted on the TXNDD within one mile.

A biological survey of the project area, to determine whether populations of threatened or endangered species, or potential habitats used by listed species occur in the area to be affected, should be conducted if this strategy is selected. A determination on whether any impacts or effects to listed species may occur would then be made. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning. The installation of wells and collection pipelines should be planned and installed so that sensitive habitats, wetlands, cultural resources, and other sensitive areas are avoided.

5.19.3.2 Permitting Issues

Since the passage of House Bill 720 (HB 720) and House Bill 1964 (HB 1964), 86th Texas Legislature, 2019, there is a well-defined process for ASR permitting in Texas, which is administered by TCEQ. TCEQ has adopted rules that govern ASR projects, including water quality and injection well construction. Permitting from a local groundwater conservation district (GCD) is not required for ASR projects, unless the withdrawals exceed the amount injected. If the project includes withdrawals that exceed the injected volumes, then a permit from the local GCD is required. In HPWD, current permitting rules require certain well spacing from property lines and other wells, depending on the rate of production.

5.19.3.3 Other

The City of Lubbock does not own groundwater rights in this area. The City of Lubbock would need to purchase groundwater rights in order to control water within the recharge area.

5.20 CRMWA to Plainview Aquifer Storage and Recovery

This ASR strategy for the City of Plainview would store water purchased from CRMWA during the fall, winter, and spring in the Ogallala Aquifer and recover the water during summer months. The ASR project aids in balancing the CRMWA deliveries by increasing the deliveries during periods of relatively low winter demands and decreasing demands on the CRMWA system during the summer. The raw CRMWA water would be delivered to the City of Plainview's water treatment plant and treated. The treated water would be delivered and injected into a new ASR well field about one mile south of the water treatment plant. Later, this water would be recovered and delivered back to the water treatment plant site, treated and blended with other treated water from CRMWA for delivery to the distribution system. The goal of the strategy is to supplement the City of Plainview's peak-day supplies and to more fully use the CRMWA water.

The major design features and assumptions of this strategy include the following.

- On average a high-capacity Ogallala Aquifer production well for the target area is expected to be able to produce about 500 gpm;
- The depth to the base of the Ogallala Aquifer is about 350 feet;
- CRMWA raw water treatment prior to ASR would occur during September to May when there is unused capacity;
- The ASR well field will be located on City of Plainview property near the Plainview Civic Center;
- A new pump station at the water treatment plant would deliver the treated water to the ASR well field through a two-way transmission pipeline;
- The well field would include 5 Ogallala Aquifer ASR wells, and one of the wells is considered to be contingency or standby;
- The well spacing is 1,320 feet or greater;
- The recovered water would be treated and delivered to the water treatment plant clearwell for blending with treated water from the CRMWA supply, and the blended water would be pumped into the distribution system through the water treatment plant high service pump station;
- During peak recovery period, wells may be operated in rotation to maintain target groundwater levels in the well field;
- The migration of the injected water would be minimal;

Figure 5-26 shows the relative locations of the ASR and production wells and associated infrastructure.

Figure 5-26. CRMWA to Plainview Aquifer Storage and Recovery Infrastructure

5.20.1 Quantity of Water Available

This strategy assumes that CRMWA would maintain delivering water at a rate of 3,393 ac-ft/yr. It also assumes that CRMWA average unused water is 848 ac-ft/yr based on usage from 2020 through 2023. For evaluation purposes, the system is assumed to operate under recharge conditions for 6 to 9 months of the year and recovery conditions for 3 months (June through August). This results in an average of 848 ac-ft/yr of water available for ASR storage. Recovering this same amount would require a recovery rate of 604 gpm and a recharge rate of 525 gpm.

Depending on groundwater levels, nearby pumping, and stored volume, some of this stored supply may be lost to other wells. As a result, there would be a minor blend of native and injected water.

5.20.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-19. Assumptions and conditions associated with these costs include the following.

- Costs for raw water treatment at the existing water treatment plant were not considered;
- Engineering, legal, fiscal, and contingency costs is 30 percent of pipelines and 35 percent for other facilities;
- Power is available at $0.09 per kW-hr;

- Interest during construction is 3.5 percent, and a 0.5 percent return on investments; and
- The project would be financed for 20 years at a 3.5 percent interest rate.

Table 5-19. CRMWA to Plainview Aquifer Storage and Recovery Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Pump Station (3 MGD)	$1,038,000
Transmission Pipeline (14 in dia., 1.2 miles)	$2,764,000
Well Field (Wells, Pumps, and Piping)	$6,345,000
SCADA System	$152,000
TOTAL COST OF FACILITIES	**$10,299,000**
Engineering:	
- Planning (3%)	$309,000
- Design (7%)	$721,000
- Construction Engineering (1%)	$103,000
Legal Assistance (2%)	$206,000
Fiscal Services (2%)	$206,000
Pipeline Contingency (15%)	$415,000
All Other Facilities Contingency (20%)	$1,507,000
Environmental & Archaeology Studies and Mitigation	$131,000
Land Acquisition and Surveying (22 acres)	$171,000
Interest During Construction (3.5% for 1 year with a 0.5% ROI)	$458,000
TOTAL COST OF PROJECT	**$14,526,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,022,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$93,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$26,000
Pumping Energy Costs (0.09 $/kW-hr)	$683,000
TOTAL ANNUAL COST	**$1,824,000**
Available Project Yield (ac-ft/yr)	848
Annual Cost of Water ($ per ac-ft), based on PF=4	$2,150
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=4	$946
Annual Cost of Water ($ per 1,000 gallons), based on PF=4	$6.60
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=4	$2.90

Acronyms: mgd = million gallons per day; ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

As shown, the total project cost is estimated to be $14,526,000. Annual debt service is $1,022,000 and annual operational cost, including power, is $802,000. This results in a total annual cost of $2,824,000. The unit cost for an 848 ac-ft/yr peaking supply is estimated to be $2,150 per ac-ft, or $6.60 per 1,000 gallons.

5.20.3 Implementation Issues

5.20.3.1 Environmental Issues

The proposed project occurs within the High Plains physiographic region of Texas and is within the Kansan biotic province[200]. The project components are within areas defined as mesquite shrub and

[200] Blair, W.F. 1950. “The Biotic Provinces of Texas, “Tex. J. Sci. 2:93-117.

crops vegetation types[201]. The mesquite shrub vegetation type commonly includes grassland pricklypear, cholla, blue grama, hairy grama, purple three-awn, buffalograss, and other grasses, shrubs, and herbaceous species. Crops include cultivated cover or row crops providing food or fiber and also may include grassland associated with crop rotations. EMST data, more detailed vegetation data recently produced by TPWD[202], show the area containing urban, floodplain and riparian herbaceous vegetation, shortgrass prairie, and playa grassland habitats.

Areas of 100-year floodplain (Zone A) and special flood hazard areas (without a base flood elevation Zone AE) are located in areas of playas along Ennis Street at Travis Trussell Park, and along Running Water Draw within the proposed project area.[203] For this project, ASR wells would be placed outside the floodway or 100-year floodplain. Portions of the ASR pipeline could be located within these floodplains. Several freshwater emergent wetlands or ponds were identified on the NWI maps along the potential ASR pipeline route. The NWI maps also identified freshwater emergent wetlands along Running Water Draw within the potential ASR well field. Depending upon regulations at the time of development, these features may or may not be considered waters of the U.S. A NWP or coordination with the USACE may be required for impacts to waters of the U.S. No TCEQ surface water segments were identified, and no surface water quality concerns were noted on the TCEQ Surface Water Quality Viewer[204] within the proposed project area, or within 5 miles.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (P196-515), and the Archeological and Historic Preservation Act (PL93-291). The City of Plainview, as the owner or controller of the project, would be required to comply with the Antiquities Code. Based on the review of available GIS datasets, Plainview Cemetery in Plainview Memorial Park was the only cultural resource site identified in the datasets within a one-mile buffer of the proposed project area. No state historic sites, National Register of Historic Places-listed sites, or historical markers were located within a one-mile buffer of the proposed project area. A review of archeological resources in the proposed project area should be conducted during project planning.

According to IPaC, provided by USFWS for the project area on February 21, 2025, two threatened or endangered species, the sharpnose shiner and smalleye shiner, could potentially be affected by the project. Additionally, the monarch butterfly is listed as proposed threatened within the project area. The piping plover, and red knot are also mentioned, but only need to be considered for wind energy projects. There are no critical habitats in the project area.

Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Hale County are shown in Appendix D under Hale County, Texas.

Based on the TPWD TXNDD, there were two documented occurrences of the swift fox, an SGCN-designated species, in the area of proposed improvements. The most recent documented recording

[201] McMahan, C.A., R.G. Frye, and K.L. Brown, 1984. “The Vegetation Types of Texas.” Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ March 22, 2019.

[202] TPWD, Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

[203] FEMA. 2025. FEMA’s National Flood Hazard Layer (NFHL) Viewer. Accessed online: FEMA's National Flood Hazard Layer (NFHL) Viewer February 21, 2025.

[204] TCEQ. 2025. Surface Water Quality Viewer. Accessible online: Surface Water Quality Viewer accessed February 21, 2025.

of this species within the project area was in 1963. No other documented occurrences of threatened, endangered or rare species or natural communities were reported within five miles of the project area.

A biological survey of the project area should be conducted to determine whether populations of threatened or endangered species, or potential habitats used by listed species occur in the area to be affected, if this strategy is selected. A determination on whether any impacts or effects to listed species may occur would then be made. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

The installation of wells and collection pipelines should be planned and installed so that sensitive habitats, wetlands, cultural resources, and other sensitive areas are avoided.

5.20.3.2 Permitting Issues

Since the passage of HB 720 and HB 1964, 86th Texas Legislature, 2019, there is a well-defined process for ASR permitting in Texas, which is administered by TCEQ. TCEQ has adopted rules that govern ASR projects, including water quality and injection well construction. Permitting from a local GCD is not required for ASR projects, unless the withdrawals exceed the amount injected. If the project includes withdrawals that exceed the injected volumes, then a permit from the local GCD is required. In HPWD, current permitting rules require certain well spacing from property lines and other wells, depending on the rate of production.

5.20.3.3 Other

Wells would be placed on properties where the City of Plainview owns the land and water rights, which includes the rights to surface improvements to extract and convey the groundwater beneath the City’s property. The City of Plainview would need to negotiate work with surface owners to accommodate the surface operations and plans if the well field was located off of city-owned property.

5.21 New Transmission Line to Aqueduct for Roberts County Well Field

The CRMWA is planning to expand its groundwater supplies through expansion of the RCWF by expanding the well field and well field transmission pipeline capacity for delivery to the CRMWA Aqueduct. Currently a 54-inch diameter transmission line with a 65-mgd capacity delivers water from the RCWF west toward Borger and then south to Amarillo. The capacity of the CRMWA Aqueduct between Amarillo and Lubbock is 53 mgd. A new 54-inch diameter transmission line is being planned using a new right-of-way to deliver water to the CRMWA Aqueduct on the north side of Amarillo. Additional wells will be necessary to increase the RCWF production capacity to fully use the increased pipeline capacity. Eventually, replacement wells would be necessary to maintain the proposed RCWF production capacity. For purposes of this strategy, Lee Wilson & Associates, a consultant under contract with CRMWA, states that 19 wells would initially be required and, by 2045, an additional 17 wells in three increments would be required to maintain the target production capacity of 63,000 ac-ft/yr.

Two 54-inch diameter transmission lines (one existing and one planned) delivering water from the RCWF could deliver a peak supply of 130 mgd to the CRMWA Aqueduct (65 mgd from each pipeline). The City of Lubbock's portion would be 48.2 mgd (37.058 percent of the total CRMWA-produced water available). The City of Lubbock's current allocation is approximately 42 mgd.

This strategy does not consider adding new wells to maintain the current capacity of the well field and existing 54-inch pipeline.

The major design features of this strategy include the following.

- Construct 36 new Ogallala Aquifer wells to the top of the Red Beds, which is estimated to average approximately 950 feet below land surface and operate at a peak rate of 2,250 gpm per well. Well construction would occur in phases as the water demands increased.
- Install collector pipelines between wells and deliver water to terminal at head of new pipeline.
- Install approximately 67.9 miles of 54-inch diameter transmission pipeline.
- Install a ground storage tank and pump station at the well field and at two booster pump stations and install ground storage tanks along the pipeline, sized for 65 mgd.

Figure 5-27 depicts the relative locations of the well field, new wells, transmission lines, and associated infrastructure.

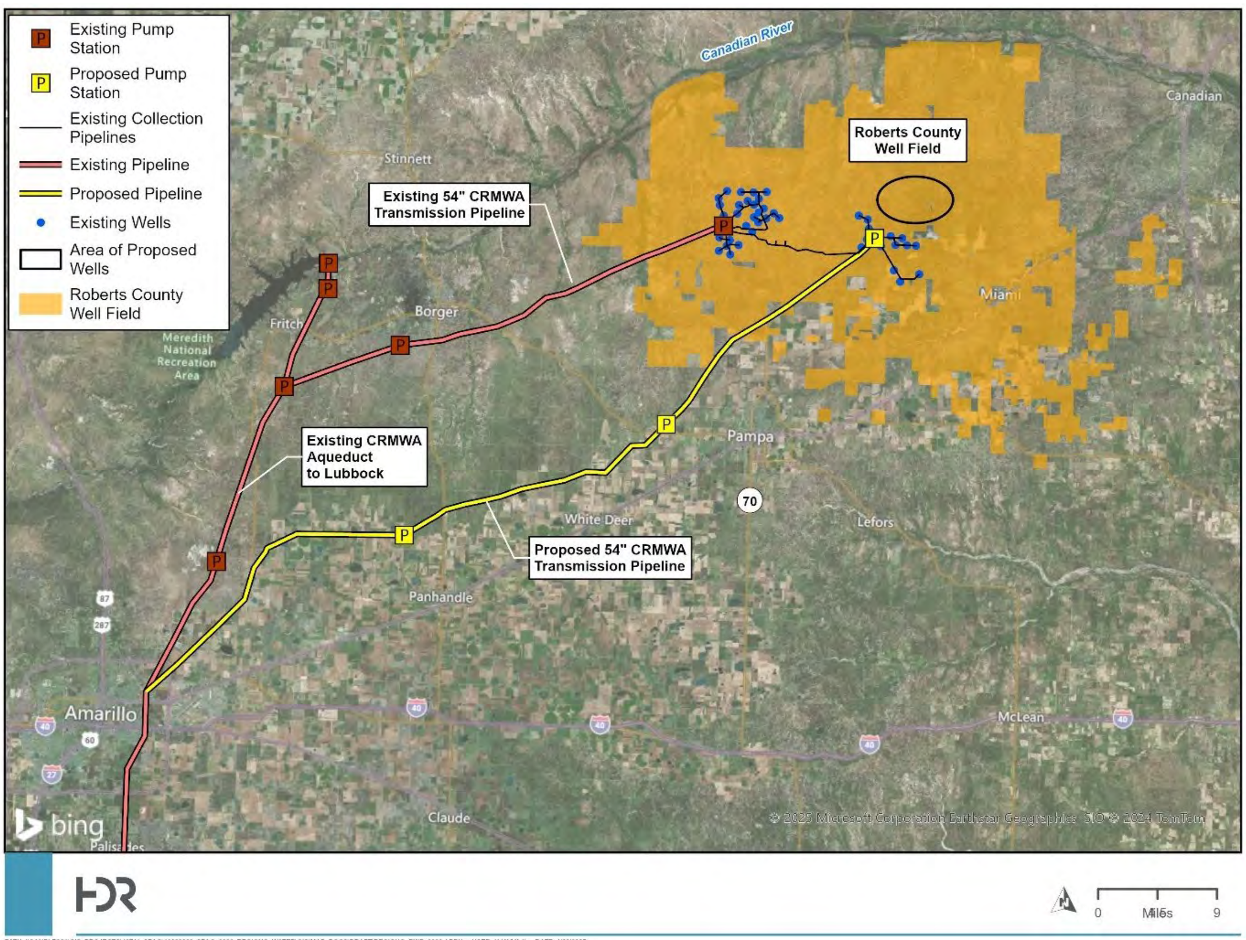

Figure 5-27. RCWF – New Transmission Line to Aqueduct Strategy

5.21.1 Quantity of Available Water

It is assumed that CRMWA will operate the new transmission line between RCWF and the CRMWA Aqueduct at an annual average of 80 percent of its 65-mgd capacity (58,240 ac-ft/yr). Therefore, the City of Lubbock's incremental increase in annual allocation from CRMWA is estimated to be 21,583 ac-ft/yr (65 mgd x 1120 ac-ft/yr/mgd x 0.8 x 0.37058). The City of Lubbock's portion of the total CRMWA-produced water available is 37.058 percent. Consequently, the CRMWA Aqueduct between Plainview and the City of Lubbock will be flowing near its peak capacity of 53 mgd with 42 mgd being the City of Lubbock's portion. Under this strategy, the City of Lubbock's total CRMWA allocations are as follows:

- City of Lubbock's current CRMWA allocation: 24,088 ac-ft/yr
- Additional supply with new transmission line: 21,583 ac-ft/yr
- City of Lubbock's updated CRMWA supply: 45,671 ac-ft/yr

Maintaining the target quantity of water in the future will require a production CM program of adding new wells to account for reduced wells yields due to declining groundwater levels. For purposes of regional water planning, estimated costs are included for a 50-year planning period.

5.21.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-20. Assumptions and conditions associated with these costs include the following.

- The City of Lubbock will pay for 37.058 percent of the costs for this project;
- Capital costs were estimated by the Unified Costing Model. The total cost estimate is very similar to the estimate provided by CRMWA.
- All new wells are located on property for which CRMWA owns the water rights, and the authority to build facilities on the surface to develop and transport the water;
- Engineering, legal, and contingency costs are 35 percent for facilities required by this strategy;
- Power is available at $0.09 per kW-hr;
- Interest during construction is 3.0 percent, and a 0.5 percent return on investments; and
- The project will be financed for 20 years at a 3.5 percent interest rate.

The total project cost for the complete project is estimated to be $432,346,000 for facilities to provide the full capacity of 65 mgd. Annual debt service is $29,676,000, and annual operational cost, including power, is $20,502,000. This results in a total annual cost of $50,178,000. With debt service, the unit cost for the average annual supply is estimated at $862/ac-ft or $2.64 per 1,000 gallons. After debt service, the unit cost of water is estimated at $352/ac-ft or $1.08 per 1,000 gallons.

These costs are for delivery of water to the existing CRMWA Aqueduct to the City of Lubbock. It does not include the power cost in the aqueduct nor any subsequent treatment or transmission from the NWTP. The supply and costs from this strategy will be shared by other CRMWA members. The City of Lubbock's annual cost will be $18,595,000, which is 37.058 percent of $50,178,000.

Table 5-20. RCWF New Transmission Line to Aqueduct Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Pump Stations (65 mgd)	$44,427,000
Transmission Pipeline (54-in dia., 67.9 miles)	$176,604,000
Transmission Storage Tank(s)	$2,742,000
Well Fields (36 Wells, Pumps, and Piping)	$70,667,000
Integration, Relocations, Backup Generator & Other	$9,545,000
TOTAL COST OF FACILITIES	$303,985,000
Engineering:	
- Planning (3%)	$9,120,000
- Design (7%)	$21,279,000
- Construction Engineering (1%)	$3,040,000
Legal Assistance (2%)	$6,080,000
Fiscal Services (2%)	$6,080,000
Pipeline Contingency (15%)	$26,491,000
All Other Facilities Contingency (20%)	$25,476,000
Environmental & Archaeology Studies and Mitigation	$2,462,000
Land Acquisition and Surveying (445 acres)	$1,565,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$25,743,000
TOTAL COST OF PROJECT	**$431,321,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$29,676,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,596,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$1,111,000
Pumping Energy Costs (0.09 $/kW-hr)	$16,795,000
TOTAL ANNUAL COST	**$50,178,000**
Available Project Yield (ac-ft/yr)	58,240
Annual Cost of Water ($ per ac-ft), based on PF=1	$862
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$352
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$2.64
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.08

Notes: mgd = million gallons per day; ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; $/ac-ft = dollars per acre-foot; PF = peak factor

5.21.3 Implementation Issues

5.21.3.1 Environmental Issues

The proposed project occurs within the High Plains physiographic region of Texas, on the edge of the Rolling Plains, and is within the Kansan biotic province[205]. TPWD has defined four vegetation associations within the project area: mesquite shrub, mesquite-juniper brush, cottonwood-hackberry-saltcedar brush/woods, and crops.[206] Commonly found on the High Plains and Rolling Plains, the mesquite shrub vegetation type typically includes honey mesquite (*Prosopis glandulosa*), narrow-leaf yucca (*Yucca angustissima*), juniper, grassland pricklypear (*Opuntia cymochila*), cholla (*Cylindropuntia sp.*), blue grama, hairy grama (*B. hirsuta*), and other species of grasses and forbs.

[205] Blair, W.F. 1950. “The Biotic Provinces of Texas, “Tex. J. Sci. 2:93-117.

[206] McMahan, C. A., R. G. Frye and K. L. Brown. 1984. “The Vegetation Types of Texas -- Including Cropland,” Texas Parks and Wildlife Department - PWD Bulletin 7000-120.

Vegetation impacts would include clearing of areas for the installation of wells and construction of the ground storage tank and pump stations. Additionally, an approximately 72-mile-long pipeline easement would be required and, depending on installation techniques, could require the clearing of vegetation for the width of the proposed right-of-way.

FEMA floodplains have not been mapped within Roberts and Carson counties[207]. There are flood hazard areas located within the proposed project area in Gray and Potter counties where the proposed pipeline would be constructed. The proposed pipeline intersects with many features identified in the NWI dataset as riverine or wetland features. The proposed new RCWF also includes many mapped NWI features. Coordination with USACE would be required for construction within waters of the U.S. Impacts from this proposed project resulting in a loss of less than 0.5 acres of waters of the U.S. could be covered under NWP 58 for utility line activities. TCEQ's Surface Water Quality Viewer[208] shows there are impaired stream segments within 5 miles of proposed project components. Lake Meredith Reservoir (Segment 0102) showed impairments, including chloride, mercury in edible tissue, sulfate, and TDS. Dixon Creek (Segment 0101A) had impairments, including bacteria (recreational use), depressed dissolved oxygen, and selenium in water.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (P196-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets, there were three historical markers located within a one-mile buffer of the proposed project components: Spring Creek School, Fort Smith-Santa Fe Trail Gregg Route, 1840 and the Fort Smith-Santa Fe Trail Marcy Route, 1849. No other state historic sites, National Register of Historic Places-listed sites, historical markers, national register properties, national register districts, or cemeteries are located within a one-mile buffer of the proposed project area.

The GIS dataset reviewed showed a number of archeological surveys had occurred within a one-mile buffer of the proposed project area. A review of archeological resources in the proposed project area should be conducted during project planning. The owner or controller of the project would be required to coordinate with the Texas Historical Commission regarding impacts to cultural resources.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Roberts, Hutchison, Gray, Carson, and Potter counties are shown in Appendix D under Roberts, Hutchison, Gray, Carson, and Potter counties, Texas.

According to IPaC, provided by USFWS on February 21, 2025, the Lesser prairie-chicken, Arkansas river shiner, peppered chub, sharpnose shiner, smalleye shine, and monarch federally-listed species that could potentially be in the project area. Critical habitat for the peppered chub could potentially be found in the project area. TPWD's TxNDD documents the occurrences of rare species in Texas.

[207] FEMA. 2025. FEMA Flood Map Service Center. Accessed online https://msc.fema.gov/portal/home February 2, 2025.

[208] TCEQ. 2025. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed February 21, 2025.

There were three documented occurrences of the swift fox, an SGCN-designated species, in the area of the proposed project area.

A biological survey and habitat assessment of the project area should be conducted to determine the presence of threatened and endangered species or their potential habitats. Based on the findings, an evaluation will be made to determine whether the proposed activities may impact listed species. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning. The installation of wells and collection pipelines should be planned so that sensitive habitats, cultural resources, and other environmentally sensitive areas are avoided. CRMWA should seek to minimize environmental impact when planning the route for the new 54-inch transmission pipeline.

Summary

The project is proposed to increase CRMWA's groundwater supplies through expansion of the RCWF. Expanding this capacity would allow for land use changes, density, or type of development to occur in accordance with proposed project area plans. Permanent land use impacts in the project area would be limited to the new wells, collector lines, pump station and ground storage tank at the well field, as well as, a new 72-mile water line easement, and booster pump stations and ground storage tank along the pipeline. Disturbance to area land use would depend upon the type of construction used to install the pipelines (open cut, boring, etc.).

5.21.3.2 Permitting Issues

Currently, CRMWA owns the groundwater interests in over 450,000 acres of property and wells would be drilled within this area. CRMWA would need to secure permits from the Panhandle GCD and the TCEQ must approve the design and construction of public water supply wells and water transmission facilities.

5.21.3.3 Other

Wells would be placed on properties where CRWMA owns the water rights, which include the rights to surface improvements to extract and convey their groundwater. An easement is currently being acquired for the new transmission pipeline.

5.22 Roberts County Well Field Capacity Maintenance

The RCWF produces water from the Ogallala Aquifer. For operational sustainability and flexibility, CRMWA has a production capacity in the RCWF that is approximately 30 percent greater than the capacity of the transmission line from the RCWF to the main CRMWA Aqueduct. The capacity of the RCWF is 84 mgd; and, the maximum capacity of the transmission line is 65 mgd. As is common in Ogallala well fields, the RCWF's capacity from existing wells declines over time with continued use. Eventually, replacement wells become necessary to maintain a given well field capacity.

This Roberts County Well Field Capacity Maintenance strategy is designed to maintain the RCWF's capacity at 84 mgd. Modeling by Lee Wilson & Associates (a consultant under contract with CRMWA) estimates that 11 replacement wells will be needed approximately every 30 years in order to sustain an average production of 65 mgd and maintain a RCWF peak production capacity of 84 mgd. For the 50-year planning cycle, 19 new wells would be required.

The major design features and assumptions of this strategy include the following:

- Construct 19 wells constructed to the top of the Red Beds, at approximately 950 feet deep on average.
- Operate wells at 1,750 gpm, with a peak capacity of 2,250 gpm on average.
- Locate new wells on property where CRMWA holds the interest in groundwater rights.
- No additional treatment is included in the costs.

Figure 5-28 shows the relative locations of well field and associated infrastructure.

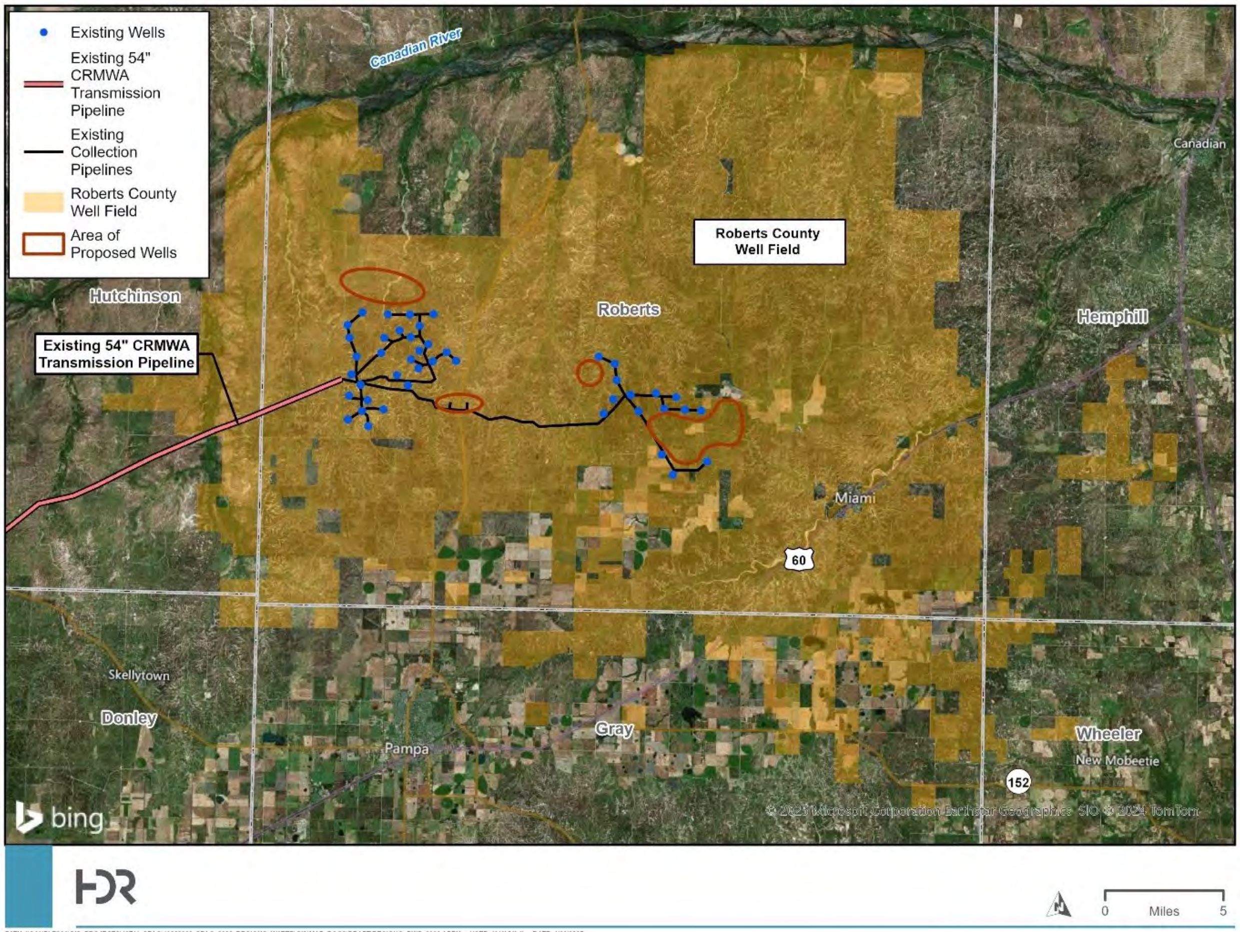

Figure 5-28. Potential New Well Locations for the RCWF Capacity Maintenance Strategy

5.22.1 Quantity of Available Water

The RCWF CM strategy is designed to maintain the target RCWF production capacity of 84 mgd. Under this strategy, the Lubbock's allocation from CRMWA will remain at 25,570 ac-ft/yr and the transmission line from the RCWF to the CRMWA Aqueduct will remain near capacity (65 mgd) at all times. The wells in this strategy restore the diminished RCWF production capacity by 46.7 mgd (approximately 19 wells with an annual average production rate of 1,750 gpm each, for a total of approximately 52,300 ac-ft/yr) before the end of the planning period.

5.22.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-21. Assumptions and conditions associated with these costs include the following:

- Capital cost for wells and collector and transmission pipelines is calculated by the Unified Costing Model that is used for strategies in the regional water plans.
- Engineering, legal, and contingency costs are 35 percent for facilities required by this strategy.
- Power is available at $0.09 per kW-hr.
- Interest during construction is estimated at 3.0 percent, and a 0.5 percent return on investments over a one-year period.
- The project will be financed for 20 years at a 3.5 percent annual interest rate.
- City of Lubbock will pay for 37.058 percent of the costs for this project, which is the City of Lubbock's allocation of water from CRMWA.

As shown, the total project cost is estimated to be $224,107,000. Annual debt service is $22,050,000 and annual operational cost, including power, is $7,055,000. This results in a total annual cost of $29,105,000. CRMWA project and operational costs are shared amongst the 11 member cities. The City of Lubbock's share of the project is 37.058 percent, which will result in an annual cost estimated at $10,786,000 and 19,381 ac-ft/yr. With debt service, this results in a unit cost of $557 per ac-ft, or $1.71 per 1,000 gallons. After debt service, the unit cost of water is estimated at $135 per ac-ft, or $0.41 per 1,000 gallons. The calculated capital costs do not include any costs for maintenance, upgrades, or rehabilitation to existing equipment. The capital cost shown are only for project components that would directly increase the volumetric supply of water available.

Table 5-21. RCWF Capacity Maintenance Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Well Field (19 Wells, Pumps, and Piping)	$224,107,000
TOTAL COST OF FACILITIES	**$224,107,000**
Engineering:	
- Planning (3%)	$6,723,000
- Design (7%)	$15,687,000
- Construction Engineering (1%)	$2,241,000
Legal Assistance (2%)	$4,482,000
Fiscal Services (2%)	$4,482,000
All Other Facilities Contingency (20%)	$44,821,000
Environmental & Archaeology Studies and Mitigation $950,000 Land Acquisition and Surveying (201 acres)	$19,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$9,865,000
TOTAL COST OF PROJECT	**$313,377,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$22,050,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,241,000
Pumping Energy Costs (0.09 $/kW-hr)	$4,814,000
TOTAL ANNUAL COST	**$29,105,000**
Available Project Yield (ac-ft/yr)	52,300
Annual Cost of Water ($ per ac-ft), based on PF=1.29	$557
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.29	$135
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.29	$1.71
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.29	$0.41

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; $/ac-ft = dollars per acre-foot; PF = peak factor

5.22.3 Implementation Issues

5.22.3.1 Environmental Issues

The proposed project occurs within the High Plains and Southwestern Tablelands physiographic regions of Texas and is within the Kansan biotic province[209]. The project components are within an area defined as mesquite shrub and crops vegetation types[210]. The mesquite shrub vegetation type is found on the High Plains, Rolling Plains, and northwestern Edwards Plateau. Commonly associated plants include narrow-leaf yucca, tasajillo (*Opuntia leptocaulis*), juniper, cholla, blue grama, hairy grama, purple three-awn (Aristida purpurea), buffalograss (*Bouteloua dactyloides*), sandlily (*Leucocrinum montanum*), sandsage, and wild buckwheat, among others. Crops include a variety of cultivated row or cover crops. EMST data and TPWD's more detailed and recently produced vegetation data[211], identify several different habitat types within the proposed well field areas including canyon breaks, deciduous shrubland, short and mixed grass prairie, herbaceous

[209] Blair, W.F. 1950. "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117.

[210] McMahan, C.A., R.G. Frye, and K.L. Brown. 1984. "The Vegetation Types of Texas." Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ March 22, 2019.

[211] TPWD. 2019. Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

vegetation, and urban low intensity. Vegetation impacts would include clearing areas for construction of approximately 19 new wells and collection pipelines.

There are many riverine and wetland features identified within the proposed new well field areas, based on NWI data. Coordination with USACE would be required for construction within waters of the U.S. Impacts from this proposed project resulting in a loss of less than 0.5 acres of waters of the U.S. could be covered under NWP 58 for utility line activities. TCEQ's Surface Water Quality Viewer[212] identifies no impaired stream or reservoir segments within 5 miles of the proposed well fields.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (P196-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets from the Texas Historical Commission, there are no state historic sites, National Register of Historic Places-listed sites, historical markers, national register properties, national register districts, or cemeteries located within a one-mile buffer of the proposed well field areas.

Several archeological surveys have been completed near the proposed well field areas, as shown in publicly available Texas Historical Commission GIS layers. A review of archeological resources in the proposed project area should be conducted during project planning. The owner or controller of the project would be required to coordinate with the Texas Historical Commission regarding impacts to cultural resources.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened, or SGCN in Roberts County are listed in Appendix D under Roberts County, Texas.

According to IPaC, provided by USFWS on February 21, 2025, th lesser prairie-chicken, Arkansas river shiner, peppered chub and monarch are federally listed species that could potentially be in the project area. The piping plover and rufa red knot were also included on the IPaC list but only need to be considered for wind energy projects. This proposed project area potentially overlaps the critical habitat for the peppered chub. TPWD's TxNDD documents the occurrences of rare species in Texas. No occurrences of endangered, threatened or SGCN-listed species have been documented within one mile of the proposed well field areas.

A biological survey and habitat assessment of the project area should be conducted to determine the presence of threatened and endangered species or their potential habitats. Based on the findings, an evaluation will be made to determine whether the proposed activities may impact listed species. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning. The installation of wells and collection pipelines should be planned so that sensitive habitats, cultural resources, and other environmentally sensitive areas are avoided.

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[212] TCEQ. 2025. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed January 16, 2025.

Summary

The project is proposed for CM of existing water supply and is not anticipated to impact land use, density, or type of development beyond that already planned within the project area. Permanent land use impacts in the project area would be limited to the new wells and collector lines. The proposed project would not require additional treatment. Disturbance to area land use would depend upon the type of construction used to install the pipelines (open cut, boring, etc.). Studies would be necessary to determine the actual impact to cultural resources, wetlands, and threatened and endangered species.

5.22.3.2 Permitting Issues

Currently, CRMWA owns the groundwater interests in over 450,000 acres of property. Wells would be drilled within this area. CRMWA would need to secure well drilling permits from the Panhandle GCD. The TCEQ must approve the design and construction of public water supply wells and water transmission facilities.

5.22.3.3 Other

Wells would be placed on properties where CRWMA owns the water rights, which include the rights to surface improvements to extract and convey their groundwater.

5.23 City of Seminole Groundwater

The City of Seminole has a water need due to increasing demand from population growth and plans to pursue a groundwater development project. The city considers nearby groundwater too expensive to purchase. Instead, a project may be located in Region F (Andrews and/or Winkler counties). The project will seek to develop 1,725 ac-ft of supply from the Edwards-Trinity (Plateau) Aquifer in the Colorado Basin. The exact locations of the additional supply wells and transmission pipeline are not yet known but would be located on property the City of Seminole would need to purchase or lease.

The major design features of this strategy include the following. The project would be implemented in two phases with eight active and two contingency wells constructed in 2020 to supply 1,225 ac-ft/yr and one additional active well constructed in 2040 to supply an additional 500 ac-ft/yr.

- Construct 10 supply wells (8 active and 2 contingency).
- Install 9,500 feet of well field piping to a new pump station.
- Construct pump station.
- Install 40 miles of main water line to the existing distribution system.

5.23.1 Quantity of Available Water

This strategy is designed to help the City of Seminole meet its increasing water demands. The well field is estimated to produce 1.5 mgd (1,725 ac-ft).

5.23.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-22.

Table 5-22. Seminole Groundwater Development Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Pump Station (2.3 mgd)	$2,933,000
Transmission Pipeline (12-in dia., 40 miles)	$16,729,000
Transmission Pump Station (2.3 mgd)	$5,867,000
Well Fields (Wells, Pumps, and Piping)	$3,583,000
TOTAL COST OF FACILITIES	**$29,112,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$9,353,000
Environmental & Archaeology Studies and Mitigation	$1,078,000
Land Acquisition and Surveying (162 acres)	$1,964,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$1,142,000
TOTAL COST OF PROJECT	**$42,649,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,001,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$203,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$220,000
Pumping Energy Costs (0.08 $/kW-hr)	$259,000
TOTAL ANNUAL COST	**$3,683,000**
Available Project Yield (ac-ft/yr)	1,725
Annual Cost of Water ($ per ac-ft), based on PF=1.5	$2,135
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.5	$395
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$6.55
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$1.21

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; $/ac-ft = dollars per acre-foot; PF = peak factor

5.23.3 Implementation Issues

5.23.3.1 Environmental Issues

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened or SGCN in Crosby County are listed in Appendix D under Seminole County, Texas.

Other specific environmental considerations for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

Summary

This strategy would provide a potable water source for the City of Seminole. The project proposed would not be anticipated to impact land use, density, or type of development beyond that already planned within the project area. Permanent land use impacts in the project area would be limited to the new wells, collector and distribution pipelines, and water treatment facilities. Disturbance to area land use would depend upon the type of construction used to install the pipelines (open cut, boring, etc.). Studies would be necessary to determine the actual impact to cultural resources, wetlands, and threatened and endangered species.

5.23.3.2 Permitting Issues

The City of Seminole already owns land where wells would be drilled within this area. The City of Seminole would need to acquire permits from the Llano Estacado Underground Water Conservation District, and the TCEQ must approve the design and construction of public water supply wells, and water transmission facilities.

5.23.3.3 Other

Wells would be placed on properties where the City of Seminole owns the water rights, which includes the rights to surface improvements to extract and convey the groundwater. The City of Seminole would need to negotiate work with surface owners to accommodate the surface operations and plans.

5.24 New Well for Littlefield

The City of Littlefield produces water from the Ogallala Aquifer. The city currently has eight active wells in a well field located in Hawsell Ranch, approximately 13 miles north of the city boundary. The wells are approximately 300 feet deep and capable of yielding between 400 to 650 gpm.

Groundwater in the Hawsell Ranch well field has a TDS of around 300 to 350 mg/L. The water that is pumped from the wellfield undergoes gaseous chlorination treatment at a treatment facility in the City of Littlefield.

This strategy adds a new well to the Hawsell Ranch well field. The well would have a depth of 300 feet and an expected average yield of 300 gpm (peak of 450 gpm) or 0.43 mgd. The well is assumed to be operational 50 percent of the time and adds 0.22 mgd of raw water to the system. The pumped water would be collected and transported by pipeline to the existing treatment facility in the City of Littlefield.

Major assumptions include the following:

- The high-capacity Ogallala production well in the well field is expected to average about 300 gpm (0.43 mgd). The well is expected to operate 50 percent of the time.
- The depth to the base of the Ogallala is about 300 feet.
- The data suggests TDS concentrations range from 300 mg/L to 350 mg/L in the well field.
- Existing well pumps near the well field are adequately sized to deliver the additional raw water to the treatment plant.

Major design features include the following:

- Install high-capacity Ogallala product well in the well field.
- Locate well on city-owned property.
- Install 6,100 feet of 6-inch raw water collection pipeline.
- Treat the water pumped from the new well with gaseous chlorination treatment at a water treatment facility in the City of Littlefield.

Figure 5-28 shows the relative well field location.

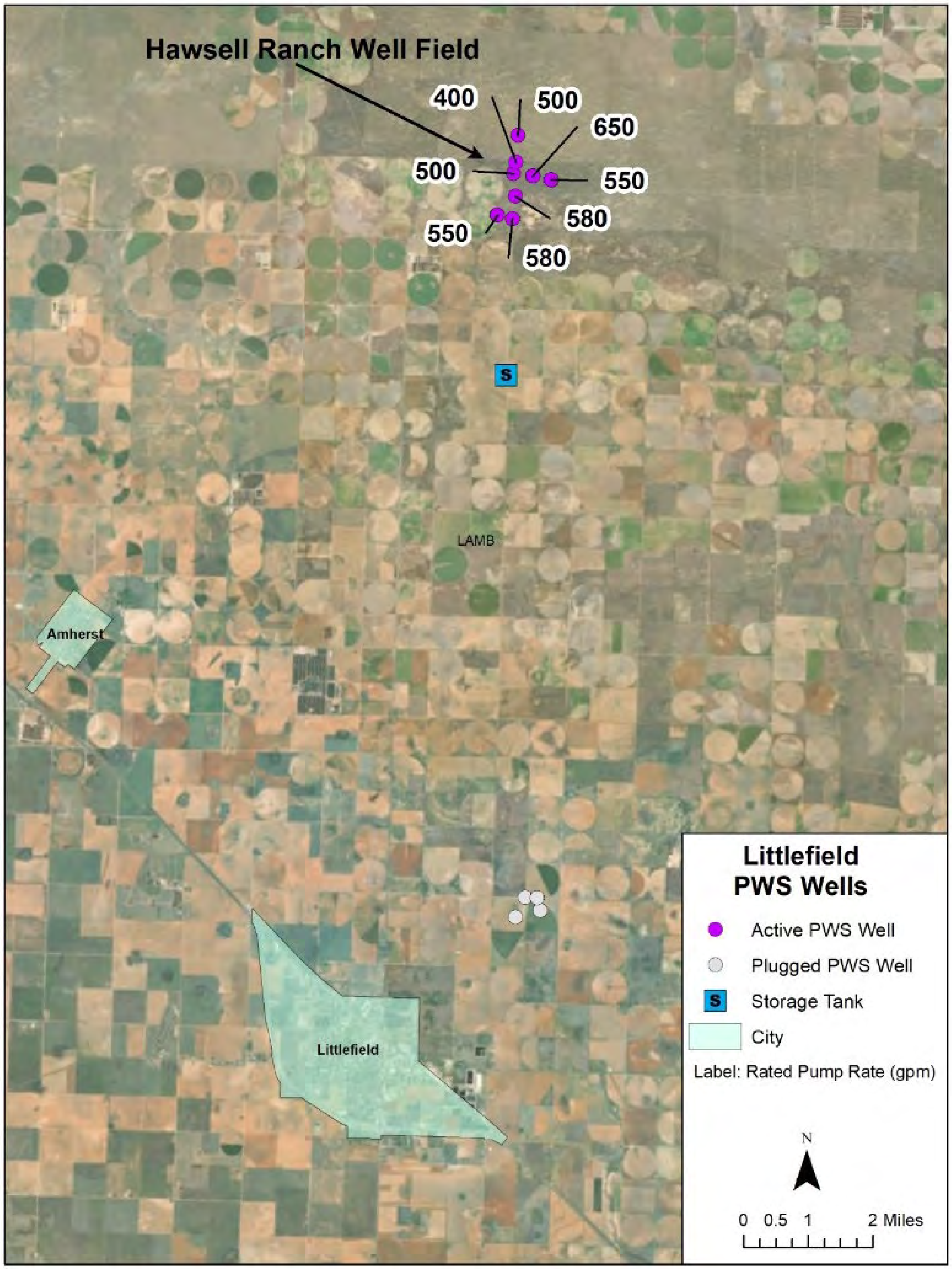

Figure 5-29. Location of Hawsell Ranch Well Field

5.24.1 Quantity of Available Water

This strategy is designed to compensate for decreased production from aging wells and to aid in meeting the City of Littlefield's peak water demands. The strategy would add a well that is projected to yield an average of 240 ac-ft/yr.

5.24.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-23. Assumptions and conditions associated with these costs include the following:

- Engineering, legal, fiscal, and contingency costs are 35 percent for facilities required by this strategy.
- Power is available at $0.09 per kW-hr.
- Interest during construction is 3.5 percent, and a 0.5 percent return on investments.
- Project will be financed for 20 years at a 3.5 percent interest rate.

As shown, the total project cost is estimated to be $2,093,000. Annual debt service is $147,000, and annual operational cost, including power is $26,000. The unit cost for 240 ac-ft/yr supply is estimated to be $721 per ac-ft or $2.21 per 1,000 gallons. This cost does not include the cost of water treatment prior to storage.

Table 5-23. City of Littlefield Additional Well Cost (September 2023 Dollars)

Item	Estimated Costs for Facilities
Public Supply Well (Well, Pumps, and Piping)	$1,475,000
TOTAL COST OF FACILITIES	**$1,475,000**
Engineering:	
- Planning (3%)	$44,000
- Design (7%)	$103,000
- Construction Engineering (1%)	$15,000
Legal Assistance (2%)	$30,000
Fiscal Services (2%)	$30,000
All Other Facilities Contingency (20%)	$295,000
Environmental & Archaeology Studies and Mitigation	$35,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$66,000
TOTAL COST OF PROJECT	**$2,093,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$147,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$15,000
Pumping Energy Costs (0.09 $/kW-hr)	$11,000
TOTAL ANNUAL COST	**$173,000**
Available Project Yield (ac-ft/yr)	240
Annual Cost of Water ($ per ac-ft), based on PF=1.5	$721
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.5	$108
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$2.21
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.33

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.24.3 Implementation Issues

5.24.3.1 Environmental Issues

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened or SGCN in Lamb County are listed in Appendix D under Lamb County, Texas.

Other specific environmental considerations for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

5.24.3.2 Permitting Issues

The City of Littlefield would require a drilling permit from the HPWD, and a public water supply well permit from the TCEQ. TCEQ must review and approve the design and construction of water supply wells.

5.25 New Well for City of Muleshoe

The City of Muleshoe has a wellfield, the Sanderosa Wellfield, of 20 active wells that pump from the Ogallala Aquifer. The wellfield is approximately a mile to the southwest of the city boundary. The wells are approximately 200 feet deep and capable of yielding between 200 to 400 gpm.

The water quality data in the Sanderosa Wellfield suggests a TDS ranging from 350 mg/L to 515 mg/L. The water that is pumped from the wellfield undergoes gaseous chlorination treatment at a treatment facility in the City of Muleshoe.

This goal of this strategy is to add a new well to the Sanderosa Wellfield. The well will pump from the Ogallala Aquifer and have a total depth of 240 feet below ground surface. Water from the well will be pumped into an existing storage tank and chlorinated while in the storage tank and before municipal distribution.

The well will be plumbed into the existing well field infrastructure via a 1,200-foot 6-inch pipeline. The pipeline is rated for a maximum pressure of 250 psi.

Major assumptions include the following:

- The high-capacity Ogallala production well in the well field is expected to average about 300 gpm (0.43 mgd). The well is expected to operate 50 percent of the time.
- The depth to the base of the Ogallala is about 200 feet.
- The data suggests TDS concentrations range from 350 mg/L to 515 mg/L in the well field.
- Existing well pumps near the well field are adequately sized to deliver the additional raw water to the storage tank and treatment plant.

Major design features include the following:

- Construct high-capacity Ogallala production well in well field located on city-owned property.

- Plumb the well with 1,200 feet of 6-inch raw water collection pipeline to existing city-owned infrastructure.
- Treat the water pumped from this well with gaseous chlorination treatment at a water treatment facility in the City of Muleshoe before municipal distribution.

Figure 5-30 shows the relative well field location.

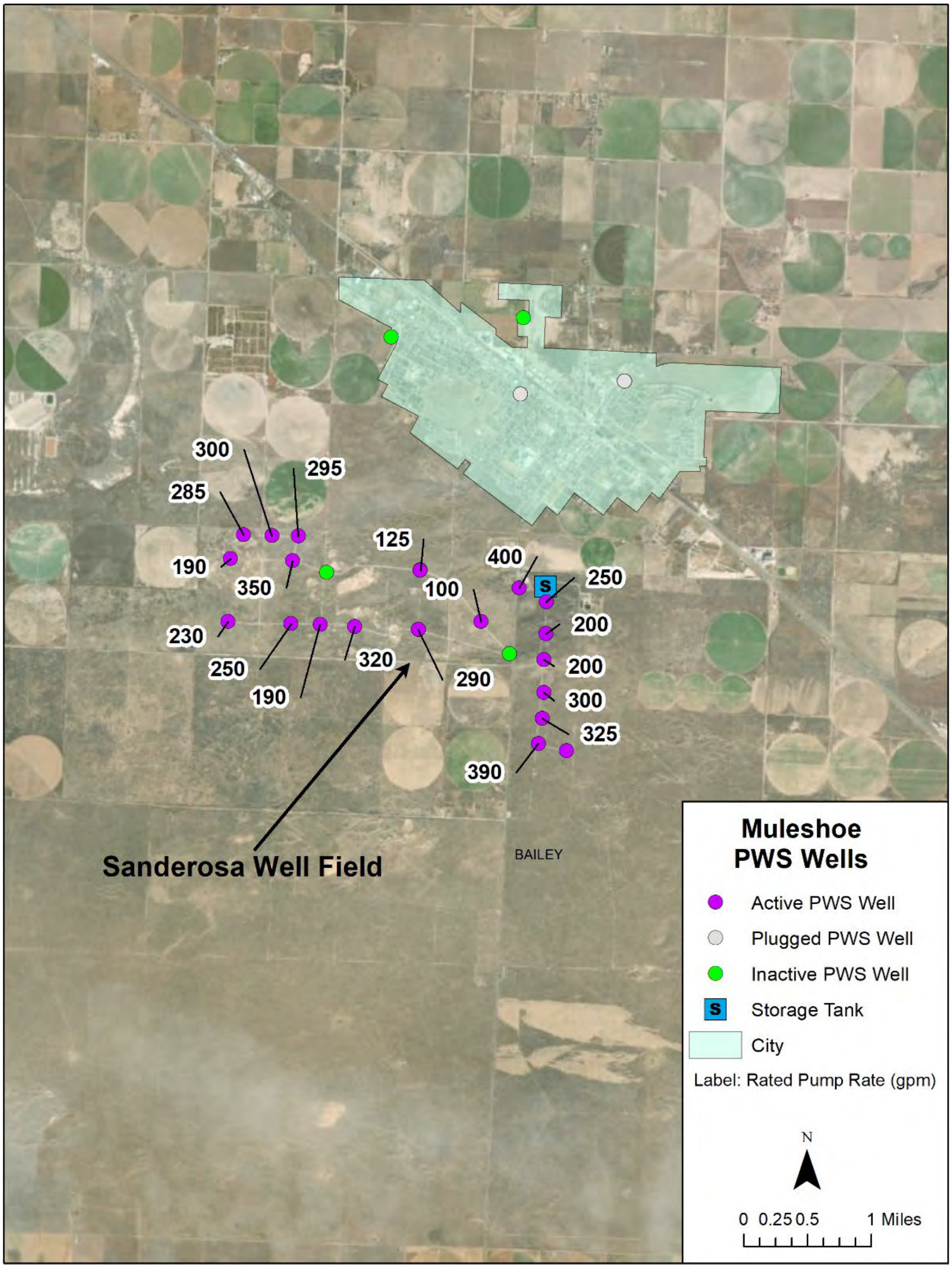

Figure 5-30. Location of Sanderosa Well Field

5.25.1 Quantity of Available Water

The strategy is intended to keep pace with the growing demand and peak need of the city. The strategy is designed to add a new well that will add 240 acre-ft per year into the system.

5.25.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-24. Assumptions and conditions associated with these costs include the following.

- Engineering, legal, fiscal, and contingency costs are 35 percent for facilities required by this strategy.
- Power is available at $0.09 per kW-hr.
- Interest during construction is 3.5 percent, and a 0.5 percent return on investments.
- Project will be financed for 20 years at a 3.5 percent interest rate.

As shown, the total project cost is estimated to be $959,000. Annual debt service is $67,000, and annual operational cost, including power, is $13,000. The unit cost for 240 ac-ft/yr supply is estimated to be $333 per ac-ft or $1.02 per 1,000 gallons. This cost does not include the cost of water treatment prior to storage.

Table 5-24. City of Muleshoe Additional Well Cost (September 2023 Dollars)

Item	Estimated Costs for Facilities
Public Supply Well (Well, Pumps, and Piping)	$687,000
TOTAL COST OF FACILITIES	**$687,000**
Engineering:	
- Planning (3%)	$21,000
- Design (7%)	$48,000
- Construction Engineering (1%)	$7,000
Legal Assistance (2%)	$14,000
Fiscal Services (2%)	$14,000
All Other Facilities Contingency (20%)	$137,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$31,000
TOTAL COST OF PROJECT	**$959,000**
Debt Service (3.5 percent, 20 years)	$67,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$7,000
Pumping Energy Costs (0.09 $/kW-hr)	$6,000
TOTAL ANNUAL COST	**$80,000**
Available Project Yield (ac-ft/yr)	240
Annual Cost of Water ($ per ac-ft), based on PF=1.2	$333
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.2	$54
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.2	$1.02
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.2	$0.17

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.25.3 Implementation Issues

5.25.3.1 Environmental Issues

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened or SGCN in Bailey County are listed in Appendix D under Bailey County, Texas.

Other specific environmental considerations for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

5.25.3.2 Permitting Issues

The City of Muleshoe would require a drilling permit from HPWD, and a public water supply well permit from the TCEQ. The TCEQ must review and approve the design and construction of water supply wells.

5.26 City of Wolfforth Groundwater

The strategy proposes a well field located approximately 5 miles southwest of the City of Wolfforth. The well field would consist of 12 new wells, 10 active and two contingent, drilled to approximately 300 feet and screened in the Edwards-Trinity Aquifer. Currently, three test wells are being drilled at the well field site to confirm that the Edwards-Trinity Aquifer is a feasible source of water for the area. If it is determined that the Edwards-Trinity Aquifer is not an adequate source of water, the wells will be drilled in the Ogallala Aquifer.

The wells are expected to have an average production rate of 150 gpm (0.22 mgd). The gathering line for each well will be approximately 6 inches in diameter and 1,500 feet in length. The gathering lines will be plumbed into the main trunkline that leads to the well field's primary pump station. The main trunkline will range from 8 to 16 inches in diameter and will be 13,500 feet in length. The pumped water will be transported via a new 5.5-mile transmission pipeline, 16 inches in diameter, to Wolfforth's Water Treatment Plant at 113 Loop 193 Wolfforth, Texas.

The water treatment facility has already hit its capacity of 1.5 mgd numerous times this year. A construction plan to increase the capacity of water treatment plant from 1.5 to 4.5 mgd should be developed. At 4.5 mgd, the water treatment plant should be able to handle the additional supply from the new well field.

There are two Ogallala wells that currently exist within the bounds of the proposed well field. The two wells have a TDS of 564 mg/L and 678 mg/L. The water produced by the strategy's new wells are expected to be of low enough salinity that an advanced treatment method will not be needed to treat the water.

Major assumptions include the following.

- Each Edwards-Trinity production well in the well field is expected to average about 150 gpm (0.22 mgd).
- The depth to the base of the Ogallala is about 200 feet.

- The wells will be screened in Edwards-Trinity at a depth of approximately 300 feet.
- The preliminary data suggests TDS concentrations range from 550 to 700 mg/L in the well field.

Major design features include the following.

- Construct 12 new wells, ten active and two contingent, drilled to approximately 300 feet and screened in the Edwards-Trinity Aquifer.
- Locate wells on city-owned property.
- Plumb the wells with 12 1,500-foot segments of 6-inch raw water collection pipeline to existing city-owned infrastructure.
- Expand the city treatment plant from 1.5 mgd to 4.5 mgd to handle the additional produced water.
- Install new primary pump station capable of pumping 4.4 mgd of raw water to the city's treatment plant.
- Install new 16-inch transmission pipeline spanning 5.2 miles from the well field to the city treatment plant.

Figure 5-31 shows the relative location of the well field.

5.26.1 Quantity of Available Water

This strategy is designed with a primary pump station capable of pumping 4.4 mgd from the well field to the city. The well field is expected to produce an average of 3,300 ac-ft/yr. The water yield from the well field is expected to meet the peak demands of the city and satisfy its growing water demand.

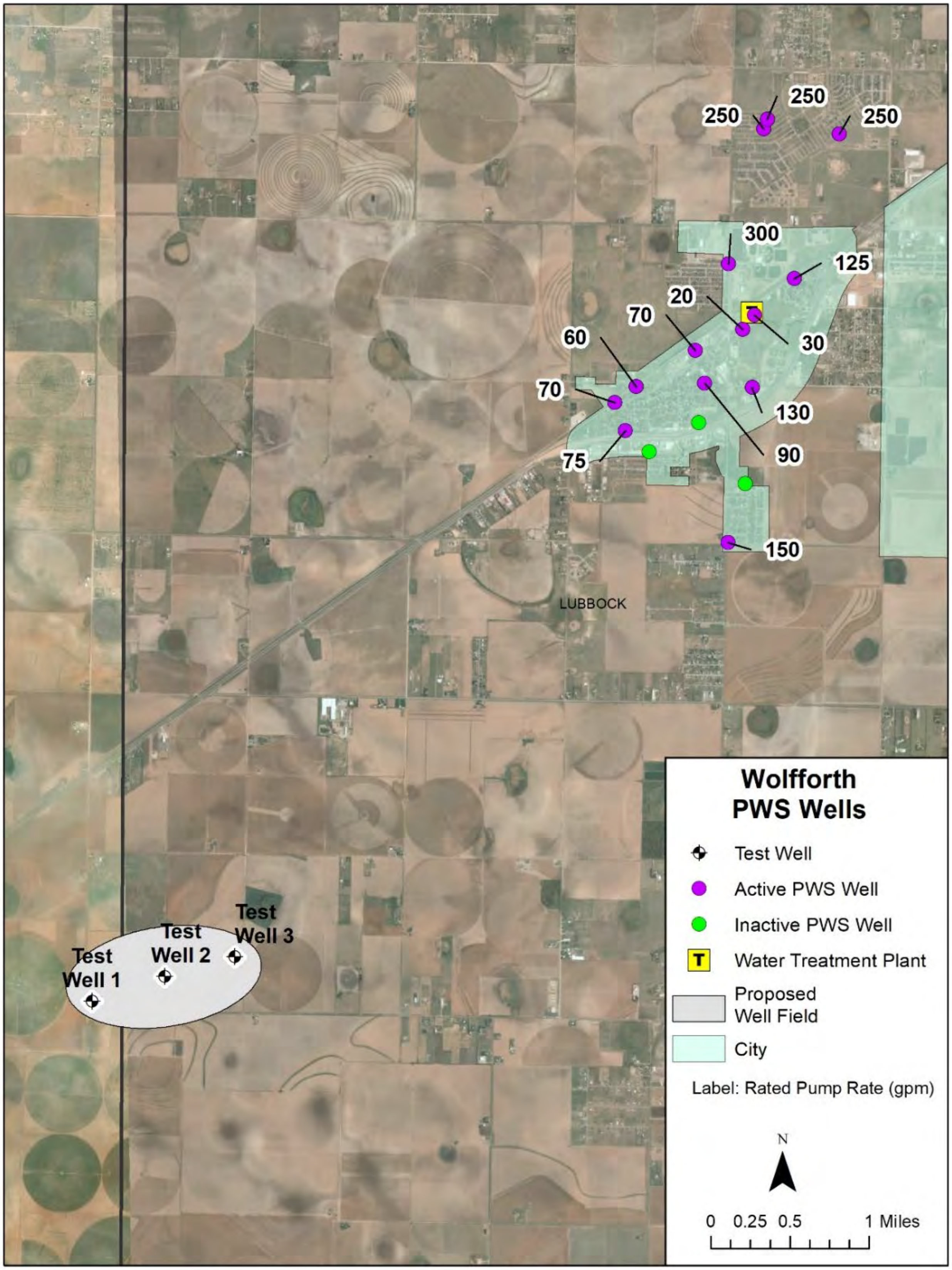

Figure 5-31. Location of Wolfforth Proposed Well Field

5.26.2 Strategy Costs

A cost summary is provided in Table 5-25. Assumptions and conditions associated with these costs include the following.

- Engineering, legal, fiscal, and contingency costs are 30 percent for the transmission pipeline and 35 percent for facilities required by this strategy.
- Power is available at $0.09 per kW-hr.
- Interest during construction is 3.5 percent, and a 0.5 percent return on investments.
- Project will be financed for 20 years at a 3.5 percent interest rate.

As shown, the total project cost is estimated to be $48,818,000. Annual debt service is $3,433,000 and annual operational cost, including power is $1,455,000. The unit cost for 3,300 ac-ft/yr supply is estimated to be $1,481 per ac-ft or $4.54 per 1,000 gallons. This cost does not include the cost of water treatment prior to storage.

Table 5-25. City of Wolfforth Additional Well Field Cost (September 2023 Dollars)

Item	Estimated Costs for Facilities
Primary Pump Station (4.4 MGD)	$2,582,000
Transmission Pipeline (16-in dia., 5.2 miles)	$9,577,000
Well Field (Wells, Pumps, and Piping)	$10,654,000
Water Treatment Plant Expansion (3 MGD)	$12,255,000
Integration, Relocations, Backup Generator & Other	$33,000
TOTAL COST OF FACILITIES	**$35,101,000**
Engineering:	
- Planning (3%)	$1,053,000
- Design (7%)	$2,457,000
- Construction Engineering (1%)	$351,000
Legal Assistance (2%)	$702,000
Fiscal Services (2%)	$702,000
Pipeline Contingency (15%)	$1,437,000
All Other Facilities Contingency (20%)	$5,105,000
Environmental & Archaeology Studies and Mitigation	$335,000
Land Acquisition and Surveying (53 acres)	$39,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,536,000
TOTAL COST OF PROJECT	**$48,818,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,433,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$203,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$65,000
Water Treatment Plant	$1,033,000
Pumping Energy Costs (0.09 $/kW-hr)	$154,000
TOTAL ANNUAL COST	**$4,888,000**
Available Project Yield (ac-ft/yr)	3,300
Annual Cost of Water ($ per ac-ft), based on PF=1.5	$1,481
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.5	$441
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$4.54
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$1.35

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.26.3 Implementation Issues

5.26.3.1 Environmental Issues

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened or SGCN in Lubbock County are listed in Appendix D under Lubbock County, Texas.

Other specific environmental considerations for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

5.26.3.2 Permitting Issues

The City of Wolfforth would require drilling permits from the HPWD and public water supply well permits from the TCEQ. The TCEQ must approve the design and construction of water supply wells. The city already owns the land and groundwater rights for the area that the wells would be drilled in.

5.27 City of Brownfield Groundwater

The CRMWA supplies water to Brownfield as well as seven other cities. CRMWA delivers water from Lake Meredith to Brownfield via pipeline.

The City of Brownfield has a total of 19 wells that have been installed within the city boundary. All are either inactive or plugged. The wells are approximately 100 to 175 feet deep and each well was rated between 155 to 475 gpm.

Water quality samples taken from the City of Brownfield wells show a wide array of TDS values ranging from 371 mg/L to 2591 mg/L. The TDS values tend to be higher towards the southern portion of the city.

The strategy adds a new well in the northern part of the City of Brownfield. The well would have a depth of about 170 feet and an average yield of 200 gpm (peak of 300 gpm) or 0.29 mgd. The well is expected to be operational 50 percent of the time and adds 0.15 mgd of raw water to the system.

Major assumptions include the following:

- The high-capacity Ogallala production well in the city limits is expected to average about 200 gpm (0.29 mgd). The well is expected to operate 50 percent of the time.
- The depth to the base of the Ogallala is about 170 feet.
- The data suggests TDS concentrations range from 700 mg/L to 990 mg/L in the northern part of the city.
- Existing pumps near the well are adequately sized to deliver the additional raw water to the treatment plant.
- The water pumped from this well would be stored in a storage tank within the city limits.

Major design features include the following:

- Construct high-capacity Ogallala production well.

- Locate the well on city-owned property.
- Plumb the well with 2,100 feet of 6-inch raw water collection pipeline into existing infrastructure.

Figure 5-32 shows the relative location of the well field.

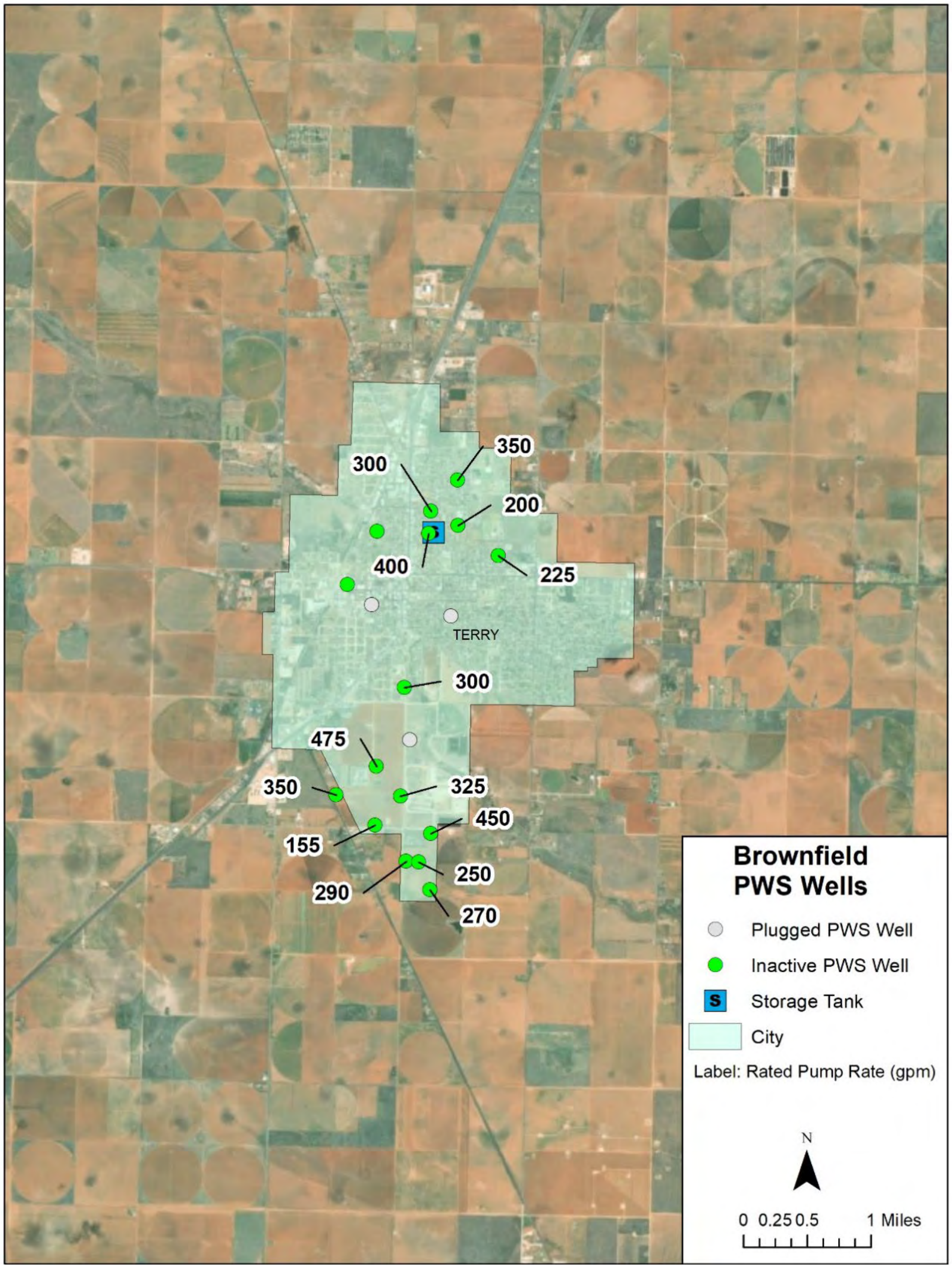

Figure 5-32. City of Brownfield Public Water Supply Wells

5.27.1 Quantity of Available Water

The strategy is designed to add a new well that will add 160 ac-ft per year into the system and help the City of Brownfield meet its increasing water demands.

5.27.2 Strategy Costs

A cost summary is provided in Table 5-26. Assumptions and conditions associated with these costs include the following.

- Engineering, legal, fiscal, and contingency costs are 35 percent for facilities required by this strategy.
- Power is available at $0.09 per kW-hr.
- Interest during construction is 3.5 percent, and a 0.5 percent return on investments.
- Project will be financed for 20 years at a 3.5 percent interest rate.

As shown, the total project cost is estimated to be $1,305,000. Annual debt service is $92,000, and annual operational cost, including power is $14,000. The unit cost for 160 ac-ft/yr supply is estimated to be $663 per ac-ft or $2.03 per 1,000 gallons. This cost does not include the cost of water treatment prior to storage.

Table 5-26. City of Brownfield Additional Well Cost (September 2023 Dollars)

Item	Estimated Costs for Facilities
Public Supply Well (Well, Pumps, and Piping)	$923,000
TOTAL COST OF FACILITIES	**$923,000**
Engineering:	
- Planning (3%)	$28,000
- Design (7%)	$65,000
- Construction Engineering (1%)	$9,000
Legal Assistance (2%)	$18,000
Fiscal Services (2%)	$18,000
All Other Facilities Contingency (20%)	$185,000
Environmental & Archaeology Studies and Mitigation	$14,000
Land Acquisition and Surveying (2 acres)	$3,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$42,000
TOTAL COST OF PROJECT	**$1,305,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$92,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$9,000
Pumping Energy Costs (0.09 $/kW-hr)	$5,000
TOTAL ANNUAL COST	**$53,000**
Available Project Yield (ac-ft/yr)	160
Annual Cost of Water ($ per ac-ft), based on PF=1.5	$663
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.5	$88
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$2.03
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.27

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.27.3 Implementation Issues

5.27.3.1 Environmental Issues

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened or SGCN in Terry County are listed in Appendix D under Terry County, Texas.

Other specific environmental considerations for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

5.27.3.2 Permitting Issues

The City of Brownfield would require a permit from the South Plains Underground Water Conservation District and a public water supply well permit from the TCEQ.

5.28 City of Ralls Groundwater

The City of Ralls has one active well located in the city limits near the intersection of Avenue E and 7th Street. Other than the lone active well, the City of Ralls purchases the remainder of its water from the White River Municipal Water District (WRMWD). WRMWD also supplies the cities of Crosbyton, Post and Spur.

The strategy plans to install three wells, two active and one contingent, at a nearby well field that is owned by WRMWD. The well field currently has 11 active wells and is located approximately 4 miles east of the City of Ralls. The wells are approximately 350 feet deep and can yield 50 to 150 gpm.

Under this strategy, minimal additional infrastructure would be needed to plumb the new wells into the existing WRMWD network. The new wells would be plumbed into the existing WRMWD transmission pipeline, which would pump the water to the City of Ralls.

The major design features and assumptions of this strategy include the following:

- The total production from the three proposed wells would average about 150 gpm (0.22 mgd).
- The depth to the base of the Ogallala is about 350 feet.
- Install three wells, two active and one contingent.
- Locate the wells on property owned by WRMWD.
- Plumb with three 1,000-foot segments of 6-inch raw water collection pipeline into existing WRMWD infrastructure.

Figure 5-33 shows the relative location of the well field.

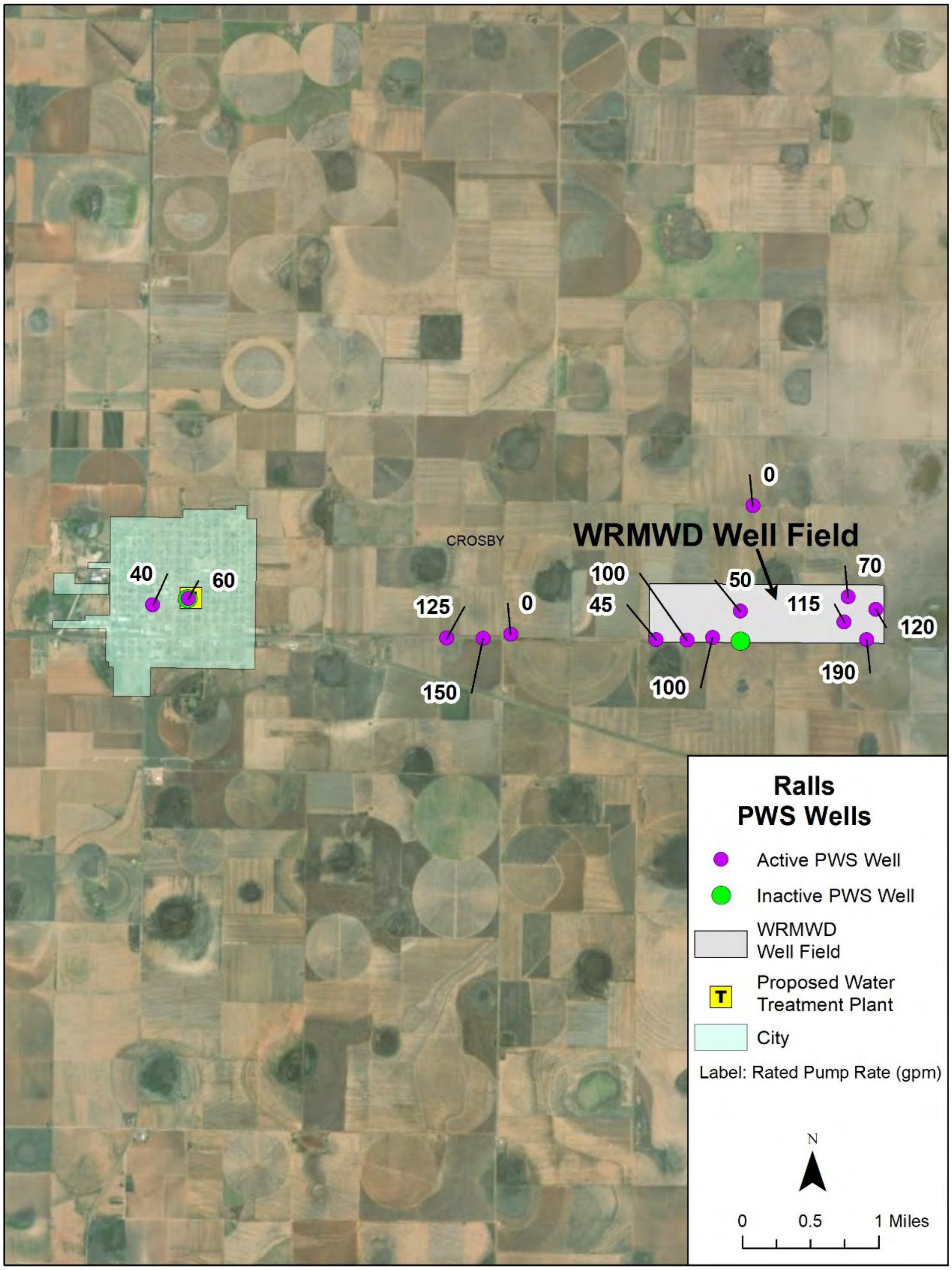

Figure 5-33. Location of WRMWD Well Field

5.28.1 Quantity of Available Water

The strategy is designed to add three wells that can pump an average total of 160 ac-ft/yr. The additional water production is expected to meet peak demands. The city will continue to purchase water from WRMWD to supplement its water needs.

5.28.2 Strategy Costs

A cost summary is provided in Table 5-27. Assumptions and conditions associated with these costs include the following.

- Engineering, legal, and contingency costs are 35 percent for facilities required by this strategy.
- Power is available at $0.09 per kW-hr.
- Interest during construction is 3 percent, and a 0.5 percent return on investments.
- Project will be financed for 20 years at a 3.5 percent interest rate.

As shown, the total project cost is estimated to be $846,000. Annual debt service is $60,000, and annual operational cost, including power, is $6,000. The unit cost for 160 ac-ft/yr supply is estimated to be $450 per ac-ft or $1.38 per 1,000 gallons. This cost does not include the cost of water treatment prior to storage.

Table 5-27. City of Ralls Additional Well Cost (September 2018 Dollars)

Item	Estimated Costs for Facilities
Public Supply Wells (3 Wells, Pumps, and Piping)	$586,000
TOTAL COST OF FACILITIES	**$586,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$205,000
Environmental & Archaeology Studies and Mitigation	$29,000
Land Acquisition and Surveying (5 acres)	$6,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$23,000
TOTAL COST OF PROJECT	**$849,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$60,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$6,000
Pumping Energy Costs (0.08 $/kW-hr)	$6,000
TOTAL ANNUAL COST	**$72,000**
Available Project Yield (ac-ft/yr)	160
Annual Cost of Water ($ per ac-ft), based on PF=1.5	$450
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.5	$75
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$1.38
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.23

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.28.3 Implementation Issues

5.28.3.1 Environmental Issues

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened or SGCN in Crosby County are listed in Appendix D under Crosby County, Texas.

Other specific environmental considerations for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

5.28.3.2 Permitting Issues

The City of Ralls would require a permit from the HPWD and the TCEQ. The TCEQ must approve the design and construction of water supply wells. The city would need to coordinate with WRMWD on the placement of the new wells.

5.29 City of New Deal Groundwater

The City of New Deal currently receives supplies from the following sources:

- City-owned wellfield located approximately 3 miles east of the city.
- Wholesale water from the City of Lubbock delivered through Lubbock's distribution system.
- Wholesale water from the City of Slaton (from CRMWA allocation and delivered through the Lubbock distribution system).

As described in the 2016 LERWP, the City of New Deal drilled a new well in 2011 to meet growing demands. Anticipating new residential growth in the area, the City of New Deal is considering adding another well located within the city's wellfield. The city owns 20 acres adjacent to their existing wells for this purpose. A HPWD monitoring well (HPWD #66120, north of FM 1729) near the site shows depths to water levels in the Ogallala Aquifer averaging 235 feet and an aquifer saturated thickness of approximately 77 feet. The new well is anticipated to produce an average of 150 gpm or 242 ac-ft/yr.

Major design features include the following:

- The well would be located on property owned by the City of New Deal.
- 1,000-foot segment of 6-inch raw water collection pipeline would plumb the well into existing City of New Deal infrastructure.

Figure 5-34 shows the location of the City of New Deal's existing well field and the location of the new well.

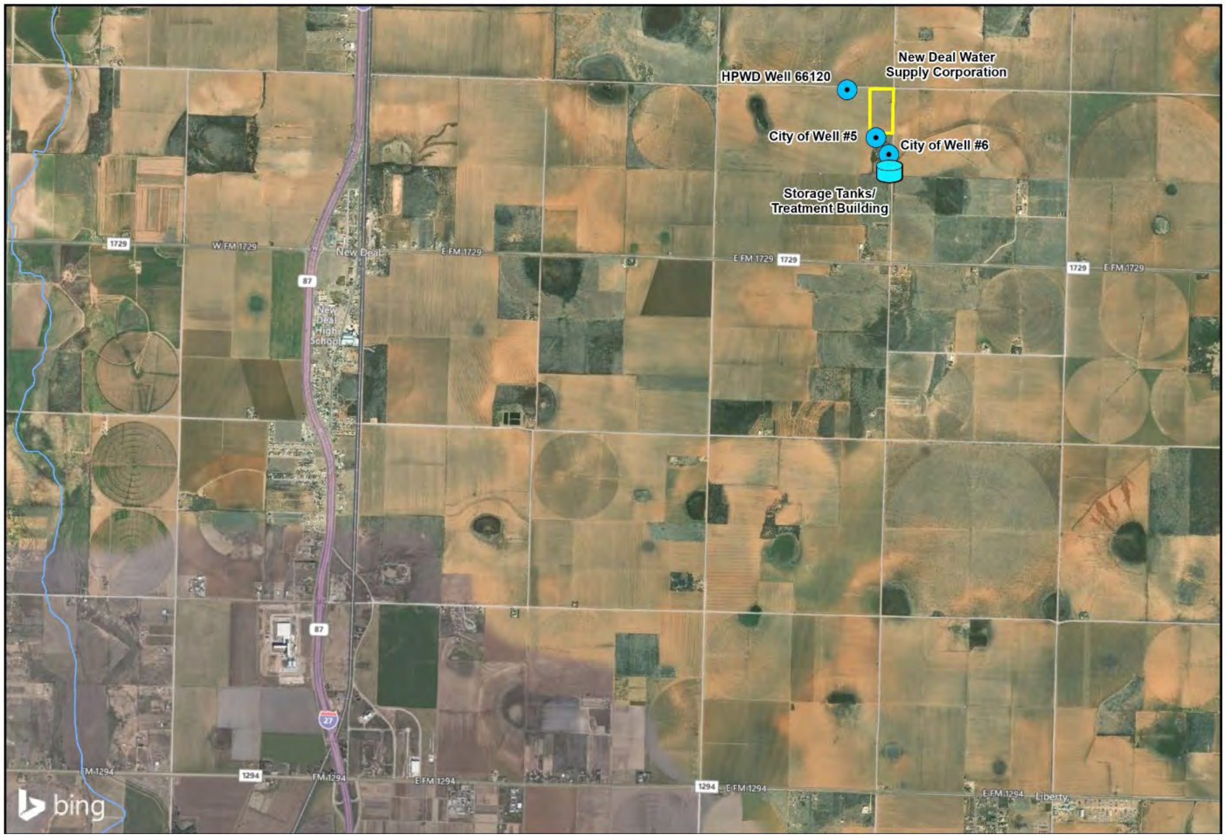

Figure 5-34. Location Map of City of New Deal New Well

5.29.1 Quantity of Available Water

The strategy is designed to add one well that can pump an average total of 150 gpm or 242 ac-ft/yr. The additional water production is expected to meet future demands.

5.29.2 Strategy Costs

A cost summary is provided in Table 5-28. Assumptions and conditions associated with these costs include the following:

- Land is already owned for well site and piping to existing infrastructure.
- Engineering, legal, and contingency costs are 35 percent for facilities required by this strategy.
- Power is available at $0.09 per kW-hr.
- Interest during construction is 3 percent, and a 0.5 percent return on investments.
- Project will be financed for 20 years at a 3.5 percent interest rate.

As shown, the total project cost is estimated to be $704,000. Annual debt service is $49,000, and annual operational cost, including power, is $16,000. The unit cost for 242 ac-ft/yr supply is estimated to be $269 per ac-ft or $0.82 per 1,000 gallons.

Table 5-28. City of New Deal Additional Well Cost (September 2023 Dollars)

Item	Estimated Costs for Facilities
Public Supply Well (1 Wells, Pumps, and Piping)	$500,000
TOTAL COST OF FACILITIES	**$500,000**
Engineering	
- Planning (3%)	$15,000
- Design (7%)	$35,000
- Construction Engineering (1%)	$5,000
Legal Assistance (2%)	$10,000
Fiscal Services (2%)	$10,000
All Other Facilities Contingency (20%)	$100,000
Environmental & Archaeology Studies and Mitigation	$6,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$23,000
TOTAL COST OF PROJECT	**$704,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$49,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$5,000
Pumping Energy Costs (0.08 $/kW-hr)	$11,000
TOTAL ANNUAL COST	**$65,000**
Available Project Yield (ac-ft/yr)	242
Annual Cost of Water ($ per ac-ft), based on PF=1	$269
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$66
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.82
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.20

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.29.3 Implementation Issues

5.29.3.1 Environmental Issues

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened or SGCN in Lubbock County are listed in Appendix D under Lubbock County, Texas.

Other specific environmental considerations for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

5.29.3.2 Permitting Issues

The City of New Deal would require a permit from the HPWD and the TCEQ. The design and construction of water supply wells must be approved by the TCEQ. The city would need to coordinate with WRMWD on the placement of the new wells.

5.30 City of Lockney Groundwater

The City of Lockney currently receives supplies from the following sources:

- Lockney-owned wellfield, with four wells, spanning from approximately 1 mile west of the city to just within the city boundary.

- Wholesale water from Lake Mackenzie purchased from the Mackenzie Municipal Water Authority (MMWA).

In 2010, the City of Lockney installed two wells on land they had recently acquired. The wells have proven unreliable and one well pumps air during the irrigation season. The wells recover somewhat during the non-irrigation season with one well producing 50 to 60 gpm and the other well producing 30 to 40 gpm.

Because Lockney's existing supplies are decreasing, the city is considering adding up to four wells located on land the city would acquire. The new wells would tie-in via a ½- to ¾-mile pipeline to an existing pipeline north of Highway 70 between Aiken and Lockney. A Lockney public water supply well (State Well Number 1161111, approximately 1 mile west of Lockney) shows a depth to water level in the Ogallala Aquifer averaging 247 feet below land surface and 80 to 100 feet of saturated thickness for the aquifer. Each of the new wells is anticipated to produce an average of 50 gpm or 80 ac-ft/yr.

Major design features include the following:

- Drill and complete up to four wells in the Ogallala Aquifer in an area between Aiken and Lockney.
- Construct a ½- to ¾-mile pipeline to tie the wells into an existing pipeline north of Highway 70 between Aiken and Lockney.
- Raw water will be pumped into the transmission line pending water quality data from the newly drilled wells. If a water treatment plant is needed, a new treatment plant will be built for the wellfield, and water will be treated before being pumped into Lockney.

Figure 5-35 shows the location of the City of Lockney's existing well field and the location of the potential well field.

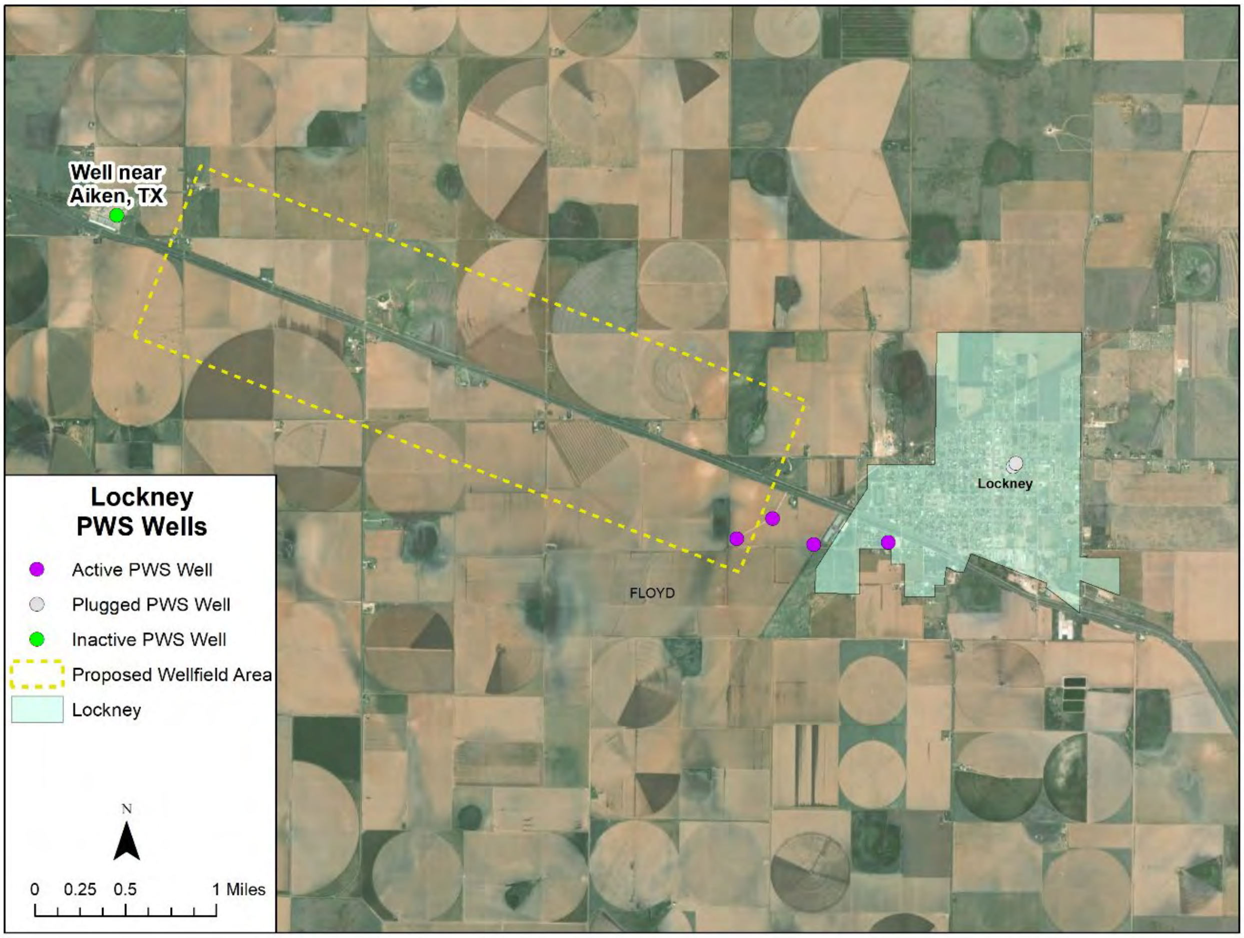

Figure 5-35. Location Map of City of Lockney Proposed Wellfield

5.30.1 Quantity of Available Water

The strategy is designed to add four wells that can each pump an average of 50 gpm or 80 ac-ft/yr for a total supply from this strategy of 320 ac-ft/yr. The additional water production is expected to meet future demands.

5.30.2 Strategy Costs

A cost summary is provided in Table 5-29. Assumptions and conditions associated with these costs include the following:

- Land will be purchased for well site and piping to existing infrastructure.
- A new water treatment plant is not required.
- Engineering, legal, and contingency costs are 35 percent for facilities required by this strategy.
- Power is available at $0.09 per kW-hr.
- Interest during construction is 3.5 percent, and a 0.5 percent return on investments.
- Project will be financed for 20 years at a 3.5 percent interest rate.

As shown, the total project cost is estimated to be $3,484,000. Annual debt service is $245,000, and annual operating cost, including power, is $37,000. The unit cost for 320 ac-ft/yr of supply is estimated to be $881 per ac-ft or $2.70 per 1,000 gallons.

Table 5-29. City of Lockney Additional Well Cost (September 2023 Dollars)

Item	Estimated Costs for Facilities
Public Supply Well (4 Wells, Pumps, and Piping)	$2,395,000
TOTAL COST OF FACILITIES	**$2,395,000**
Engineering	
- Planning (3%)	$72,000
- Design (7%)	$168,000
- Construction Engineering (1%)	$24,000
Legal Assistance (2%)	$48,000
Fiscal Services (2%)	$48,000
All Other Facilities Contingency (20%)	$479,000
Environmental & Archaeology Studies and Mitigation	$108,000
Land Acquisition and Surveying (18 acres)	$32,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$110,000
TOTAL COST OF PROJECT	**$3,484,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$245,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$24,000
Pumping Energy Costs (0.08 $/kW-hr)	$13,000
TOTAL ANNUAL COST	**$282,000**
Available Project Yield (ac-ft/yr)	320
Annual Cost of Water ($ per ac-ft), based on PF=1.2	$881
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.2	$116
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.2	$2.70
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.2	$0.35

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.30.3 Implementation Issues

5.30.3.1 Environmental Issues

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened or SGCN in Floyd County are listed in Appendix D under Floyd County, Texas.

Other specific environmental considerations for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

5.30.3.2 Permitting Issues

The City of Lockney would require a permit from the HPWD and the TCEQ. The design and construction of water supply wells must be approved by the TCEQ.

5.31 Gaines County Other Groundwater

Gaines County is the only county in the Llano Estacado Region that has projected water needs for uses other than municipal, irrigation, industrial, or livestock. These other water demands are projected to be 10 ac-ft/yr in 2030 and increase to 1,880 ac-ft/yr in 2070.

The strategy would add wells to meet the projected water needs of the county. There are no constraints on where the wells are expected to be located other than that they must be within the county boundary. Transmission pipelines and pumping stations were not considered in this strategy as the general locations of the wells are unknown.

Interested parties will install enough wells to meet the county's projected needs. The well specifications such as yield, depth, and elevation are estimated based on existing wells within an area of interest in the county. The wells are expected to have an average production rate of 150 gpm (0.22 mgd). The gathering line for each well will be 6 inches in diameter and 1,000 feet in length.

Major assumptions include the following:

- The Ogallala production wells are expected to average about 150 gpm (0.22 mgd).
- All production wells would produce from the Ogallala Aquifer.
- Wells are priced as if they were public water supply wells.

Major design features include the following:

- Install 1,000-foot segments of 6-inch raw water collection pipeline.
- Install 2,000-foot segments of 6- to 12-inch raw water main pipeline.

5.31.1 Quantity of Available Water

The strategy is designed to add 10 wells, 8 active and 2 contingents that can pump an average total of 1930 ac-ft/yr. The additional water production is expected to meet peak demands.

5.31.2 Strategy Costs

A cost summary is provided in Table 5-30. Assumptions and conditions associated with these costs include the following:

- Engineering, legal, and contingency costs are 35 percent for facilities required by this strategy.
- Power is available at $0.09 per kW-hr.
- Interest during construction is 3 percent, and a 0.5 percent return on investments.
- Project will be financed for 20 years at a 3.5 percent interest rate.

As shown, the total project cost is estimated to be $4,159,000. Annual debt service is $293,000, and annual operational cost, including power is $108,000. The unit cost for 1,930 ac-ft/yr supply is estimated to be $208 per ac-ft or $0.64 per 1,000 gallons. This cost does not include the cost of water treatment prior to storage.

Table 5-30. Gaines County Other Additional Well Cost (September 2023 Dollars)

Item	Estimated Costs for Facilities
Public Supply Wells (10 Wells, Pumps, and Piping)	$2,902,000
TOTAL COST OF FACILITIES	**$2,902,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,016,000
Environmental & Archaeology Studies and Mitigation	$111,000
Land Acquisition and Surveying (19 acres)	$18,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$112,000
TOTAL COST OF PROJECT	**$4,159,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$293,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$29,000
Pumping Energy Costs (0.08 $/kW-hr)	$79,000
TOTAL ANNUAL COST	**$401,000**
Available Project Yield (ac-ft/yr)	1,930
Annual Cost of Water ($ per ac-ft), based on PF=1.1	$208
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.1	$56
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.1	$0.64
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.1	$0.17

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.31.3 Implementation Issues

5.31.3.1 Environmental Issues

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened or SGCN in Gaines County are listed in Appendix D under Gaines County, Texas.

Other specific environmental considerations for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

5.31.3.2 Permitting Issues

Entities in Gaines County would need to acquire permits from the Llano Estacado Underground Water Conservation District, and the TCEQ must approve the design and construction of public water supply wells, and water transmission facilities.

5.32 Reclaimed Water Aquifer Storage and Recovery to Lubbock North Water Treatment Plant

The Reclaimed Water ASR to NWTP Strategy is included in the 2018 Lubbock Strategic Water Supply plan. The proposed project will treat and transport reclaimed water from the SEWRP to an ASR facility located northeast of the City, near the NWTP. Treated supplies would be conveyed through a new 20-inch diameter, 7.3-mile pipeline to the ASR well field. The reclaimed water will then be injected into the Ogallala Aquifer and then recovered approximately 0.25 miles downgradient to the east. The recovered water will be delivered to the NWTP for disinfection and blending with other treated water from CRMWA for distribution to customers. Recharge into ASR is assumed to occur uniformly throughout the year. The injected water will be closely monitored as it migrates downgradient over 1 to 2 years to the recovery well field to allow for soil aquifer treatment and residence time.

The major design features of this strategy include:

- Nine Ogallala ASR injection wells (500 gpm) with spacing of 1,320 feet or greater, including two contingency or standby wells.
- Seventeen 250 gpm ASR recovery wells constructed at about 160 feet deep with horizontal spacing of 1,320 feet or greater, including three contingency or standby wells.
- 7.3-mile pipeline from SEWRP to the ASR Well Field.
- A new 18-in, 2.5-mile pipeline to deliver the recovered water to the NWTP. A booster pump station and ground storage are included for delivery to the NWTP.
- An expansion of the NWTP is necessary for additional chlorine disinfection.
- Assume SEWRP upgrades for biological nutrient removal (BNR) have been completed.
- 3.5 mgd RO treatment to reduce TDS to less than 500 mg/L from the SEWRP effluent prior to injection in the Ogallala.
- RO concentrate (0.5 mgd) will be stream discharged.
- Requires a two-year piloting program prior to TCEQ acceptance of the soil aquifer treatment. Piloting project will include treatment to reduce nitrate and TDS, one 500 gpm recharge well, one recovery well, and one monitoring well. The location of the recovery well will provide a travel time of 30 days to evaluate water quality through soil aquifer treatment.

Figure 5-36 depicts the relative locations of the Reclaimed Water ASR wells and associated infrastructure.

5.32.1 Quantity of Available Water

This Reclaimed Water ASR to NWTP Strategy assumes that up to 5 mgd of reclaimed water will be sent to the ASR system and recovered. The final supply of 5 mgd (5,600 ac-ft/yr) will be blended and distributed at the NWTP.

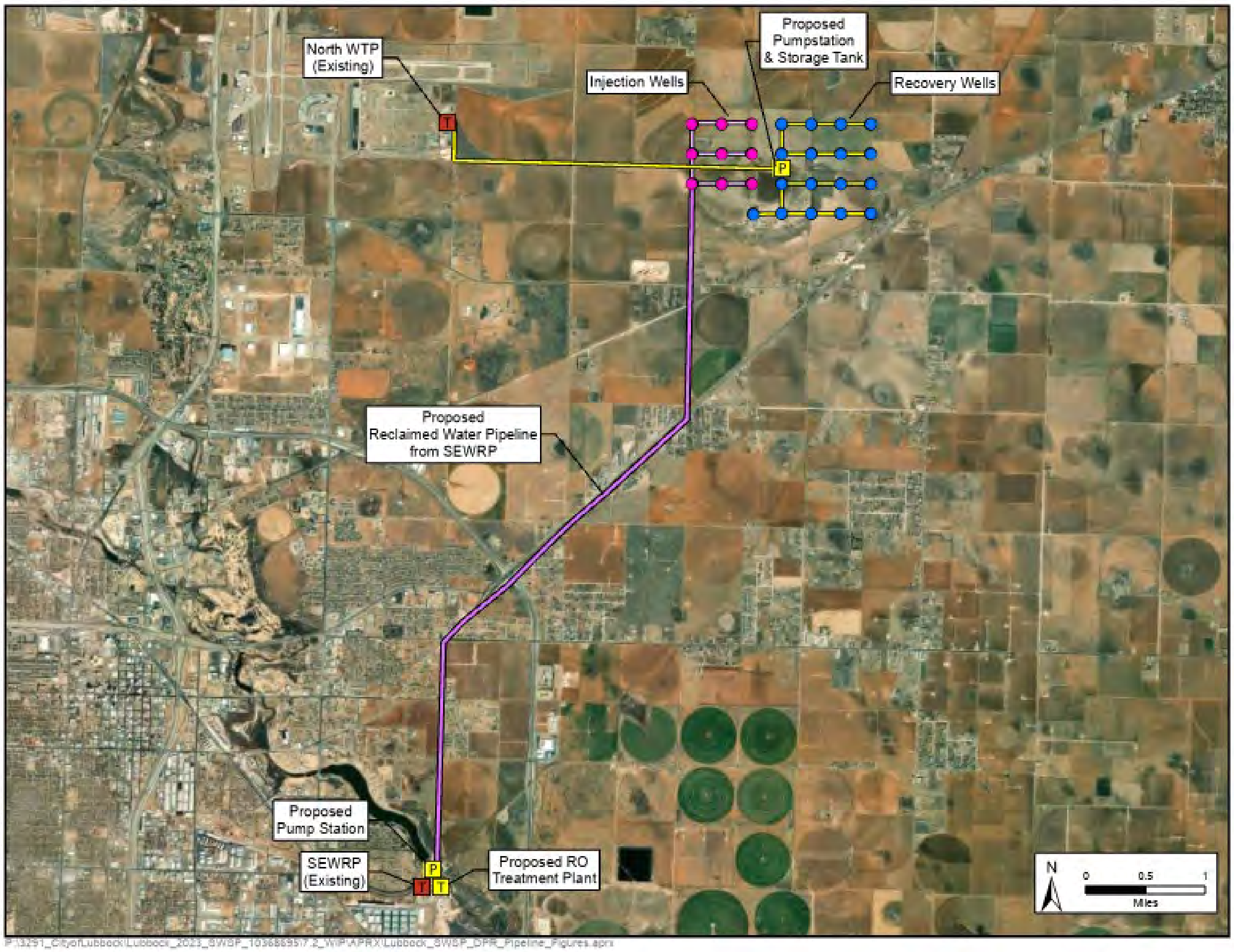

Figure 5-36. Reclaimed Water Aquifer Storage and Recovery to NWTP Infrastructure

5.32.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-31. Assumptions and conditions associated with these costs include:

- Property for the well field is estimated to be purchased for $3,200 per acre, based on a blend of agricultural and residential land cost data from the Lubbock Central Appraisal District.
- The depth to the base of the Ogallala Aquifer is about 160 feet.
- Additional costs for well field SCADA, valves and pump controls were included in the strategy costs.
- Engineering, legal, and contingency costs is 30 percent of pipelines and 35 percent for other facilities.
- Power is available at $0.09 per kwh.
- Interest during construction is 3.5 percent, and a 0.5 percent return on investments.
- The project will be financed for 20-years at a 3.5 percent interest rate.
- The project is assumed to have a 2-year construction period.

As shown, the total cost is estimated to be $124,134,000. The pilot project costs for two years are estimated at $5,485,000. Annual debt service is $8,726,000; and, annual operational cost, including power, is $8,632,000. This results in a total annual cost of $17,358,000. With debt service, the unit cost for 5,600 ac-ft/yr of supply at the NWTP is estimated to be $3,100 per ac-ft, or $9.51 per 1,000 gallons. After debt service, the unit cost of water for water at the NWTP is estimated to be $1,541 per ac-ft, or $4.73 per 1,000 gallons. This cost does not include the distribution of the potable water from the NWTP to potential customers.

Table 5-31. Reclaimed Water Aquifer Storage and Recovery to NWTP Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Pump Stations (5.3 mgd)	$4,142,000
Transmission Pipeline (18-20 in dia., 9.2 miles)	$18,131,000
Well Fields (Wells, Pumps, and Piping)	$19,848,000
RO Treatment (3.5 mgd) and Disinfection (5 mgd)	$38,708,000
SCADA and Integration, Relocations, Backup Generator	$1,507,000
TOTAL COST OF FACILITIES	**$82,336,000**
Engineering:	
- Planning (3%)	$2,470,000
- Design (7%)	$5,764,000
- Construction Engineering (1%)	$823,000
Legal Assistance (2%)	$1,647,000
Fiscal Services (2%)	$1,647,000
Pipeline Contingency (15%)	$2,720,000
All Other Facilities Contingency (20%)	$12,841,000
Pilot Project (Infrastructure and Program costs)	$5,485,000
Environmental & Archaeology Studies and Mitigation	$712,000
Land Acquisition and Surveying (129 acres)	$454,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$7,235,000
TOTAL COST OF PROJECT	**$124,134,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$8,726,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$395,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$104,000
Water Treatment Plant	$7,189,000
Pumping Energy Costs (@ 0.09 $/kW-hr)	$944,000
TOTAL ANNUAL COST	**$17,358,000**
Available Project Yield (ac-ft/yr)	5,600
Annual Cost of Water ($ per ac-ft), based on PF=1	$3,100
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$1,541
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$9.51
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$4.73

Notes: mgd = million gallons per day; SCADA = Supervisory Control and Data Acquisition; ROI = return on investment; kwh = kilowatt-hour; ac-ft/yr = acre-feet per year.

5.32.3 Implementation Issues

5.32.3.1 Environmental Issues

The installation of wells and collection pipelines should be planned and installed so that sensitive habitats, cultural resources, and other sensitive areas are avoided.

5.32.3.2 Permitting Issues

TCEQ requires a DPR process that provides 5.5, 6, and 8-log reduction for crypto, giardia, viruses,[213] respectively at the recharge wellhead. For the proposed ASR to be permitted, TCEQ will require a demonstration project to claim soil aquifer treatment credits. The recharge well will require an Experimental Class V injection well authorization for piloting the treatment effectiveness.

The recharge piloting would likely take 2 years to accumulate the operational and sampling data necessary to support a Class V ASR injection well permit for non-drinking water and for TCEQ approval to recover the water through water wells for treatment in the existing NWTP.

Because the recharge water would not reliably meet drinking water standards prior to injection, the ASR injection well would likely need an individual Class V authorization, which would require public notice and might require one or more public hearings. The HPWD would have no permitting authority of the ASR injection or production wells as long as there is a net positive balance of recoverable water in the storage zone.

The design and construction of public water supply wells and water transmission facilities must be approved by the TCEQ. There may also be permitting obligations pursuant to Texas Water Code depending upon regulatory characterization of the associated return flows.

5.33 Reclaimed Water Aquifer Storage and Recovery to South Water Treatment Plant

The Reclaimed Water ASR to SWTP Strategy is included in the 2024 Lubbock Strategic Water Supply plan will treat and transport reclaimed water from the SEWRP to an ASR facility located near the SWTP. Treated supplies would be conveyed through the existing transmission system to the HLAS after the site is decommissioned then delivered to the ASR well field. The reclaimed water will be injected into the ETHP Aquifer and recovered approximately 1 mile downgradient to the east. The recovered water will be delivered to the SWTP for disinfection and blending with other treated water from Lake Alan Henry for distribution to customers. Recharge into ASR is assumed to occur uniformly throughout the year. Losses will be minimal, and it is assumed that nearly all of the original 5 mgd of reclaimed supply could be recovered down gradient after 1 to 2 years of residence time in the aquifer.

The major design features of this strategy include:

- Seventeen ETHP ASR recharge wells with spacing of 700 feet or greater, including three contingency or standby wells.

[213] TWDB, “Direct Potable Reuse Resource Document”. April 2015. 3-10

- Twenty-one ASR recovery wells with horizontal spacing of 700 feet or greater, including three contingency or standby wells.
- A total of 10 monitoring wells will be constructed within the recharge and recovery well fields.
- A 6-mgd advanced ATP at the Lubbock SEWRP with stream discharge of RO concentrate.
- A booster pump station to deliver the reclaimed water from the ground storage to ASR wells for injection.
- A new 18-inch, 2-mile pipeline to deliver the recovered water to the SWTP. Due to the relatively small quantity of water being recovered, a booster pump station and ground storage were not deemed necessary for delivery to the SWTP.
- A 5-mgd expansion of the SWTP and associated expansion of the high service pump station at the SWTP.
- An existing 4.5-mile, 30-in Low Head C Transmission pipeline to allow flow from the SWTP to reach Pumping Station 16 or Bailey County groundwater to flow to Pumping Station 14 (see Figure 4.11).
- An existing 15-mgd Low Head C Pump Station to transfer water from the SWTP to Pumping Station 16.

Figure 5-37 depicts the relative locations of the Reclaimed Water ASR wells and associated infrastructure.

5.33.1 Quantity of Available Water

This Reclaimed Water ASR to SWTP Strategy assumes that up to 5 mgd (5,600 ac-ft/yr) of reclaimed water will be recovered from the ASR well field.

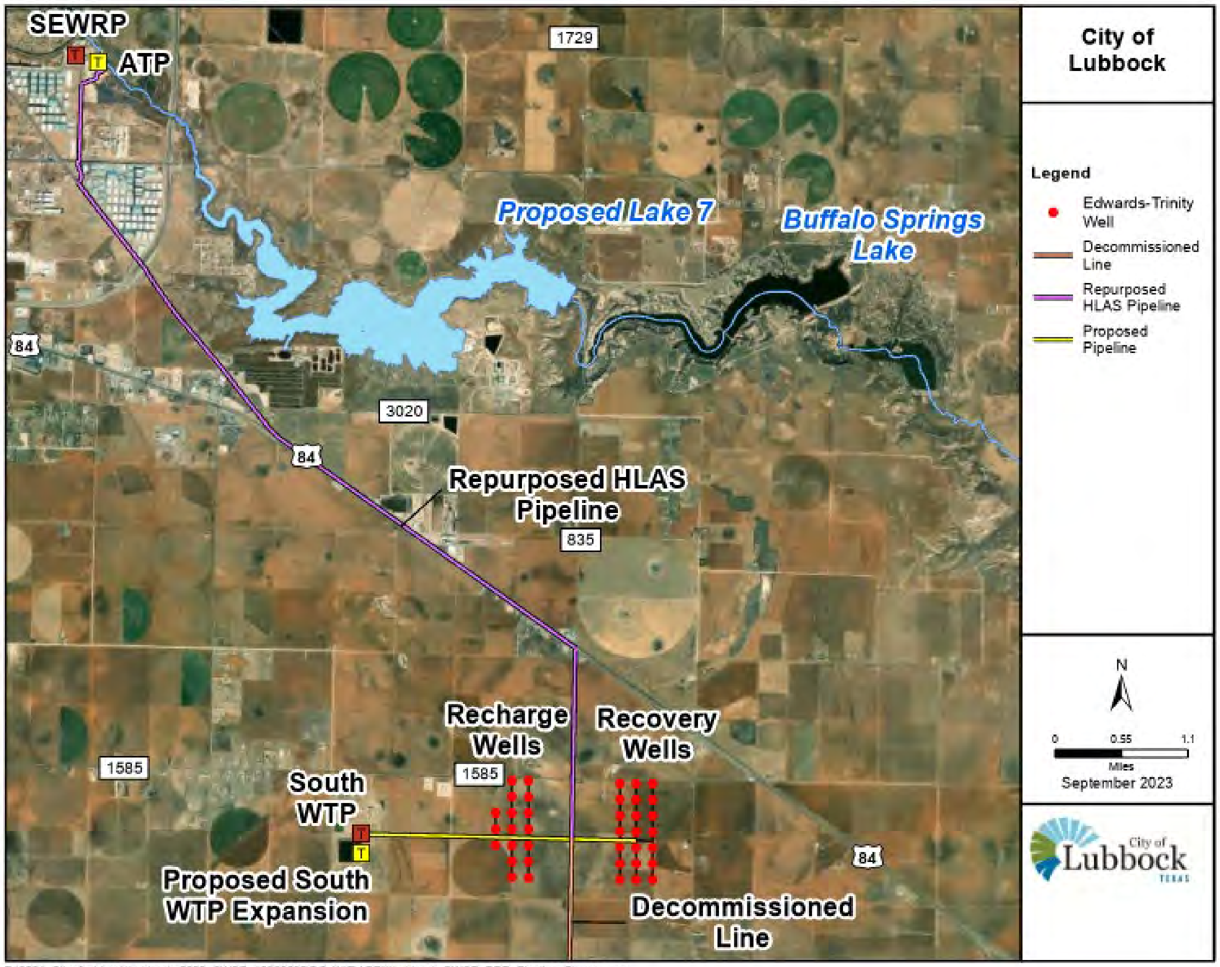

Figure 5-37. Reclaimed Water Aquifer Storage and Recovery to SWTP Infrastructure

5.33.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-32. Assumptions and conditions associated with these costs include:

- The existing transmission system for the decommissioned HLAS will be repurposed for delivery of purified water to the ASR project. This repurposed use is dependent on the future use of this line by Xcel Energy and for the existing outfall.
- Property for the well field is estimated to be purchased for $3,200 per acre, based on a blend of agricultural and residential land cost data from the Lubbock Central Appraisal District.
- The depth to the base of the ETHP Aquifer is about 250 feet.
- Additional costs for well field SCADA, valves and pump controls were included in the strategy costs.
- Engineering, legal, and contingency costs is 30 percent of pipelines and 35 percent for other facilities.
- Power is available at $0.09 per kwh.
- Interest during construction is 3.5 percent, and a 0.5 percent return on investments.

- The project will be financed for 20-years at a 3.5 percent interest rate.
- The project is assumed to have a 2-year construction period.

As shown, the total project cost is estimated to be $146,233,000. Annual debt service is $10,286,000; and, annual operational cost, including power, is $4,587,000. This results in a total annual cost of $14,873,000. During debt service, the unit cost for 5,600 ac-ft/yr of supply at the SWTP is estimated to be $2,656 per ac-ft, or $8.15 per 1,000 gallons. After debt service, the unit cost of water at the SWTP is estimated to be $819 per ac-ft, or $2.51 per 1,000 gallons.

Table 5-32. Reclaimed Water Aquifer Storage and Recovery to SWTP Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Transmission Pipeline (18 in dia., 2 miles)	$3,320,000
Well Fields (Wells, Pumps, and Piping)	$22,568,000
South Water Treatment Plant Expansion (5 mgd)	$16,986,000
Advanced Treatment Plant (6 mgd)	$53,066,000
SCADA and Integration, Relocations, Backup Generator	$2,539,000
TOTAL COST OF FACILITIES	**$98,479,000**
Engineering:	
- Planning (3%)	$2,954,000
- Design (7%)	$6,894,000
- Construction Engineering (1%)	$985,000
Legal Assistance (2%)	$1,970,000
Fiscal Services (2%)	$1,970,000
Pipeline Contingency (15%)	$498,000
All Other Facilities Contingency (20%)	$19,032,000
Environmental & Archaeology Studies and Mitigation	$2,275,000
Land Acquisition and Surveying (640 acres)	$2,253,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$8,923,000
TOTAL COST OF PROJECT	**$146,233,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$10,286,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$284,000
Pump Stations (2.5% of Cost of Facilities)	$0
Water Treatment Plant	$3,500,000
Pumping Energy Costs (@ 0.09 $/kwh)	$803,000
TOTAL ANNUAL COST	**$14,873,000**
Available Project Yield (ac-ft/yr)	5,600
Annual Cost of Water ($ per ac-ft), based on PF=1	$2,656
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$819
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$8.15
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.51

Notes: mgd = million gallons per day; SCADA = Supervisory Control and Data Acquisition; ROI = return on investment; kwh = kilowatt-hour; ac-ft/yr = acre-feet per year.

5.33.3 Implementation Issues

5.33.3.1 Environmental Issues

The installation of wells and collection pipelines should be planned and installed so that sensitive habitats, cultural resources, and other environmentally sensitive areas are avoided.

5.33.3.2 Permitting Issues

The City does not own the land or groundwater rights in the area of interest. Groundwater rights and/or land will need to be purchased so wells can be drilled within the proposed ASR area. The HPWD would have no permitting authority of the ASR injection or production wells as long as there is a net positive balance of recoverable water in the storage zone.

The City will need to acquire an ASR permit through TCEQ (rules still under development) and notice the HPWD. The design and construction of public water supply wells and water transmission facilities must be approved by the TCEQ. There may also be permitting obligations pursuant to Texas Water Code depending upon regulatory characterization of the associated return flows.

The drinking water produced for the project will meet or exceed all state and federal drinking water standards. The TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. TCEQ will require a pilot study prior to regulatory approval and for determining design values for the treatment technologies. Treatment requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, results of effluent quality sampling/monitoring data, and wastewater treatment process.

Disposal of residuals from the project would meet all state and federal requirements for discharge of waste. A TPDES permit will be required to discharge RO concentrate. The water quality for RO concentrate discharged into the North Fork of the Double Mountain Fork (NFDMF) of the Brazos River will meet or exceed the stream standards for that segment.[214]

Stream crossings would be subject to Section 404 of the Clean Water Act. Due to the minimal and temporary impacts associated with the pipeline installation, it is likely that most of the proposed project would be authorized by Nationwide Permit 12.

Monitoring is likely to include Cryptosporidium (or a surrogate organism), other regulated contaminants, and may include contaminants on the USEPA CCL, including ECCs and PPCPs.

[214] City of Lubbock, “Potable Water Reuse Implementation Feasibility Study”. March 2017. 7-9.

5.34 City of Shallowater Groundwater

The strategy proposes a well field located in Lubbock County. The well field will consist of 2 new wells, drilled approximately 170 feet in the Ogalla Aquifer.

The wells are anticipated to have an average production rate of 500 gpm (0.72 mgd). The collection line for each well will be approximately 8 inches in diameter and 750 feet in length. The collection lines will tie into the main trunkline that leads to the proposed 1.5 MG ground storage tank and pump station located on-site. The proposed 1.5 MGD pump station will transfer the groundwater from the GST via a new 6.1-mile transmission pipeline, 12 inches in diameter, to the City of Shallowater's existing water treatment plant.

The existing water treatment plant is currently at capacity. A construction plan to expand the capacity of the water treatment plant from 0.5 mgd to 2.0 mgd is underway and construction is expected to begin in 2027. At 2.0 mgd, the water treatment plant should be able to handle the additional water supply from the new well field.

Major assumptions include the following:

- Each Ogallala production well in the well field is expected to average about 500 gpm (0.72 mgd).
- The depth of the base of the Ogallala is about 170 feet.

Major design features include the following:

- Construction two new wells in Lubbock County, drilled to approximately 170 feet and screened in the Ogallala Aquifer.
- Locate wells on city-owned property.
- Install approximately 1,500 feet of 8-inch raw water collection lines in the well field connecting to the GST.
- Expand the City's WTP from 0.5 mgd to 2.0 mgd.
- Install a new 12-inch diameter, 6.1-mile transmission line from the GST and pump station at the well field to the City's WTP.

5.34.1 Quantity of Available Water

This strategy is designed with a primary pump station capable of pumping 2 mgd from the well field to the WTP. The well field is expected to produce an average of 750 ac-ft/yr.

5.34.2 Strategy Costs

A cost summary is provided in Table 5-33. Assumptions and conditions associated with these costs include the following:

- Engineering, legal, fiscal, and contingency costs are 30 percent for the transmission pipeline and 35 percent for facilities required by this strategy.
- Power is available at $0.09 per kW-hr.
- Interest during construction is 3.5 percent, and a 0.5 percent return on investments.

- Project will be financed for 20 years at a 3.5 percent interest rate.

As shown, the total project cost is estimated to be $41,600,000. Annual debt service is $2,927,000 and annual operational cost, including power is $1,154,000. The unit cost for 750 ac-ft/yr supply is estimated to be $5,441 per ac-ft or $16.70 per 1,000 gallons. This cost does not include the cost of water treatment prior to storage.

Table 5-33 City of Shallowater Well Field Cost (September 2023 Dollars)

Item	Estimated Costs for Facilities
Primary Pump Station (2 MGD)	$6,000,000
Transmission Pipeline (12-in dia., 6.1 miles)	$12,318,000
Well Field (Wells, Pumps, and Piping)	$1,576,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,500,000
Water Treatment Plant Expansion (1.5 MGD)	$8,706,000
TOTAL COST OF FACILITIES	**$30,100,000**
Engineering:	
- Planning (3%)	$903,000
- Design (7%)	$2,107,000
- Construction Engineering (1%)	$301,000
Legal Assistance (2%)	$602,000
Fiscal Services (2%)	$602,000
Pipeline Contingency (20%)	$1,848,000
All Other Facilities Contingency (20%)	$3,556,000
Environmental & Archaeology Studies and Mitigation	$210,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,310,000
TOTAL COST OF PROJECT	**$41,600,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,927,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$154,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$150,000
Water Treatment Plant	$823,000
Pumping Energy Costs (0.09 $/kW-hr)	$27,000
TOTAL ANNUAL COST	**$4,081,000**
Available Project Yield (ac-ft/yr)	750
Annual Cost of Water ($ per ac-ft)	$5,441
Annual Cost of Water After Debt Service ($ per ac-ft)	$1,539
Annual Cost of Water ($ per 1,000 gallons)	$16.70
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$4.72

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year

5.34.3 Implementation Issues

The need for a new well field and 1.5 mgd WTP expansion results from increasing population and demands. The increasing population also results in the need for additional capacity for the City of Shallowater wastewater treatment plant (WWTP). In consideration of the fact that the WWTP is at maximum capacity and is at the end of its useful life, planning for a new WWTP is underway and construction is expected to begin in 2027. The proposed WWTP will increase capacity from 0.29 mgd to 1.4 mgd and is estimated to cost $28,500,000.

Additional implementation issues include infrastructure improvements related to elevated storage capacity, ground storage capacity, fire flow improvements, and waterline replacements which are required to keep the City in compliance with regulatory requirements. These improvements are expected to cost $6,300,000.

As the City of Shallowater's population continues to increase, the City is interested in studying the feasibility of using the Dockum Aquifer as a future water supply. A test hole is expected to be drilled in the Spring of 2025 to determine capacity and treatment options.

5.34.3.1 Environmental Issues

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened or SGCN in Lubbock County are listed in Appendix D under Lubbock County, Texas.

Other specific environmental considerations for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

5.34.3.2 Permitting Issues

The City of Shallowater would require drilling permits from the HPWD and public water supply well permits from the TCEQ. The TCEQ must approve the design and construction of water supply wells. The City is currently in the process of procuring groundwater rights for the area that the wells would be drilled in. The City owns all land required for the remaining proposed project elements.

5.35 City of Slaton Groundwater

The strategy proposes two new wells located approximately 2 miles southwest of the City of Slaton. The well field would consist of two new wells, one active and one contingent, drilled approximately 250 feet deep in the Ogalla Aquifer.

The wells are expected to have an average production rate of 100 gpm (0.14 mgd). The collection pipeline for each well will be approximately 6 inches in diameter and 1,500 feet in length. The collection pipelines will connect into the main trunkline that leads to the well field's existing primary pump station and connects to the City's existing distribution system. The main trunkline will be 8 inches in diameter and will be 1,500 feet in length.

There are two inactive Ogallala wells that currently exist within the bounds of the City's existing well field, and location of the proposed wells. The two existing wells have an average TDS of 792 mg/L. The water produced by the strategy's new wells are expected to be of low enough salinity that an advanced treatment method will not be needed to treat the water.

Major assumptions include the following.

- Each Ogallala production well in the well field is expected to average about 100 gpm (0.14 mgd).
- The depth to the base of the Ogallala is about 250 feet.
- The preliminary data suggests TDS concentrations average 792 mg/L in the well field.

Major design features include the following.

- Construct two new wells, one active and one contingent, drilled to approximately 250 feet and screened in the Ogallala Aquifer.

- Locate wells on city-owned property.
- Connect the wells with two 1,500-foot segments of 6-inch raw water collection pipeline to existing city-owned infrastructure.

5.35.1 Quantity of Available Water

The well field with this strategy is expected to produce an average of 165 ac-ft/yr. The water yield from the well field is expected to satisfy the City's growing water demand.

5.35.2 Strategy Costs

A cost summary is provided in Table 5-34. Assumptions and conditions associated with these costs include the following.

- Engineering, legal, fiscal, and contingency costs are 30 percent for the transmission pipeline and 35 percent for facilities required by this strategy.
- Power is available at $0.09 per kW-hr.
- Interest during construction is 3.5 percent, and a 0.5 percent return on investments.
- Project will be financed for 20 years at a 3.5 percent interest rate.

As shown, the total project cost is estimated to be $1,875,000. Annual debt service is $132,000 and annual operational cost, including power is $18,000. The unit cost for 165 ac-ft/yr supply is estimated to be $909 per ac-ft or $2.79 per 1,000 gallons. This cost does not include the cost of water treatment prior to storage.

Table 5-34 City of Slaton Groundwater Cost (September 2023 Dollars)

Item	Estimated Costs for Facilities
Well Field (Wells, Pumps, and Piping)	$1,325,000
TOTAL COST OF FACILITIES	**$1,325,000**
Engineering:	
- Planning (3%)	$40,000
- Design (7%)	$93,000
- Construction Engineering (1%)	$13,000
Legal Assistance (2%)	$27,000
Fiscal Services (2%)	$27,000
All Other Facilities Contingency (20%)	$265,000
Environmental & Archaeology Studies and Mitigation	$26,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$59,000
TOTAL COST OF PROJECT	**$1,875,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$132,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$13,000
Pumping Energy Costs (0.09 $/kW-hr)	$5,000
TOTAL ANNUAL COST	**$150,000**
Available Project Yield (ac-ft/yr)	165
Annual Cost of Water ($ per ac-ft), based on PF=1.5	$909
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.5	$109
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$2.79
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.33

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.35.3 Implementation Issues

5.35.3.1 Environmental Issues

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened or SGCN in Lubbock County are listed in Appendix D under Lubbock County, Texas.

Other specific environmental considerations for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

5.35.3.2 Permitting Issues

The City of Slaton would require drilling permits from the HPWD and public water supply well permits from the TCEQ. The TCEQ must approve the design and construction of water supply wells. The city already owns the land and groundwater rights for the area that the wells would be drilled in.

C. Water Conservation

5.36 Background on Conservation

Water conservation is defined as those methods and practices that either reduce the demand for water supply or increase the efficiency of the supply. When supply is conserved it can be made available for future use. Water conservation is typically a non-capital-intensive alternative that any water supply entity can pursue.

Water supply entities and major water right holders that meet the following criteria are required by TWC and TAC statute to submit a water conservation plan to TCEQ and/or the TWDB every 5 years.

- Entities requesting TWDB financial assistance greater than $500,000
- Entities with 3,300 connections or more
- Surface water right holders of
  - Greater than 1,000 ac-ft/yr (non-irrigation)
  - Greater than 10,000 ac-ft/yr (irrigation)

The purpose of a water conservation plan is to establish strategies for reducing water consumption and water loss or waste; maintain and improve water use efficiency; and increase water recycling and reuse. Water conservation plans must identify 5- and 10-year targets and goals (Table 5-39) for water use and water loss, including methods used to track progress in meeting targets and goals.

TCEQ has prepared model water conservation plans (WCPs) for municipal public water suppliers, wholesale providers, industrial and mining entities, and agricultural users to provide guidance and suggestions to entities regarding the preparation of water conservation plans. Not all items in the model plan will apply to every system's situation, but the overall model plan can be used as a starting point for most entities. For WUGs wishing to develop a new WCP, the LERWPG suggests considering best management practices (BMPs) from local WCPs for entities similar in size in addition to the TCEQ model WCPs. The TCEQ model WCPs can be found on TCEQ's website at the following link: https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/conserve.html, or by calling TCEQ at 512-239-4691 and requesting a printed copy of the form.

The TWDB guidance and TAC §357.34(f)2 requires regional water planning groups to consider water conservation practices, including potentially applicable BMPs, for each WUG with an identified water need (shortage) in the regional water plan.

5.37 Municipal Water Conservation

Several water conservation resources have been developed for use in preparing regional water plans. The TWDB developed the Municipal Water Conservation Planning Tool to assist individual water utilities with planning conservation programs. The tool allows the user to include a mix of BMPs and produces the expected annual conservation savings and associated capital and annual costs. The tool comes with population and water demand projections (and other data such as number of connections) for many municipal WUGs. The tool includes user-based functionality to load baseline demand projections, select conservation measures (plan or single-year savings) based on implementation activity, manage scenarios (to evaluate various BMP combinations) and use this information to calculate water savings and costs.

In 2009, the Texas Legislature enacted House Bill 2667 (HB 2667) establishing new minimum standards for plumbing fixtures sold in Texas beginning in 2014. HB 2667 clarifies and sets out the national standards of the American Society of Mechanical Engineers (ASME) and American National Standards Institute (ANSI) by which plumbing fixtures will be produced and tested. This bill establishes a phase-in of high-efficiency plumbing fixtures brought into Texas, which allows manufacturers the time to change their production, at the same time allowing retailers the opportunity to turn over their inventory. HB 2667 creates an exemption for those manufacturers that volunteer to register their products with the EPA's WaterSense Program, which should result in additional water savings. This bill also repeals TCEQ's certification process for plumbing fixtures since the plumbing fixtures must meet national certification and testing procedures.

TCEQ has promulgated rules to reflect this new change in law. The 2009 law requires that by January 2014, all toilets use no more than 1.28 gallons per flush (20 percent savings from the 1991 1.6 gallons per flush standard). Based upon an average frequency of per-person toilet use in households of 5.1 and a per-use savings of 0.32 gallons per use the supplementary savings of adopting high-efficiency toilets is 1.63 gallons per capita per day (gpcd). This change is reflected in Table 5-35.

Table 5-35. Standards for Plumbing Fixtures

Fixture	Standard
Toilets*	1.28 gallons per flush
Shower Heads	2.75 gallons per minute at 80 psi
Urinals	0.5 gallon per flush
Faucet Aerators	2.20 gallons per minute at 60 psi
Drinking Water Fountains	Shall be self-closing

*Bill 2667 of the 81st Texas Legislature, 2009

The TWDB has estimated that the effect of the new plumbing fixtures in dwellings, offices, and public places will reduce per capita water use by approximately 20 gpcd, in comparison to what would have occurred with previous generations of plumbing fixtures. The TWDB estimated water conservation effect of 20 gpcd is shown in Table 5-36. The low-flow plumbing fixtures effects that are already included in the water demand projections are deducted from the 20 gpcd plumbing fixtures potentials for municipal water demand reduction before additional conservation measures are suggested.

Table 5-36. Water Conservation Potentials of Low Flow Plumbing Fixtures

Plumbing Fixture	Water Savings (gpcd)
Toilets and Showerheads	16.0
Additional Savings (High Efficiency Toilet)*	1.63
Faucet Aerators – 2.2 gallons per minute	2.0
Urinals – 1.0 gallon per minute	0.3
Drinking Fountains (self-closing)	0.1
Total	20.03 (~20 gpcd)

* TWDB 2013
gpcd = gallons per capita per day

5.37.1 Conservation Strategy

For regional water planning purposes, municipal water use is defined as residential and commercial water use. Municipal water is primarily for drinking, sanitation, cleaning, cooling, fire protection, and landscape watering for residential, commercial, and institutional establishments. A key parameter for assessing municipal water use within a typical city or water service area is the number of gallons used per person per day (per capita water use). The objective of water conservation is to decrease the amount of water, measured in gpcd, that a typical person uses.

The TWDB provided population and municipal water demand projections for the Llano Estacado Region water planning, based on water user surveys that are used to calculate per capita water use. The 2011 per capita water use minus accumulated plumbing code savings was used as the base per capita value. Year 2011 is the starting point for per capita water use because it is representative of drought conditions within the Llano Estacado Planning Region. Projected future demands included only slight reductions in gpcd values (and in some cases no reduction in gpcd values) because most of the savings due to plumbing code changes have already been realized. Future municipal conservation savings will need to come from other best management practices as outlined in this section. For planning purposes for this water management strategy, WUGs with a base gpcd of greater than 140 was assumed to see a reduction in gpcd of 0.05% per year until the gpcd value reached 140. After this goal has been reached, no further water conservation was assumed. EachWUG in the Llano Estacado Region is listed in Table 5-37, in order from low to high base per capita water use. This table also shows the reduction in gpcd as determined using the methodology above.

As part of House Bill 807 (HB 807), the regional planning groups are required to “set one or more specific goals for gpcd in each decade of the period covered by the plan for the municipal WUGs in the regional water planning area.” The goals reported in the LERWP may be different than the goals set by utilities as part of their WCP. The WCP goals are typically based on multi-year averages, not drought year water use. The goals delineated below are the dry year gpcd used for this 2026 Llano Estacado Regional Water Plan (LERWP).

Table 5-37. Municipal Water User Groups Projected Reduction in Per Capital Water Use (GPCD)

No.	County	Water User	Base Year gpcd	Reduction in GPCD with Conservation (gpcd)					
				2030	2040	2050	2060	2070	2080
1	Hale	Seth Ward WSC	65	0	0	0	0	0	0
2	Lynn	County-Other, Lynn	104	0	0	0	0	0	0
3	Deaf Smith	County-Other, Deaf Smith	106	0	0	0	0	0	0
4	Crosby	County-Other, Crosby	107	0	0	0	0	0	0
5	Floyd	County-Other, Floyd	108	0	0	0	0	0	0
6	Gaines	County-Other, Gaines	108	0	0	0	0	0	0
7	Lubbock	Slaton	109	0	0	0	0	0	0
8	Hockley	County-Other, Hockley	110	0	0	0	0	0	0
9	Yoakum	County-Other, Yoakum	110	0	0	0	0	0	0
10	Bailey	County-Other, Bailey	111	0	0	0	0	0	0
11	Dawson	County-Other, Dawson	111	0	0	0	0	0	0
12	Terry	County-Other, Terry	111	0	0	0	0	0	0
13	Hale	Hale Center	112	0	0	0	0	0	0
14	Garza	County-Other, Garza	114	0	0	0	0	0	0
15	Lamb	Amherst	115	0	0	0	0	0	0
16	Hale	County-Other, Hale	117	0	0	0	0	0	0
17	Hockley	Anton	117	0	0	0	0	0	0
18	Lubbock	County-Other, Lubbock	117	0	0	0	0	0	0
19	Lubbock	New Deal	117	0	0	0	0	0	0
20	Garza	Post	118	0	0	0	0	0	0
21	Swisher	County-Other, Swisher	118	0	0	0	0	0	0
22	Dickens	County-Other, Dickens	121	0	0	0	0	0	0
23	Floyd	Lockney	123	0	0	0	0	0	0
24	Dawson	O'Donnell	124	0	0	0	0	0	0
25	Lynn	O'Donnell	124	0	0	0	0	0	0
26	Lamb	County-Other, Lamb	130	0	0	0	0	0	0
27	Castro	County-Other, Castro	131	0	0	0	0	0	0
28	Castro	Hart Municipal Water System	132	0	0	0	0	0	0
29	Lamb	Littlefield	134	0	0	0	0	0	0
30	Crosby	Ralls	135	0	0	0	0	0	0
31	Lubbock	Shallowater	135	0	0	0	0	0	0
32	Swisher	Happy	137	0	0	0	0	0	0
33	Crosby	Crosbyton	141	1	0	0	0	0	0
34	Terry	Brownfield	144	4	0	0	0	0	0
35	Gaines	Seagraves	148	4	4	0	0	0	0
36	Hockley	Levelland	148	4	4	0	0	0	0
37	Lubbock	Wolfforth	150	4	6	0	0	0	0
38	Lynn	Tahoka Public Water System	151	4	7	0	0	0	0
39	Briscoe	Silverton	152	4	7	1	0	0	0
40	Dickens	Spur	155	4	8	4	0	0	0
41	Lamb	Earth	156	4	8	4	0	0	0
42	Floyd	Floydada	159	4	8	7	0	0	0
43	Swisher	Tulia	159	4	8	7	0	0	0
44	Lubbock	Idalou	161	4	8	7	2	0	0
45	Lubbock	Lubbock	161	4	8	7	2	0	0
46	Motley	County-Other, Motley	161	4	8	7	2	0	0
47	Parmer	Bovina	161	4	8	7	2	0	0
48	Parmer	Friona	162	4	8	8	3	0	0

No.	County	Water User	Base Year gpcd	Reduction in GPCD with Conservation (gpcd)					
				2030	2040	2050	2060	2070	2080
49	Crosby	Lorenzo	165	4	8	8	5	0	0
50	Hale	Plainview	167	4	8	8	7	0	0
51	Parmer	County-Other, Parmer	175	4	9	8	8	6	0
52	Bailey	Muleshoe	182	5	9	8	8	8	7
53	Lamb	Olton	186	5	9	9	8	8	7
54	Cochran	Morton PWS	197	5	10	9	9	8	8
55	Deaf Smith	Hereford	202	5	10	9	9	8	8
56	Castro	Dimmitt	203	5	10	9	9	8	8
57	Dawson	Lamesa	206	5	10	10	9	9	8
58	Cochran	Whiteface	211	5	10	10	9	9	8
59	Hale	Abernathy	212	5	10	10	9	9	8
60	Lubbock	Abernathy	212	5	10	10	9	9	8
61	Lamb	Sudan	215	5	10	10	9	9	9
62	Dickens	Red River Authority of Texas	220	6	11	10	10	9	9
63	Motley	Red River Authority of Texas	220	6	11	10	10	9	9
64	Briscoe	Quitaque	225	6	11	10	10	9	9
65	Hale	Petersburg Municipal Water System	230	6	11	11	10	10	9
66	Yoakum	Plains	231	6	11	11	10	10	9
67	Parmer	Farwell	234	6	11	11	10	10	9
68	Hockley	Sundown	243	6	12	11	11	10	10
69	Yoakum	Denver City	251	6	12	12	11	10	10
70	Lubbock	Ransom Canyon	257	6	13	12	11	11	10
71	Briscoe	County-Other, Briscoe	285	7	14	13	13	12	11
72	Gaines	Seminole	296	7	14	14	13	12	12
73	Motley	Matador	312	8	15	14	14	13	12
74	Cochran	County-Other, Cochran	334	8	16	15	15	14	13
75	Castro	Nazareth	341	9	17	16	15	14	14

gpcd = gallons per capita per day

As stated above, the 2026 LERWP follows the State of Texas Water Conservation Task Force (Task Force) recommendation that cities seek to achieve a total per capita demand of 140 gallons per day (gpd). Municipal water conservation recommendations in the LERWP are centered on this target. The municipal WUG category is projected to account for approximately 14.9 percent of water demands and approximately 73.7 percent of water needs in 2080.

Of the 75 WUGs in the Llano Estacado Region, 43 had base per capita water use rates equal to or higher than 140 gpcd. The LERWPG recommends municipal water conservation strategies categorized as administrative, residential indoor, residential outdoor, or commercial.

The LERWPG acknowledges the need for conservation, and there are a variety of municipal conservation efforts underway in the region (Table 5-38). Many WUGs have also set 5- and 10-year water conservation goals as part of their ongoing water conservation planning program (Table 5-39). The largest WUG in the High Plains, the City of Lubbock, has the most developed municipal conservation program and is cited as a model for the region. Conservation can be achieved in a variety of ways, including using these BMPs identified by Llano Estacado Region entities.

1. Conservation coordinator
2. Cost effective analysis
3. Water survey for single-family and multi-family customers
4. Wholesale agency assistance programs
5. Water conservation pricing
6. Metering of all new connections and retrofit of existing connections
7. System water audit and water loss control
8. Landscape irrigation conservation and incentives
9. Athletic field conservation
10. Golf course conservation
11. Park conservation
12. Residential landscape irrigation evaluation
13. School education
14. Public information
15. Small utility outreach and education
16. Partnerships with nonprofit organizations
17. Conservation programs for ICI accounts
18. Water wise landscape design and conversion programs
19. New construction graywater
20. Prohibitions on wasting water
21. Water Conservation Policy in Wholesale Contracts

TWDB water demand and per capita projections include little to no water savings through mandated plumbing fixture replacement programs as most of those savings have already been realized. The target water conservation goals recommended by the LERWP are to be achieved with additional BMPs to achieve the desired water savings above the amount already included in TWDB projections.

Table 5-38. Summary of Water Conservation BMPs for WUGs or MWPs in the Llano Estacado Region

BMP	City of Lamesa	City of Levelland	City of Littlefield	City of Lubbock	City of Plainview	City of Seagraves	City of Wilson	Valley WSC	White River MWD
1. Conservation coordinator	-	-	-	X	X	-	X	X	-
2. Cost effective analysis	-	-	-	X	X	-	-	-	-
3. Water survey for single-family and multi-family customers	-	-	-	X	-	-	-	-	-
4. Wholesale agency assistance programs	-	-	-	X	-	-	-	-	-
5. Water conservation pricing	X	-	-	X	X	X	-	-	X
6. Metering of all new connections and retrofit of existing connections	X	-	X	X	X	X	X	X	X
7. System water audit and water loss control	X	X	X	-	X	-	-	-	X
8. Landscape irrigation conservation and incentives	X	-	-	-	X	X	-	-	X
9. Athletic field conservation	-	-	-	X	X	-	-	-	-
10. Golf course conservation	X	-	-	X	-	-	-	-	-
11. Park conservation	X	X	-	X	-	X	-	-	-
12. Residential landscape irrigation evaluation	-	-	-	X	X	-	-	-	-
13. School education	X	X	-	X	X	-	-	-	-
14. Public information	X	X	X	X	X	X	-	X	-
15. Small utility outreach and education	-	-	-	X	-	-	-	-	-
16. Partnerships with nonprofit organizations	-	-	-	X	-	-	-	-	-
17. Conservation programs for ICI accounts	-	-	-	X	-	-	-	-	-
18. Water wise landscape design and conversion programs	-	X	-	-	-	-	-	-	-
19. New construction gray water	-	-	-	X	-	-	-	-	-
20. Prohibitions on wasting water	-	X	-	X	-	X	-	-	-
21. Water Conservation Policy in Wholesale Contracts	X	-	-	-	X	-	-	-	X

MWD = municipal water district; WSC = water supply corporation

Table 5-39. Summary of 5- and 10-Year Goals for Water Conservation in the Llano Estacado Region

WUG	5-year goal		10-year goal	
	GPCD Target	General	GPCD Target	General
Silverton	130	Reduce total real losses by 10% of current real losses	125	Reduce real losses by 15% of current real losses
Seagraves	180	Reduce peak daily water demand, maintain water loss at or below 15%, and reduce amount of unaccounted water	167	Reduce peak daily water demand, maintain water loss at or below 15%, and reduce amount of unaccounted water
Seminole	255	Reduce water loss from 6% to 5.82%	241	Reduce water loss from 6% to 5.4%.
Post	172	Reduce water loss by 5%	140	Reduce water loss by 10%
Plainview	130	Will be accomplished with conservation programs	127	Will be accomplished with conservation programs
Anton	86.4	reducing water usage by 2%, or 1.8 gpcd in the next 5 years	84.7	by 4% or 3.5 gpcd in the next 10 years
Lamesa		5% per capita water usage reduction annually		5% per capita water usage reduction annually
Levelland	145	Reduce water loss by 3.3%	140	Continue to utilize best management practices to reduce water loss by having a water loss program in place
Littlefield	195	reducing residential water usage by 2% or 4 gpcd	191	reducing residential water usage by 4% or 8 gpcd
Lubbock	128	0.5% per year reduction in per capita water use goal	125	0.5% per year reduction in per capita water use goal
New Deal	120	Maintain per capita water loss at less than 14%, or less than 16 gallons per capita	115	Maintain per capita water loss at less than 14%, or less than 16 gallons per capita
Shallowater	110.3	Reduce annual per person water use by 2 percent	106.9	Reduce annual per person water use by 5 percent
Tahoka Public Water System	135	Reducing water usage by 5%	128	Reducing water usage by 5%
Red River Authority of Texas	116	The goals will be met by reducing the overall water losses, especially those systems which exceed 30% water loss	111	The goals will be met by reducing the overall water losses, especially those systems which exceed 30% water loss
Brownfield		Set a goal of 5% per capita water use reduction		Set a goal of 5% per capita water use reduction
Ropesville	140	Reducing water loss and other conservation goals	136	Reducing water loss and other conservation goals
White River Municipal Water District	540	Reduce water loss by 12%	530	Reduce water loss by 7%

gpcd = gallons per capita per day

5.37.2 Water Loss Audit

Retail public water suppliers are required to submit a water loss audit once every 5 years to the TWDB. The water supplies that have an active financial obligation with the TWDB or have 3,300 connections have to submit an audit annually. This water loss audit is intended to assist utilities with understanding water loss in the distribution system and track water loss over time. The results from the 2023 Water Loss Survey are included in Table 5-43.

5.37.3 Quantity of Available Water

The available supply attributed to implementation of this strategy would be a 0.5 percent annual reduction in demand over and above that assumed in the TWDB water demand projections. All entities, in order to be in line with projections, will need to verify that their conservation planning measures are consistent with TCEQ standards and the TWDB projections. Beyond that, some communities with projected needs may be able to reduce or eliminate those needs with stronger conservation planning. Table 5-40 lists municipal WUGs' projected needs (shortages) and additional water saved after conservation.

Table 5-40. Estimated Water Savings for WUGs with Recommended Conservation

County Name	Water User Group	Projected Water Needs						Additional Water Saved With Conservation (ac-ft/yr)					
		2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
Bailey	County-Other, Bailey	-	-	-	-	-	-	-	-	-	-	-	-
Bailey	Muleshoe	-	-	-	-	-	-	26	52	51	50	49	49
Briscoe	County-Other, Briscoe	-	-	-	-	-	-	4	6	6	5	5	4
Briscoe	Quitaque	-	-	-	-	-	-	2	3	3	3	2	2
Briscoe	Silverton	-	-	-	-	-	-	2	4	-	-	-	-
Castro	County-Other, Castro	-	-	-	-	-	-	-	-	-	-	-	-
Castro	Dimmitt	-	-	-	-	-	-	21	41	38	36	34	32
Castro	Hart Municipal Water System	-	-	-	-	-	-	-	-	-	-	-	-
Castro	Nazareth	-	-	-	-	-	-	2	5	5	5	5	5
Cochran	County-Other, Cochran	-	-	-	-	-	-	6	11	9	8	7	6
Cochran	Morton PWS	-	-	-	-	-	-	8	15	13	12	10	9
Cochran	Whiteface	-	-	-	-	-	-	2	3	3	3	2	2
Crosby	County-Other, Crosby	-	-	-	-	-	-	-	-	-	-	-	-
Crosby	Crosbyton	-	-	-	-	-	-	2	-	-	-	-	-
Crosby	Lorenzo	-	-	-	-	-	-	4	7	6	4	-	-
Crosby	Ralls	-	-	-	-	-	-	-	-	-	-	-	-
Dawson	County-Other, Dawson	-	-	-	-	-	-	-	-	-	-	-	-
Dawson	Lamesa	-	69	161	225	214	201	45	86	81	75	70	64
Dawson	O'Donnell	-	-	-	-	-	-	-	-	-	-	-	-
Deaf Smith	County-Other, Deaf Smith	-	-	-	-	-	-	-	-	-	-	-	-
Deaf Smith	Hereford	-	-	-	-	-	-	86	172	167	161	156	154
Dickens	County-Other, Dickens	-	-	-	-	-	-	-	-	-	-	-	-
Dickens	Red River Authority of Texas	-	-	-	-	-	-	-	-	-	-	-	-
Dickens	Spur	-	-	-	-	-	-	3	6	2	-	-	-
Floyd	County-Other, Floyd	-	-	-	-	-	-	-	-	-	-	-	-
Floyd	Floydada	-	-	-	-	-	-	11	20	19		-	-
Floyd	Lockney	-	-	-	-	-	-	-	-	-	-	-	-
Gaines	County-Other, Gaines	-	-	-	-	-	-	-	-	-	-	-	-
Gaines	Seagraves	-	-	-	-	-	-	8	8	-	-	-	-
Gaines	Seminole	539	694	840	933	1,043	1,168	59	124	124	122	121	120
Garza	County-Other, Garza	-	-	-	-	-	-	-	-	-	-	-	-

County Name	Water User Group	Projected Water Needs						Additional Water Saved With Conservation (ac-ft/yr)					
		2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
Garza	Post	-	-	-	-	-	-	-	-	-	-	-	-
Hale	Abernathy	-	-	-	-	-	-	14	30	30	31	32	35
Hale	County-Other, Hale	-	-	-	-	-	-	-	-	-	-	-	-
Hale	Hale Center	-	-	-	-	-	-	-	-	-	-	-	-
Hale	Petersburg Municipal Water System	-	-	-	-	-	-	6	11	10	9	8	7
Hale	Plainview	-	-	-	-	-	-	105	204	194	184	-	-
Hale	Seth Ward WSC	-	-	-	-	-	-	-	-	-	-	-	-
Hockley	Anton	-	-	-	-	-	-	-	-	-	-	-	-
Hockley	County-Other, Hockley	-	-	-	-	-	-	-	-	-	-	-	-
Hockley	Levelland	-	-	-	-	-	-	51	60	-	-	-	-
Hockley	Sundown	-	-	-	-	-	-	8	15	14	12	11	9
Lamb	Amherst	-	-	-	-	-	-	-	-	-	-	-	-
Lamb	County-Other, Lamb	-	-	-	-	-	-	-	-	-	-	-	-
Lamb	Earth	-	-	-	-	-	-	4	7	4	-	-	-
Lamb	Littlefield	-	-	-	-	-	-	-	-	-	-	-	-
Lamb	Olton	-	-	-	-	-	-	10	19	17	16	15	14
Lamb	Sudan	-	-	-	-	-	-	5	11	10	10	10	10
Lubbock	Abernathy	-	-	-	-	-	-	5	9	9	9	9	9
Lubbock	County-Other, Lubbock	-	-	-	-	-	-	-	-	-	-	-	-
Lubbock	Idalou	-	-	-	-	-	-	10	18	16	4	-	-
Lubbock	Lubbock	7,341	14,616	25,098	37,251	48,197	57,940	1,353	2,931	3,066	767	-	-
Lubbock	New Deal	-	-	-	-	-	-	-	-	-	-	-	-
Lubbock	Ransom Canyon	-	-	-	-	-	-	8	16	16	16	17	17
Lubbock	Shallowater	-	-	-	3	333	418	-	-	-	-	-	-
Lubbock	Slaton	295	393	450	487	485	478	-	-	-	-	-	-
Lubbock	Wolfforth	-	1,395	2,374	2,747	3,031	3,206	69	181	-	-	-	-
Lynn	County-Other, Lynn	-	-	-	-	-	-	-	-	-	-	-	-
Lynn	O'Donnell	-	-	-	-	-	-	-	-	-	-	-	-
Lynn	Tahoka Public Water System	-	-	-	-	-	-	10	18	-	-	-	-
Motley	County-Other, Motley	-	-	-	-	-	-	2	4	4	1	-	-
Motley	Matador	-	-	-	-	-	-	4	7	7	6	6	6

County Name	Water User Group	Projected Water Needs						Additional Water Saved With Conservation (ac-ft/yr)					
		2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
Motley	Red River Authority of Texas	-	-	-	-	-	-	-	-	-	-	-	-
Parmer	Bovina	-	-	-	-	-	-	7	12	9	2	-	-
Parmer	County-Other, Parmer	-	-	-	-	-	-	12	21	16	11	5	-
Parmer	Farwell	-	-	-	-	-	-	10	22	23	23	25	26
Parmer	Friona	-	-	-	-	-	-	19	40	40	14	-	-
Swisher	County-Other, Swisher	-	-	-	-	-	-	-	-	-	-	-	-
Swisher	Happy	-	-	-	-	-	-	-	-	-	-	-	-
Swisher	Tulia	-	-	-	-	-	-	17	31	28	-	-	-
Terry	Brownfield	-	-	-	81	118	159	36	4	-	-	-	-
Terry	County-Other, Terry	-	-	-	-	-	-	-	-	-	-	-	-
Yoakum	County-Other, Yoakum	-	-	-	-	-	-	-	-	-	-	-	-
Yoakum	Denver City							35	72	71	70	68	67
Yoakum	Plains	-	-	-	-	-	-	9	18	18	17	16	15

ac-ft/yr = acre-feet per year

5.37.4 Strategy Costs

The TWDB requires that costs and water supply estimates be developed for each recommended WMS. The BMP list was uploaded into the TWDB's Municipal Water Conservation Planning Tool, which was used to calculate water savings and cost, as appropriate. These unit costs were originally developed for the 2021 Regional Water Plan. Those unit costs were updated for use in the 2026 Regional Water Plan using the Producer's Price Index (PPI). The WUGs were split into large-, medium-, and small-sized WUGs, and costs were created for these entities with the BMP tool. The water savings and costs were then applied to WUGs for which conservation is a recommended WMS. The estimated cost to achieve the water conservation is located in Table 5-41

The LERWPG selected a mix of BMPs for large, medium, and small-sized WUGs based upon the most likely to be used in the region. The cost was calculated by multiplying a unit cost, by the amount of water saved with advanced water conservation. For remaining BMPs for which water savings and cost is not readily available, the TWDB's "Best Management Practices for Municipal Water Providers, November 2013" provides information on municipal BMPs, applicability, description, implementation, water savings, and cost.

The TWDB summarized "Best Management Practices for Wholesale Water Providers, October 2017" in a document to provide recommendations to wholesale water providers. These BMP recommendations include developing water conservation and drought contingency plans, educating customers about conservation, distributing water conservation equipment, and other voluntary efficiency measures.

Table 5-41. Estimated Cost of Conservation to Achieve Water Savings

Water User Group	Costs of Water Savings ($/yr)					
	2030	2040	2050	2060	2070	2080
Muleshoe	$12,414	$24,829	$24,351	$23,874	$23,396	$23,396
County-Other, Briscoe	$1,910	$2,865	$2,865	$2,387	$2,387	$1,910
Quitaque	$955	$1,432	$1,432	$1,432	$955	$955
Silverton	$955	$1,910	$-	$-	$-	$-
Dimmitt	$10,027	$19,576	$18,144	$17,189	$16,234	$15,279
Nazareth	$955	$2,387	$2,387	$2,387	$2,387	$2,387
County-Other, Cochran	$2,865	$5,252	$4,297	$3,820	$3,342	$2,865
Morton PWS	$3,820	$7,162	$6,207	$5,730	$4,775	$4,297
Whiteface	$955	$1,432	$1,432	$1,432	$955	$955
Crosbyton	$897	$-	$-	$-	$-	$-
Lorenzo	$1,910	$3,342	$2,865	$1,910	$-	$-
Lamesa	$21,486	$41,063	$38,675	$35,810	$33,423	$30,558
Hereford	$38,577	$77,155	$74,912	$72,221	$69,978	$69,081
Spur	$1,432	$2,865	$955	$-	$-	$-
Floydada	$5,252	$9,549	$9,072	$-	$-	$-
Seagraves	$3,820	$3,820	$-	$-	$-	$-
Seminole	$28,171	$59,206	$59,206	$58,252	$57,774	$57,297
Abernathy (Hale)	$6,685	$14,324	$14,324	$14,802	$15,279	$16,711
Petersburg Municipal Water System	$2,865	$5,252	$4,775	$4,297	$3,820	$3,342
Plainview	$47,100	$91,509	$87,024	$82,538	$-	$-
Levelland	$22,877	$26,915	$-	$-	$-	$-
Sundown	$3,820	$7,162	$6,685	$5,730	$5,252	$4,297
Earth	$1,910	$3,342	$1,910	$-	$-	$-
Olton	$4,775	$9,072	$8,117	$7,640	$7,162	$6,685
Sudan	$2,387	$5,252	$4,775	$4,775	$4,775	$4,775
Abernathy (Lubbock)	$2,387	$4,297	$4,297	$4,297	$4,297	$4,297
Idalou	$4,775	$8,594	$7,640	$1,910	$-	$-
Lubbock	$536,177	$1,161,518	$1,215,017	$303,952	$-	$-
Ransom Canyon	$3,820	$7,640	$7,640	$7,640	$8,117	$8,117
Wolfforth	$30,952	$81,192	$-	$-	$-	$-
Tahoka Public Water System	$4,775	$8,594	$-	$-	$-	$-
County-Other, Motley	$955	$1,910	$1,910	$477	$-	$-
Matador	$1,910	$3,342	$3,342	$2,865	$2,865	$2,865
Bovina	$3,342	$5,730	$4,297	$955	$-	$-
County-Other, Parmer	$5,730	$10,027	$7,640	$5,252	$2,387	$-

Water User Group	Costs of Water Savings ($/yr)					
	2030	2040	2050	2060	2070	2080
Farwell	$4,775	$10,504	$10,982	$10,982	$11,937	$12,414
Friona	$9,072	$19,099	$19,099	$6,685	$-	$-
Tulia	$8,117	$14,802	$13,369	$-	$-	$-
Brownfield	$17,189	$1,910	$-	$-	$-	$-
Denver City	$16,711	$34,378	$33,900	$33,423	$32,468	$31,991
Plains	$4,297	$8,594	$8,594	$8,117	$7,640	$7,162

5.37.5 Implementation Issues

There are several issues that may slow water conservation efforts. The most crucial issue to change is getting water customers to change their water use habits. Effective public outreach and education can go a long way to increasing water conservation, but in the end, the effectiveness of any program is dependent upon the individual.

5.37.5.1 Environmental Issues

No substantial environmental impacts are anticipated, as water conservation is typically a non-capital intensive alternative that is not associated with direct physical impacts to the natural environment. A summary of the few potential environmental issues that might arise for this alternative are presented in Table 5-42.

Table 5-42. Environmental Issues: Municipal Water Conservation

Water Management Option	Municipal Water Conservation
Implementation Measures	Voluntary reduction, reduced diversions, changing water pricing, mandatory restrictions (landscaping ordinances, watering days), reducing unaccounted for water
Environmental Water Needs / Instream Flows	No substantial impact identified, assuming relatively low reduction in diversions and return flows; substantial reductions in municipal and industrial diversions from water conservation would potentially result in low to moderate positive impacts as more stream flow would be available for environmental water needs and instream flows
Bays and Estuaries	No substantial impact identified, assuming relatively low reduction in diversions and return flows
Fish and Wildlife Habitat	No substantial impact identified, assuming relatively low reductions in diversions and return flows; potential low to moderate positive impact to aquatic and riparian habitats with substantial reductions as more stream flow would be available to these habitats; potential moderate positive benefits from implementation of site-specific xeriscape landscaping
Cultural Resources	No substantial impacts anticipated.
Threatened and Endangered Species	No substantial impact identified, assuming relatively low reduction in diversions and return flows; potential low to moderate positive impact to aquatic and riparian threatened and endangered species (where they occur) with substantial diversion reductions
Comments	Assumes no substantial change in infrastructure with attendant landscape impacts; further assumes that infrastructure improvements which do occur will largely be in urbanized settings

5.37.5.2 Water Loss Reduction

TWDB provided results of their 2023 Water Loss Audit for regional water planning groups (RWPGs) to consider when developing the regional water plans (TAC §357.34 (f)(2)D) (Table 5-43). Furthermore, WMS evaluations for the 2026 LERWP are to take into account anticipated water losses associated with each strategy when calculating the quantify of water delivered and treated, according to TWDB guidelines (TAC §357.34 (d)(3)A). The reported water losses include both real and apparent losses. Real loss is water lost through distribution system leakage and line breaks. Apparent loss includes water that was not read accurately by a meter, unauthorized consumption, including water taken by theft, and data analysis errors.

Municipal water entities seeking infrastructure replacement programs to reduce water loss may be eligible for state supported programs, including State Water Implementation Fund for Texas (SWIFT). To be eligible for SWIFT funding, the project must be recommended in the regional and state water plan with a non-zero capital cost.

Table 5-43. Summary of Water Loss Percentages Based on 2023 TWDB Water Loss Report

WUG	County Name	Total Apparent Losses (gallons)	Total Real Losses (gallons)	Total Loss Percent (%)
Muleshoe Municipal Water System	Bailey	6,119,989	15,467,093	8.2
City of Quitaque	Briscoe	2,219,233	2,089,517	17.5
City of Lorenzo	Crosby	655,316	7,483,686	13.6
City of Ralls	Crosby	4,862,935	12,225,475	16.8
White River MWD	Crosby	462,180	21,641,497	54.4
City of Ackerly	Dawson	260,178	1,346,254	11.1
City of Lamesa	Dawson	50,000	7,723,880	1.4
Hereford Municipal Water System	Deaf Smith	91,533,808	8,385,330	5.6
City of Dickens	Dickens	1,070,314	3,566,941	44.0
Valley WSC	Dickens	92,492	1,476,575	12.3
City of Seagraves	Gaines	2,541,232	18,396,251	16.9
Loop WSC	Gaines	191,055	240,945	4.8
City of Seminole	Gaines	15,866,723	12,384,971	5.5
Plainview Municipal Water System	Hale	65,276,731	55,137,256	11.3
City of Anton	Hockley	639,542	3,517,596	11.1
City of Levelland	Hockley	12,743,897	93,301,512	17.4
City of Smyer	Hockley	351,625	2,190,177	15.4
City of Littlefield	Lamb	16,369,613	52,602,850	21.8
Lubbock Public Water System	Lubbock	359,155,436	573,047,977	7.3
City of Idalou	Lubbock	13,389,964	17,493,499	24.5
City of Shallowater	Lubbock	3,742,102	18,069,121	16.7
City of Slaton	Lubbock	5,496,574	3,131,406	3.8
City of New Deal	Lubbock	1,289,211	2,205,888	13.5
Town of Ransom Canyon	Lubbock	1,837,427	12,073,781	15.9
City of New Home	Lynn	73,374	771,946	4.5
City of O'Donnell	Lynn	717,455	3,411,780	12.7
City of Tahoka	Lynn	2,777,570	4,757,398	6.4
City of Wilson	Lynn	633,647	3,300,419	21.1
City of Brownfield	Terry	9,911,482	39,830,490	10.4
City of Wellman	Terry	194,677	1,365,361	15.5
City of Post[1]	Garza	8,806,324	2,449,051	6.5

[1]Data from the 2018 Water Loss Report from TWDB
WSC = water supply corporation

5.38 Irrigation Water Conservation

5.38.1 Conservation Strategy

Irrigation water use is the use of freshwater that is pumped from aquifers and/or diverted from streams and reservoirs and applied directly to grow cotton, corn, sorghum, and other crops in the study area. Approximately 8.9 million ac-ft of water were used in Texas to grow a variety of crops ranging from food and feed grains to fruits and vegetables to cotton. Of these 8.9 million ac-ft, groundwater resources provide approximately 79 percent of the water used for irrigation purposes, with surface water supplies accounting for the remaining 21 percent.

The LERWPG recommends several irrigation conservation measures. These agricultural water conservation strategies are recommended for all 21 counties in the Llano Estacado Region. Achievement of these goals is considered possible through the implement of activities such as the following:

- Greater use of ground cover and implementation of low-till or no-till methods.
- Voluntary implementation of drip/micro-irrigation systems, irrigation scheduling improvements, and any other methods that are demonstrated to be practical and profitable.
- Continuation of the Texas Alliance for Water Conservation (TAWC) program public outreach and education efforts, presenting the findings of the demonstration project and the tools available to producers.
- Involvement of more Llano Estacado Region producers in the on-farm demonstrations.
- Expansion of the program to cover more of the Llano Estacado Region.
- Greater use of on-farm flow metering to measure the volume of water pumped versus water delivered allowing quantification of water losses, including real-time monitoring of soil-moisture, variable rate irrigation, and remote management of center-pivot irrigation systems.

5.38.2 Quantity of Available Water

As part of the regional water planning process, the LERWP recommended a voluntary target reduction voluntary target reduction of 5 percent by 2030 and 7 percent from 2040-2080, using some of the BMPs identified above. The total conservation savings is 50,756 ac-ft per year by 2080 based on the irrigation conservation measures suggested. Most irrigation water is from groundwater and a small amount from surface water sources and wastewater reuse. Conservation will help meet and reduce some of the irrigation needs, but there will be unmet needs in the region due to it not being economically feasible to meet these needs.

For irrigation WUGs with reported needs, the following are voluntary target reductions:

- 5 percent by 2030 and
- 7 percent from 2040-2080 is recommended.

The savings based on the voluntary reduction percentages are summarized in Table 5-44 with the amount saved in demands based on conservation reduction in inches per acre of irrigated land. Table 5-45 summarizes the projected irrigation savings in ac-ft/yr.

The conservation was calculated in inches per acre based on TWDB irrigated acres averaged over the time period 2017 to 2021. Following is an example calculation.

$$\frac{Inches}{Acre} = \frac{Conservation(ac-ft) * 12\ in\ per\ ft}{Average\ Irrigated\ (acres)}$$

Table 5-44. Conservation Savings in Inches per Acre per County per Year

County	CONSERVATION (inches/acre)					
	2030	2040	2050	2060	2070	2080
BAILEY	0.38	0.44	0.35	0.25	0.23	0.22
BRISCOE	0.47	0.51	0.39	0.27	0.23	0.20
CASTRO	0.52	0.58	0.32	0.07	0.03	0.01
COCHRAN	0.40	0.48	0.40	0.33	0.29	0.27
CROSBY	0.34	0.48	0.39	0.30	0.24	0.21
DAWSON	0.51	0.72	0.72	0.72	0.68	0.65
DEAM SMITH	0.43	0.47	0.31	0.15	0.11	0.09
DICKENS	0.62	0.87	0.87	0.87	0.87	0.87
FLOYD	0.38	0.42	0.33	0.23	0.21	0.19
GAINES	0.54	0.69	0.54	0.38	0.36	0.34
GARZA	0.48	0.68	0.68	0.68	0.68	0.68
HALE	0.44	0.53	0.30	0.07	0.05	0.04
HOCKLEY	0.44	0.46	0.37	0.29	0.26	0.25
LAMB	0.44	0.52	0.30	0.09	0.08	0.07
LUBBOCK	0.50	0.64	0.53	0.41	0.39	0.38
LYNN	0.50	0.69	0.69	0.69	0.69	0.69
MOTLEY	0.64	0.90	0.90	0.90	0.90	0.90
PARMER	0.40	0.49	0.28	0.08	0.06	0.04
SWISHER	0.41	0.47	0.34	0.21	0.17	0.14
TERRY	0.36	0.43	0.43	0.43	0.42	0.41
YOAKUM	0.56	0.66	0.49	0.32	0.30	0.28

Table 5-45. Projected Conservation Amount in ac-ft/yr

County	Basin	Conservation Savings					
		2030	2040	2050	2060	2060	2070
BAILEY	BRAZOS	2,909	3,327	2,622	1,916	1,727	1,646
BRISCOE	RED	891	977	745	512	435	384
CASTRO	BRAZOS	8,208	9,091	5,093	1,096	521	214
CASTRO	RED	4,420	4,895	2,742	590	280	115
COCHRAN	BRAZOS	2,759	3,293	2,764	2,236	2,001	1,830
COCHRAN	COLORADO	1,298	1,550	1,301	1,052	942	861
CROSBY	BRAZOS	2,895	4,053	3,296	2,539	2,048	1,741
CROSBY	RED	119	167	136	105	84	72
DAWSON	BRAZOS	45	63	63	63	60	56
DAWSON	COLORADO	3,265	4,572	4,572	4,572	4,329	4,100
DEAF SMITH	CANADIAN	70	75	50	24	18	14
DEAF SMITH	RED	6,877	7,458	4,921	2,385	1,789	1,423
DICKENS	BRAZOS	215	301	301	301	301	301
DICKENS	RED	162	227	227	227	227	227
FLOYD	BRAZOS	1,667	1,857	1,439	1,022	898	816
FLOYD	RED	2,964	3,301	2,559	1,817	1,597	1,451
GAINES	COLORADO	13,611	17,266	13,450	9,635	9,014	8,581
GARZA	BRAZOS	495	693	693	693	693	693
HALE	BRAZOS	10,384	12,465	7,097	1,729	1,258	978
HALE	RED	105	126	72	17	13	10
HOCKLEY	BRAZOS	5,213	5,410	4,382	3,353	3,087	2,925
HOCKLEY	COLORADO	392	407	330	252	232	220
LAMB	BRAZOS	8,437	9,952	5,845	1,738	1,467	1,375
LUBBOCK	BRAZOS	6,668	8,545	6,998	5,451	5,256	5,106
LYNN	BRAZOS	3,386	4,740	4,728	4,717	4,546	4,428
LYNN	COLORADO	255	357	356	355	342	333
MOTLEY	RED	450	630	630	630	630	630
PARMER	BRAZOS	5,553	6,740	3,916	1,091	786	588
PARMER	RED	1,388	1,685	979	273	196	147
SWISHER	BRAZOS	580	660	476	292	235	196
SWISHER	RED	2,641	3,005	2,168	1,331	1,068	894
TERRY	BRAZOS	255	302	302	302	295	287
TERRY	COLORADO	4,876	5,765	5,765	2,765	5,634	5,481
YOAKUM	COLORADO	5,249	6,278	4,675	3,072	2,805	2,630
	TOTAL	108,702	130,233	95,693	61,153	54,814	50,753

5.38.3 Strategy Costs

Depending on the location in the Llano Estacado Region, some BMPs may be more feasible and cost effective. The TWDB has guidance on estimated costs per BMP. These are summarized in Table 5-46. The cost of implementing the agricultural water conservation strategies will depend on many factors, including the number of acres for each crop type and variety and the irrigation equipment and methods being used. The Llano Estacado Region does not have specific data for each of these actors, but a range of potential unit costs for implementation of the agricultural water conservation strategies has been calculated. The average unit cost of implementation for the agricultural water conservation strategies is assumed to range between $50 and $1,500 per acre-foot of water that is conserved. For planning purposes, a unit cost of $619 per acre-foot of water was selected to estimate potential annual costs of implementing the agricultural water conservation strategies across the Llano Estacado Region.

Table 5-46. Potential Water Savings and Costs Associated with Each BMP

TWDB BMP	COSTS
Crop Residue Management and Conservation Tillage	The cost of conservation tillage depends on the type of field operation used to manage crop residues. Some conservation tillage programs are less expensive than conventional tillage.
Drip/Micro-Irrigation System	Micro-irrigation is typically the most capital expensive type of irrigation. Installation costs for subsurface drip irrigation range from $800 to $1,200 per acre. The operation and maintenance costs vary depending on the value of the crop being irrigated and the quality of the irrigation water supply. The high capital and operational cost for micro-irrigation is the primary reason that micro-irrigation is limited to only 1.2 percent of the irrigated land within Texas.
Education	Varies by county and educational activity.
Irrigation Scheduling	Varies depending on local conditions.
Texas Alliance for Water Conservation Project	Costs have not been quantified.
Metering	Cost for volumetric measurement of irrigation water use varies greatly from application to application. Typical impeller meter installations for irrigation pipelines with diameters between 4 and 15 inches cost between $1,100 and $2,000 per meter. Cost for indirect measurements, such as energy use, depends on the amount of time required to correlate the indirect measurement to the amount of water used and the time required to compile and record such information.

5.38.4 Implementation Issues

The rate of adoption of efficient water-using practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing. There is widespread public support for irrigation water conservation, and it is being implemented at a steady pace, and as water markets for conserved water expand, this practice will likely reach its maximum potential. A major barrier to implementation of water conservation is financing. The TWDB has irrigation conservation programs that may provide funding to irrigators to implement irrigation BMPs that increase water use efficiency.

5.38.4.1 Environmental Issues

The irrigation water conservation methods described above have been developed and tested through public and private sector research and have been adopted and applied within the Llano Estacado Region. For example, the drip/micro-irrigation system improves water use efficiency without making changes to wildlife habitat. The results are reduced transport of sediment and any fertilizers or other chemicals that have been applied to the crops. Thus, the proposed conservation practices do not have potential adverse effects, and in fact have potentially beneficial environmental effects.

5.39 Industrial Water Conservation

5.39.1 Conservation Strategy

Water uses for industrial purposes (mining, manufacturing, steam-electric) are primarily associated with manufacturing products, cleaning and waste removal, waste heat removal, dust control, landscaping, and mine dewatering. In the Llano Estacado Area, industrial water demands are assumed to be 27,578 ac-ft/yr in 2030 and are projected to decrease to 19,955 ac-ft/yr in 2080.

Manufacturing sectors require water for food processing, industrial machinery and equipment, and fabricated metals. Manufacturing water demand is projected at 7,830 ac-ft/yr in 2030 and expected to increase to 9,387 ac-ft/yr by 2080. There are no counties in the Llano Estacado Region with projected manufacturing needs; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

In the Llano Estacado Region, the steam-electric water demands are projected to decrease from 10,323 ac-ft/yr in 2030 to 6,129 ac-ft/yr in 2080. There are no needs in the counties that have steam electric demands: Hale, Lamb, Lubbock, and Yoakum. The decreasing projection in water demand is due to some power plants shutting down due to limited water supplies. The Llano Estacado Region steam-electric users are projected to receive most of their water from the ETHP Aquifer and some direct reuse.

The TWDB water demand projections for mining users is generally based on projected economic output, assuming that past and current water use trends remain constant over time. In the Llano Estacado Region, the mining water demands decrease from 9,425 ac-ft/yr in 2030 to 4,439 ac-ft/yr by 2080. In 2080, the Llano Estacado Region mining users are projected to receive all of their water supplies from three groundwater sources: Ogallala, Seymour, and Edwards-Trinity aquifers. There are no counties in the Llano Estacado Region with projected mining water needs; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.39.2 Industrial Water Conservation Approach

The LERWP recommends a voluntary target reduction of 3 percent by 2030 and 5 percent from 2040-2080. The Task Force report lists the following industrial BMPs that may be used to achieve the recommended water savings:[215]

1. Industrial Water Audit,
2. Industrial Water Waste Reduction,
3. Industrial Submetering,
4. Cooling Towers,
5. Cooling Systems (other than Cooling Towers),
6. Industrial Alternative Sources and Reuse and Recirculation of Process Water,
7. Rinsing/Cleaning,
8. Water Treatment,
9. Boiler and Steam Systems,
10. Refrigeration (including Chilled Water),
11. Once-Through Cooling,
12. Management and Employee Programs,
13. Industrial Landscape, and
14. Industrial Site-Specific Conservation.

The Task Force report describes the above BMP methods and how they reduce water use; however, information regarding specific water savings and costs to implement conservation programs is generally unavailable. Conservation savings and costs are by nature facility-specific. Since industrial

[215] Water Conservation Implementation Task Force, Report to the 79th Legislature, Texas Water Development Board.

entities are presented on a county basis and are not individually identified, identification of specific water management strategies is not a reasonable expectation.

5.39.3 Quantity of Available Water

The LERWP recommends a voluntary target reduction of 3 percent by 2030 and 5 percent from 2040 to 2080 by using BMPs identified by the Task Force. A summary of water conservation savings is in Table 5-47.

For manufacturing demands, total water savings are 470 ac-ft/yr after conservation in 2080. Mining water demands can be reduced by 222 ac-ft by 2080 with conservation. For the steam-electric users with conservation, demands can be reduced by 306 ac-ft/yr in 2080.

Table 5-47. Estimated Water Conservation Savings in ac-ft/yr

WUG Name	County	2030	2040	2050	2060	2070	2080
Manufacturing							
MANUFACTURING, CASTRO	CASTRO	2	3	4	4	4	4
MANUFACTURING, DEAF SMITH	DEAF SMITH	45	78	81	84	87	90
MANUFACTURING, GAINES	GAINES	15	27	28	29	30	31
MANUFACTURING, HALE	HALE	22	38	39	41	42	44
MANUFACTURING, HOCKLEY	HOCKLEY	37	64	66	69	71	74
MANUFACTURING, LAMB	LAMB	12	21	21	22	23	24
MANUFACTURING, LUBBOCK	LUBBOCK	35	61	63	65	68	70
MANUFACTURING, PARMER	PARMER	66	113	117	122	126	131
MANUFACTURING, TERRY	TERRY	0	2	2	2	2	2
TOTAL		**234**	**407**	**421**	**438**	**453**	**470**
Mining							
MINING, COCHRAN	COCHRAN	5	8	8	8	8	8
MINING, CROSBY	CROSBY	14	25	27	28	29	31
MINING, DAWSON	DAWSON	178	301	303	307	131	131
MINING, DICKENS	DICKENS	0	0	0	0	0	0
MINING, FLOYD	FLOYD	0	0	0	1	1	1
MINING, GAINES	GAINES	56	94	94	94	1	1
MINING, GARZA	GARZA	1	1	1	1	1	1
MINING, HALE	HALE	0	0	0	0	0	0
MINING, HOCKLEY	HOCKLEY	2	3	3	3	3	3
MINING, LAMB	LAMB	0	0	0	0	0	0
MINING, LUBBOCK	LUBBOCK	1	1	1	1	1	1
MINING, LYNN	LYNN	0	1	1	1	1	1
MINING, MOTLEY	MOTLEY	0	0	0	0	0	0
MINING, TERRY	TERRY	3	5	5	5	5	5
MINING, YOAKUM	YOAKUM	22	37	37	37	37	37
TOTAL		**282**	**476**	**480**	**486**	**218**	**222**
Steam-Electric							
STEAM-ELECTRIC, HALE	HALE	1	1	1	1	1	1
STEAM-ELECTRIC, LAMB	LAMB	174	150	150	150	150	150
STEAM-ELECTRIC, LUBBOCK	LUBBOCK	87	100	100	100	100	100
STEAM-ELECTRIC, YOAKUM	YOAKUM	48	80	80	55	55	55
TOTAL		**310**	**331**	**331**	**306**	**306**	**306**

5.39.4 Strategy Costs

The LERWPG recommends implementing water conservation for industrial users (manufacturing, steam-electric, and mining) with projected needs amounting to a 3 percent water demand reduction by 2030 and 5 percent from 2040 to 2080. Costs to implement BMPs vary from site to site and the LERWPG recognizes that industries will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing industrial water conservation strategies.

5.39.5 Implementation Issues

Demand reduction through water conservation is being implemented throughout the Llano Estacado Region. The rate of adoption of efficient water-using practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing.

There is public support for industrial water conservation, and it is being implemented at a steady pace. As water markets for conserved water expand, this practice will likely reach greater potentials. The TWDB has industrial water conservation programs, including presentations and workshops for utilities who wish to train staff to develop local programs, including water use site surveys, publications on industrial water reuse potential, and information on tax incentives for industries that conserve or reuse water.

5.39.5.1 Environmental Issues

The Task Force BMPs have been developed and tested through public and private sector research and have been applied within the region. Such programs have been installed, are in operation today, and are not expected to have significant environmental issues associated with implementation. For example, most BMPs improve water use efficiency without making significant changes to wildlife habitat. Thus, the proposed conservation practices are not anticipated to have significant potential adverse environmental effects and may have potentially beneficial environmental effects.

5.40 Livestock Water Conservation

5.40.1 Conservation Strategy

The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. The LERWP identifies two BMPs, including rainwater harvesting and land conversion. The water demand for livestock is projected to increase over time from 47,000 ac-ft/yr in 2030 to 51,433 ac-ft/yr in 2080. The main strategy for conservation is to move some land that is involved in livestock production to other land uses that require less water and to reduce the number of livestock produced in the area over time.

5.40.2 Quantity of Available Water

The LERWP recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible and implementing the suggested BMPs when possible. Most of the water from livestock is from local supply, ETHP, Dockum, and other aquifers. Groundwater is the primary source of water for livestock. The quantity of available water from livestock conservation was not quantified.

5.40.3 Strategy Costs

The LERWPG recommends implementing water conservation strategies that include changing land use from livestock production to a less water intensive use and reducing the number of livestock over time to conserve water. The three counties in the Llano Estacado Region with projected livestock water shortages can save water with the BMPs recommended and feasible for the livestock. Costs to implement BMPs vary from site to site, and the LERWPG recognizes that industries will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.40.4 Implementation Issues

Demand reduction through water conservation is being implemented throughout the Llano Estacado Region. Education with livestock owners will assist them in implementing the BMPs effectively throughout the region to conserve water and reduce demand.

5.40.4.1 Environmental Issues

The Task Force BMPs have been developed and tested through public and private sector research and have been applied within the region. Such programs have been installed, are in operation today, and are not expected to have significant environmental issues associated with implementation. For example, most BMPs improve water use efficiency without making significant changes to wildlife habitat. Thus, the proposed conservation practices are not anticipated to have significant potential adverse environmental effects and may have potentially beneficial environmental effects.

5.41 Current Conservation Activities

5.41.1 High Plains Underground Conservation Water District No. 1 Conservation Activities

The HPWD has a voluntary program Assistance in Irrigation Management (AIM) Program in partnership with the TWDB, which provides cost-share funding for purchasing qualifying telemetry-based irrigation equipment. Producers in the HPWD service area can apply to this program. The qualifying equipment includes center pivot irrigation systems and sub-surface drip irrigation systems.[216]

5.41.2 Sandy Land Underground Water Conservation District Conservation Activities

Sandy Land Underground Water Conservation District (UWCD) has been conducting a water conservation program since 1992. In 1989, the 71st Texas Legislature implemented the Agricultural Water Conservation Program to allow the TWDB to loan money to water conservation districts. This money was to be used by local districts to make loans to producers within their respective districts for improved efficiency of irrigation systems.

In the February of 1992, the TWDB approved their initial loan to Sandy Land UWCD in the amount of $500,000 to provide financing for the purchase of approved agricultural water conservation equipment, including center pivot irrigation systems, sprinkler package conversions, and drip irrigation equipment. Since that time, the TWDB has made 22 loans to Sandy Land UWCD for over $17,725,000.

[216] AIM Program: Fall 2019, High Plains Water District. http://www.hpwd.org/aim

Since 1992, Sandy Land UWCD has loaned money for 400 new and used water conserving center pivot irrigation systems, for a total of $11,709,927 to Yoakum County producers. The UWCD has also loaned money for four sprinkler packages in the intervening years. Sandy Land UWCD has never had a default on a loan. The most recent report from 2018 had a 20 percent overall efficiency improvement in the irrigation season water savings.

5.41.3 Texas Alliance for Water Conservation Activities

The TAWC is a partnership of area producers, data collection technologies, and collaborating partners, including industries, universities, and government agencies. TAWC does on-farm demonstrations of cropping and livestock systems that can be used to conserve water. The TAWC typically provides annual field days and field walks during the growing seasons, annual water college, decision-making tools to assist in irrigation and crop management; promotes a field-to-market alliance for sustainable crop production; and publishes annual reports. There are a number of tools on their website. TAWC solutions to look at water conservation, resource allocation, irrigation scheduling, and many more topics. Currently, they are conducting field days and conferences to discuss water conservation.

D. Potential Additional Water Management Strategies

5.42 Playa Lakes Enhanced Recharge

Playa lakes are a dominant wetland type in the Llano Estacado Region that captures runoff and naturally recharges the high plains aquifer. Playas are shallow, circular-shaped depressions or wetlands that rainfall runoff fills and therefore go through frequent, unpredictable, wet/dry cycles. Most of the runoff does not reach regular outlets or channels, instead the playa lakes capture the runoff. The Texas High Plains has approximately 19,300 playas in the area. In the Llano Estacado Region, over 15,500 exist (Figure 1.8), according to data disseminated through the Playa Lakes Joint Venture.[217] Playas range in size from approximately 15 acres to greater than 800 acres, although most are approximately 30 acres. Once the subject of much debate, mounting evidence points to playa lakes as a critical recharge source for the ETHP Aquifer. Playas filter and recharge as much as 95 percent of the water collected in the southern portion of the aquifer. Recharge occurs both through playa basins and along the annulus of playas. After long dry periods, runoff from intense storms can cause relatively fast recharge through desiccation cracks in the playa clay floors, especially when the playa catchment is primarily cultivated land. These cracks eventually swell shut and have limited permeability due to the presence of coarse sediments from the nearby cultivated watershed. Recharge can also occur through the coarser sediments around the annulus of the clay-lined basins.

When containing surface water, playas provide crucial habitat for wildlife that depend on water to survive. When dry, playas also support several other Great Plains wildlife species because they are often the only natural lands in a region dominated by agricultural production. Playas also are also a source of recharge water to the underlying aquifer, filter nutrients and chemicals from the surrounding watershed, and add recreational value to the region.

Given the value of water storage in aquifers, researchers have investigated recharge via natural, enhanced, and artificial means in various ways for decades. Conclusions from early studies suggested large volumes of storage were available, water could be recharged at high rates if available, and recharge was sustainable if the water quality was similar to the groundwater and the annual recharge to withdrawal was balanced.[218] However, without some enhancement or artificial methods, the natural recharge may not provide a significant volume of available water. A study of playas determined that less than 10 percent of the water reached the aquifer by natural percolation through the soil. Studies in the 1960s seemed promising, estimating some 3 million ac-ft of runoff water available with approximately 2.1 million ac-ft available for productive agricultural uses.[219] Research into the recharge dynamics of playas continued into the 1980s. Researchers found that natural recharge primarily occurs soon after rainfall around the perimeter of the playa. Some researchers determined that after this initial recharge period, additional recharge was infeasible and

[217] Playa Lakes Joint Venture. http://pljv.org/

[218] Ganesan, G., et al., 2016. Comparison of infiltration flux in playa lakes in grass-land and cropland basins, Southern High Plains of Texas, Vol. 7, No. 1, Pgs. 25–39, *Texas Water Journal.*

[219] Texas Playa Conservation Initiative. https://playasworkfortexans.com/restoring-your-playa/

did not warrant continued research efforts into practicable means of artificial recharge. A multi-year field investigation of 20 playas for observed average infiltration flux rates of approximately 10 millimeters/day (mm/d) (range 2 to 20 mm/d) and 3 mm/d (range 1 to 5 mm/d) for the cropland and grassland playas, respectively, during the hydroperiods when the playas were inundated.[220]

Using the recently reported estimate of infiltration flux of approximately 5 mm/d (0.2 inches/day), calculations of yield or the volume of supply available were performed. The annual yield volumes were summed for the Llano Estacado Region counties. The result was an estimate 1.5 million ac-ft/year available supply from playa recharge to the ETHP aquifer.

Playa lakes enhanced recharge could be achieved through playa restoration and would use runoff from rain events. It is possible to restore playas that have been modified and are no longer functioning as healthy playas[221]. Healthy playas have an intact clay basin with no excavated pits or ditches and are not buried by sediment from erosion or runoff. Playa restoration would entail establishing native vegetation to act as a buffer to sediments and contaminants. Studies have shown that buffer widths of at least 130 feet can effectively trap most of the sediments and contaminants carried in runoff. Once a buffer has been established, the accumulated sediment can be removed. Removed sediment should be used to fill in pits or channels that collect water and prevent the playa from functioning. Additionally, water flow in the surrounding area that has been modified should be redirected to the playa basin.

Up to 85 percent of the larger playas in the intensively irrigated zone in the Southern High Plains of Texas were modified for irrigation. Estimates in 1980 were that nearly 11,000 playas had been modified for agricultural uses compared to just 150 in 1965. The primary area of playa modification in the Llano Estacado Region during the 1960s and 1970s was in the south-central portion of the region in the intensively irrigated cropland zone, including Castro, Parmer, Floyd, Hale, Lamb, and Swisher counties. Knowing where modifications have previously occurred assists in identifying a targeted area to implement playa restoration. Knowledge of areas with declining well production could also be used to prioritize playa restoration.

5.42.1 Quantity of Available Water

This strategy assumes an average playa size of 30 acres and an average infiltration flux rate of 0.2 inches per day. At this rate, the annual yield resulting from the restoration of one 30-acre playa, enhancing the ability to recharge the Ogalla Aquifer can be anticipated to be 180 ac-ft/yr. Playa restoration to enhance a non-working playa that has been modified or accumulated sediment can be assumed to produce approximately 6 ac-ft/yr per acre of playa restored to healthy condition.

5.42.2 Strategy Costs

Costs associated with the restoration of one 30-acre playa are presented in Table 5-48. Assumptions and conditions associated with these costs include the following.

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[220] Ganesan, G., et al., 2016. Comparison of infiltration flux in playa lakes in grass-land and cropland basins, Southern High Plains of Texas, Vol. 7, No. 1, Pgs. 25–39, *Texas Water Journal.*

[221] Texas Playa Conservation Initiative. https://playasworkfortexans.com/restoring-your-playa/

- Facility costs are not included but used to develop contingencies, surveying, and excavation, etc.
- A vegetation buffer width of 130 feet is assumed, resulting in an estimated 13 acres of vegetation.
- Engineering, legal, fiscal, and contingency costs are 35 percent for facilities required by this strategy.
- Interest during construction (restoration) is 3.5 percent, and a 0.5 percent return on investments.
- Project will be financed for 20 years at a 3.5 percent interest rate.

As shown, the total project cost is estimated to be $125,000. Annual debt service is $6,000, and annual maintenance cost is $1,000. The unit cost for 180 ac-ft/yr supply is estimated to be $39 per ac-ft or $0.12 per 1,000 gallons.

Table 5-48 Playa Lakes Enhanced Recharge Cost (September 2023 dollars)

Item	Estimated Costs for Facilities
CAPITAL COST	
Integration, Relocations, Backup Generator & Other	$67,000
TOTAL COST OF FACILITIES	**$67,000**
Engineering:	
- Planning (3%)	$2,000
- Design (7%)	$5,000
- Construction Engineering (1%)	$1,000
Legal Assistance (2%)	$1,000
Fiscal Services (2%)	$1,000
Environmental & Archaeology Studies and Mitigation	$43,000
Land Acquisition and Surveying (30 acres)	$2,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$3,000
TOTAL COST OF PROJECT	**$125,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$6,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,000
TOTAL ANNUAL COST	**$7,000**
Available Project Yield (ac-ft/yr)	180
Annual Cost of Water ($ per ac-ft)	$39
Annual Cost of Water After Debt Service ($ per ac-ft)	$6
Annual Cost of Water ($ per 1,000 gallons)	$0.12
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.02
Note: One or more cost element has been calculated externally	
	CEB1/24/2025

5.42.3 Implementation Issues

5.42.3.1 Environmental Issues

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened or SGCN are listed in Appendix D by county.

5.42.3.2 Permitting Issues

Restoration of playa lakes is not anticipated to require permits with Llano Estacado Underground Water Conservation District or the TCEQ. Coordination with the USFWS, the Natural Resources Conservation Service (NRCS), and the Playa Lakes Joint Venture should be considered to obtain cost-share funds to assist with Playa restoration. The TPWD is an additional resource to be considered for technical assistance.

5.42.3.3 Other

Additional implementation issues that should be considered when restoring playas include the following:

- Landowner rights and willingness to comply – land acquisition is not necessary; however, the ability to access the land and the landowner's interest in maintaining the land such that the playa continues to function is necessary.
- A firm yield is not associated with this strategy and playa recharge happens with rainfall and runoff after periods of long, dry conditions.
- A method on how to identify and prioritize playas needing restored – with over 15,500 playas in the Llano Estacado Region prioritization based on landowners, proximity to lower functioning wells, etc., should be developed.

5.43 South Garza Water Supply

The South Garza Water Supply strategy was included in both the 2011 and 2016 LERWPs. In the 2021 planning cycle, the projected demands and supplies of Garza County-Other did not produce a need, or shortage, for the WUG. However, this strategy is important for several smaller systems around LAH and is included in the 2026 LERWP as an additional WMS. The South Garza Water Supply strategy provides water to the Northridge Development and to the City of Lubbock's Sam Wahl Recreation Area. South Garza Water Supply infrastructure installed in 2010 consists of a connection to the Lubbock raw water pipeline, a pump station near the Lubbock raw water pump station, a water treatment plant with a 144,000-gpd capacity, approximately 3.5 miles of 10- and 6-inch piping, a 100,000-gallon water storage tank, and a booster pump station with two 250-gpm pumps to pump water to customers. Distribution piping is all 6 inches in diameter and includes fire hydrants. The current water demand served by this system is 25 ac-ft/yr.

This strategy would provide a reliable, regional water source to the existing communities around the lake, many of which are served by wells that are low, unreliable producers and provide aesthetically displeasing water quality.

5.43.1 Description of Strategy

Under this strategy, the existing South Garza Water Supply system would be expanded and extended to serve the communities surrounding the lake. Because the condition and design standards of the existing South Garza facilities are unknown, it assumed that new treatment, pumping, and storage facilities must be built. It is further assumed that the existing 6-inch piping can continue to be used and can be extended to serve additional development on the north side of the lake.

The facilities to be constructed include the following:

- Raw water intake and pump station with 500,000-gpd capacity.
- A 0.5-mgd water treatment plant.
- A 1-million gallon water storage tank at the water treatment plant.
- Extension of the distribution piping from Northridge Development to serve the following areas:
    - Community of Justiceburg
    - Justiceburg Recreational Vehicle (RV) Park
    - Grubs RV Park
    - North Ridge RV Park

Installation of distribution piping from the treated water ground storage tank at the water treatment plant, across the Brazos River downstream of the dam, to serve the following areas.

- Rio Brazos Development
- West Rio Brazos Development/Oak Canyon Estates
- Rio Brazos RV Park
- Community of Polar

5.43.2 Quantity of Water

Table 5-49 tabulates the expected water demand from the communities to be served by the water system expansion. Although many of the water users will be seasonal, due to the recreational uses in the area, the table is based on a year-round population in order to present the most conservative estimation of yearly demand.

Table 5-49. Population and Demand Projections for South Garza Water Supply System

Water Supply	Projected Maximum Number of Connections	Population for Maximum Connections	Per Capita Water Use (gpcd)	Water Demand (ac-ft/yr)
North Side of Lake				
Justiceburg	50	150	118	20
Justiceburg RV Park	100	300	45	15
Grubs RV Park	100	300	45	15
North Ridge RV Park	120	360	45	18
North Ridge Development	100	300	118	40
Subtotal	470	1410	-	108
South Side of Lake				
Rio Brazos Development	200	600	118	79
West Rio Brazos/Oak Creek Estates	120	360	118	48
Rio Brazos RV Park	200	600	45	30
Polar Community	10	30	118	4
Subtotal	530	1590	-	161
Total	1000	3000	-	269[b]
Average use (mgd)				0.25
Peak day use[a] (mgd)				0.50

Source: 2010 Llano Estacado Regional Water Plan
gpcd = Gallons per capita per day; ac-ft/yr = Acre-feet per year; mgd = million gallons per day
[a] Peaking factor (PD/AD) = 2.0
[b] Value was rounded to 270 ac-ft/yr for this strategy

5.43.3 Reliability, Cost, and Environmental and Implementation Constraints

The full description of the strategy’s reliability, cost, and environmental and implementation constraints is presented in the 2016 LERWP.

5.44 Projects Associated with the Canadian River Municipal Water Authority

The CRMWA provides groundwater from Roberts County and surface water from Lake Meredith to users in the Panhandle Water Planning Area (PWPA) and entities in the Llano Estacado Region. The total available safe supply from the CRMWA system is 89,670 ac-ft/yr in 2020, decreasing to 74,330 ac-ft/yr by 2070 as groundwater becomes depleted within CRMWA’s current well fields. Current demands on CRMWA are estimated at approximately 101,000 ac-ft/yr in 2020 and increase to over 121,600 ac-ft/yr by 2070. This results in near-term needs of 11,400 ac-ft/yr and long-term needs of about 47,260 ac-ft/yr.

There are two projects associated with CRMWA that are used in the Llano Estacado Region to augment existing supplies for CMRWA member cities. These projects are Expanded Development of Roberts County Well Field (shown as CRMWA I & II and CRMWA II) and CRMWA ASR. These strategies are summarized below. The full description of each strategy is presented in the 2021 Panhandle Regional Water Plan.

5.44.1 Expanded Development of Roberts County Well Field

Groundwater is an important water resource for CRMWA. It is used during times when water is limited from Lake Meredith due to the lack of inflows or impaired water quality. Water from Roberts County is blended with Lake Meredith water to provide supplies that can be treated through conventional treatment. With these uncertainties for Lake Meredith, CRMWA is proceeding to expand their groundwater production and delivery capacity to be able to provide all necessary supplies from groundwater if needed. CRMWA holds water rights to 444,833 acres in Roberts and adjacent counties.

Presently, only a fraction of these rights is developed. The current capacity of the transmission system (CRMWA I) from the Robert County well field is 65 mgd and CRMWA can deliver up to 69,000 ac-ft/yr. The existing well field capacity is 84 mgd, and CRMWA is experiencing a reduction of about 1 mgd per year. This reduction is expected to slow down but over the course of the planning period, CRMWA will need to construct additional wells to replace lost groundwater supplies for the existing transmission system. It will also need to develop additional groundwater supplies and transmission capacity from the Roberts County well field to meet its projected needs.

CRMWA plans to develop a second pipeline with a capacity of 85 mgd. This capacity includes 20 mgd of transmission capacity for Amarillo’s Roberts County well field, which is expected to be online by 2065. This second pipeline, also called the CRMWA II pipeline, would have the ability to deliver about 69,000 ac-ft/yr to CRMWA and 20,000 ac-ft/yr to Amarillo. For planning purposes, the CRMWA II pipeline would likely provide 65,000 ac-ft/yr without additional local storage during the lower demand months (assumes a peaking factor of 1.15). Some years, less water will be delivered from the well field as more water from Lake Meredith is used.

With this project the total capacity from the Roberts County for CRMWA is increased to 130 mgd. It is assumed that a new 57-mile, 72-inch pipeline (CRMWA II) would be constructed from Roberts County to the terminal storage reservoir northeast of Amarillo. For CRMWA, an additional 10-mile, 66-inch pipeline would connect the CRMWA wellfield in Roberts County to the 78-inch CRMWA II pipeline being shared with Amarillo.

5.44.1.1 Time Intended to Complete

Continued expansion of the Robert County well field to fully utilize the existing transmission capacity is needed by 2020 and would be on-going through the planning period. The planning and design of CRMWA II transmission system is expected to begin by 2024 with the transmission system online by 2027. Additional wells are assumed to be needed over time to maintain the full capacities of the system.

5.44.1.2 Quantity, Reliability and Cost

The total quantity of water provided by this strategy would be about 80,000 ac-ft/yr. This includes the development of 15,000 ac-ft/yr of new groundwater supply for the existing pipeline and an additional 65,000 ac-ft/yr for the new pipeline. Reliability of Ogallala supplies is moderate to high. There are significant quantities of untapped water supplies in Roberts County, but the availability of this water also depends on other water users. Costs to expand the Roberts County well field is estimated at $454 million. This represents CRMWA’s share of the CRMWA II pipeline, new wells to provide 80,000 ac-ft/yr year of supply, and well field piping.

5.44.2 CRMWA Aquifer Storage and Recovery

CRMWA currently has 65 mgd of capacity in the existing transmission system from the Roberts County Well Field. As CRMWA develops additional well field capacity in Roberts County and constructs the new CRMWA II pipeline, the maximum quantity of water that can be transported from the well field will increase to 130 mgd. The average annual supply from this system (including CRMWA II) is estimated at 113,000 ac-ft/yr, based on system peaking factor of 1.15. This results in an average delivery of 101 mgd.

During non-peak periods, the capacity of the CRMWA transmission system is underutilized; yet during peak demand months, the ability to meet all CRMWA's customers' future peak demands may be limited. To address the need for increased peaking capacity in CRMWA's delivery system, available water from CRMWA's sources (Lake Meredith and/or Roberts County Well Field) could be treated and stored by the member cities during non-peak periods for future use during peak times. This strategy proposes to store excess non-peak water through an ASR program that will use existing well fields and infrastructure. CRMWA will be conducting a feasibility study to further evaluate this strategy for all member cities.

For CRMWA's customers in the Llano Estacado Region, CRMWA will assist in sponsoring an ASR project. Water from this project could be used by all eight member cities in the Llano-Estacado region. Until the feasibility study is completed, it is assumed that the cities of Lamesa, Plainview, Levelland, and Brownfield would receive water from the ASR project. The water would be treated at the Lubbock water treatment plant and stored at a nearby ASR site developed by CRMWA. Alternatively, each member city could utilize their existing well fields and treatment capacity.

The cost components of this strategy assume a new ASR well field, which includes 14 injection wells and 13 recovery wells. Some of the injection wells may also be used for recovery. The strategy will also include transmission from the treatment plant to the ASR well field. Since this well field has not been sited, a 5-mile transmission line has been assumed as a placeholder. Defined improvements will be determined during the feasibility study sponsored by CRMWA. It should be noted that the City of Lubbock has developed a more detailed ASR strategy that will utilize water from CRMWA. However, the supplies for Lubbock's ASR strategy are based on the average annual supply from CRMWA's system with the assumed peaking factor. Additional water may become available to Lubbock with CRMWA's sponsored ASR project. The quantities and recipients will be refined during CRMWA's feasibility study.

5.44.2.1 Time to Implement

Supply will be available for the ASR project after CRMWA II is online in 2030.

5.44.2.2 Quantity, Reliability and Cost

The quantity will vary from year to year depending on the demand from the member cities and capacities of ASR well fields. The quantity of water that could be made available annually from the CRMWA sponsored ASR project is 10,000 ac-ft/yr. If the water is stored over multiple years, additional supply may be available during drought. For purposes of this analysis, it is assumed that the water is stored and retrieved over one year. The source of this water would be Lake Meredith and/or the Ogallala aquifer in Roberts County. The actual amounts used from each source will vary by year based on demands and available supply in Lake Meredith.

Successful ASR development is highly reliable. It is possible to achieve 90 to 95 percent recovery efficiency, depending upon the natural hydraulic gradient of the receiving aquifer and competition from adjacent groundwater users. If the water is recharged and recovered over a relatively short period (e.g., one year), the likelihood of reduced reliability is low. The ASR project will increase the reliability of existing supplies by allowing storage of the supply during periods of low demand to meet high demands at a later time.

The quality of water is expected to be good. The ASR regulations for Texas specify that the quality of the recharge water must not degrade the quality of the receiving aquifer, which is generally good. The recovered ASR water would be treated to standards required by the end use. When recharge water is treated to meet drinking water standards prior to storage, the recovered water will only need simple redisinfection prior to being distributed to end-users.

Cost estimates were developed for the application of ASR a single well field. A total of 27 wells for injection and recovery and 20,000 feet of well field piping were assumed for this strategy. No additional transmission costs to the end users are included in the strategy cost. If possible, existing infrastructure would be used to deliver the stored water. The feasibility study, when completed, would identify additional project components if needed. The strategy is estimated to cost $43 million.

5.45 City of Smyer CRMWA Lease

The City of Levelland has an agreement with the City of Smyer to provide up to 1.8 mgd of Levelland’s CRMWA allocation, if Levelland does not need it. The City of Smyer would use this water to blend with their current groundwater supply. This additional supply would improve their water quality by reducing arsenic and fluoride concentrations and extend their future water supply.

This alternative project would require a new 6-inch, 2-mile pipeline connection from the existing CRMWA supply pipeline, which delivers water from Lubbock to Levelland. For planning purposes, this project is designed to provide 300 ac-ft/yr with a peaking factor of 1.5 and includes a new elevated storage tank. The primary facilities required for the strategy include the following.

- A new 0.4 mgd pump station at CRMWA pipeline connection.
- 2 miles of 6-inch main water line from the new pump station to Smyer.
- A 1,000,000-gallon elevated storage tank.

5.45.1 Quantity of Available Water

This strategy is estimated to provide an annual supply of 300 ac-ft for the City of Smyer (Hockley County-other). The source of this supply would be provided through a demand reduction by the City of Levelland from their CRWMA water allotment. The water supply would be available to the City of Smyer when the City of Levelland does not need it. The CRMWA source water is from the Ogallala Aquifer in Roberts County or Lake Meredith in the Canadian River Basin located in Region A (Panhandle Region).

5.45.2 Strategy Costs

A cost summary is provided in Table 5-50. Assumptions and conditions associated with these costs include the following:

- Water is purchased from Levelland at the 2024 cost of CRMWA water for Levelland of $1.92 per 1,000 gallons or $625.73 per ac-ft.[222]
- Engineering, legal, and contingency costs are 35 percent for facilities required by this strategy.
- Power is available at $0.09 per kW-hr.
- Interest during construction is 3.5 percent, and a 0.5 percent return on investments.
- Project will be financed for 20 years at a 3.5 percent interest rate.

As shown, the total project cost is estimated to be $10,194,000. Annual debt service is $717,000, and annual operational cost, including power and purchase of water, is $276,000. The unit cost for 300 ac-ft/yr supply is estimated to be $3,310 per ac-ft or $10.16 per 1,000 gallons.

Table 5-50. City of Smyer Water Management Strategy Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Pump Station (0.4 mgd)	$748,000
Transmission Pipeline (6 in dia., 2 miles)	$1,425,000
Elevation Storage Tank (1 mg)	$5,118,000
TOTAL COST OF FACILITIES	**$7,294,000**
Engineering:	
- Planning (3%)	$219.000
- Design (7%)	$511,000
- Construction Engineering (1%)	$73,000
Legal Assistance (2%)	$146,000
Fiscal Services (2%)	$146,000
Pipeline Contingency (15%)	$214,000
All Other Facilities Contingency (20%)	$1,174,000
Environmental & Archaeology Studies and Mitigation	$71,000
Land Acquisition and Surveying (14 acres)	$25,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$321,000
TOTAL COST OF PROJECT	**$10,194,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$717,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$65,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$19,000
Pumping Energy Costs (0.09 $/kW-hr)	$4,000
Purchase of Water (300 ac-ft/yr @ $625.73 $/ac-ft)	$188,000
TOTAL ANNUAL COST	**$993,000**
Available Project Yield (ac-ft/yr)	300
Annual Cost of Water ($ per ac-ft), based on PF=1.5	$3,310
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.5	$920
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$10.16
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$2.82

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

[222] CRMWA Comprehensive Annual Financial Report. September 2019.

5.45.3 Implementation Issues

5.45.3.1 Permitting Issues

The City of Smyer would require the necessary permits to construct the pipeline and elevated storage tank.

5.46 City of Seminole Brackish Groundwater Desalination

Desalination of brackish groundwater is a strategy in the State of Texas for meeting increasing demands. The TWDB continues to support the investigation of developing brackish groundwater including the development of models that illustrate the use of innovative, cost-effective technologies and offer practical solutions to implementation. The Seminole municipal WUG considers the Dockum Aquifer as its brackish groundwater source for desalination.

5.46.1 Quantity of Available Water

The City of Seminole could have 500 ac-ft/yr (0.45 mgd) potable supply from 714 ac-ft/yr (0.64 mgd) pumped from Dockum Aquifer, with 214 ac-ft/yr lost to concentrate generation. The strategy is designed to provide a potable water supply, with an estimated 70 percent recovery rate (RO efficiency) from the raw brackish water source: Desalination of brackish groundwater is attractive in that it is a drought-proof source of supply.

5.46.2 Strategy Costs

The City of Seminole strategy includes installation of brackish wells and construction of a treatment plant. Costs associated with this strategy are presented in Table 5-51 Assumptions and conditions associated with these costs include the following.

- 11 supply wells (9 active, 2 contingency) at 500 feet deep
  - 1,000-foot spacing
  - 50-gpm average flow rate, 100-gpm peak
  - Estimated drawdown of 150 feet
  - Estimated TDS 7,500 mg/L
- 6 injection wells
- 19,000 feet of well field piping to treatment plant
- RO water treatment plant and pump station
- 20,000 feet of main water line to distribution system
- Two 500,000-gallon tanks (for raw and treated water)
- One 2,000,000-gallon tank (concentrate)

As shown, the total project cost is estimated to be $67,672,000. Annual debt service is $4,761,000, and annual operational cost, including power, is $6,024,000. The unit cost for 500 ac-ft/yr supply is estimated to be $21,570 per ac-ft or $66.19 per 1,000 gallons.

Table 5-51. City of Seminole Brackish Groundwater Desalination Costs (September 2023 Dollars)

Item	Estimated Costs for Facilities
Primary Pump Station (0.89 MGD)	$1,184,000
Transmission Pipeline (8 in dia., 4 miles)	$3,483,000
Well Fields (Wells, Pumps, and Piping)	$13,222,000
Storage Tanks (Other Than at Booster Pump Stations)	$3,387,000
Water Treatment Plant (1.3 MGD)	$27,133,,000
Integration, Relocations, Backup Generator & Other	$7,000
TOTAL COST OF FACILITIES	**$48,416,000**
Engineering:	
- Planning (3%)	$1,452,000
- Design (7%)	$3,389,000
- Construction Engineering (1%)	$484,000
Legal Assistance (2%)	$968,000
Fiscal Services (2%)	$968,000
Pipeline Contingency (15%)	$522,000
All Other Facilities Contingency (20%)	$8,987,000
Environmental & Archaeology Studies and Mitigation	$277,000
Land Acquisition and Surveying (46 acres)	$79,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$2,130,000
TOTAL COST OF PROJECT	**$67,672,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$4,761,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$201,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$30,000
Water Treatment Plant	$5,691,000
Pumping Energy Costs (0.09 $/kW-hr)	$102,000
TOTAL ANNUAL COST	**$10,785,000**
Available Project Yield (ac-ft/yr)	500
Annual Cost of Water ($ per ac-ft), based on PF=2	$21,570
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=2	$12,048
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$66.19
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$36.97

Acronyms: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.46.3 Implementation Issues

5.46.3.1 Environmental Issues

This desalination strategy would provide a potable water source for the City of Seminole. Eleven Dockum water wells would be installed in the vicinity of the City's test well. The project would also require six injection wells, a new RO water treatment plant and pump station, storage tanks for raw water, treated water, and brine concentrate, and transmission and distribution pipeline in Seminole. It is assumed that the well field would be located in the vicinity of the desalination demonstration well, located approximately 0.5 miles northwest of the Gaines County Airport.

The project proposed would not be anticipated to impact land use, density, or type of development beyond that already planned within the project area. Permanent land use impacts in the project area would be limited to the new wells, collector and distribution pipelines, and water treatment facilities. Disturbance to area land use would depend upon the type of construction used to install the pipelines (open cut, boring, etc.).

The proposed project occurs within the High Plains physiographic region of Texas and is within the Kansan biotic province[223]. The project components are within an area defined as crops vegetation type[224]. Crops include a variety of cultivated row or cover crops. EMST data and TPWD's more detailed and recently produced vegetation data[225], identify several primarily row crops and shortgrass prairie within the proposed well field area. Vegetation impacts would include clearing areas for construction of approximately 17 new wells, RO water treatment facilities, and pipelines.

FEMA has not mapped the project area for 100-year floodplains[226]. There are a few freshwater emergent wetland features identified near the proposed new well field area, based on NWI data. Proper siting could avoid impacts to these resources. A Nationwide Permit or coordination with USACE would be required for construction within waters of the U.S. Impacts from installation of pipelines for this proposed project resulting in a loss of less than 0.5 acres of waters of the U.S. could be covered under NWP 58 for utility line activities. TCEQ's Surface Water Quality Viewer[227] identified no impaired stream or reservoir segments within 5 miles of the proposed project.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (P196-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets from the Texas Historical Commission, the Gaines County Cemetery is located northeast of the proposed well field location. No state historic sites, National Register of Historic Places-listed sites, historical markers, national register properties, or national register districts are located within a one-mile buffer of the existing demonstration well.

No archeological surveys have been completed near the proposed well field area, as shown in publicly available Texas Historical Commission GIS layers. A review of archeological resources in the proposed project area should be conducted during project planning. The owner or controller of the project would be required to coordinate with the Texas Historical Commission regarding impacts to cultural resources under the Texas Antiquities Code.

The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. Species listed by USFWS and TPWD as endangered, threatened or SGCN in Gaines County are listed in Appendix D under Gaines County, Texas.

According to IPaC, provided by USFWS on February 3, 2020, the least tern, piping plover, and red knot are federally listed species that could potentially be in the project area; however, these species

[223] Blair, W.F. 1950. "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117.

[224] McMahan, C.A., R.G. Frye, and K.L. Brown. 1984. "The Vegetation Types of Texas." Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ March 22, 2019.

[225] TPWD. 2019. Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

[226] FEMA. 2020. FEMA Flood Map Service Center: Search by Address. Accessed online https://msc.fema.gov/portal/search?AddressQuery=seminole%2C%20tx#searchresultsanchor February 3, 2020.

[227] TCEQ. 2020. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed February 3, 2020.

only need to be considered for wind energy projects. No critical habitats for these or any other species occur within the project area. TPWD's TxNDD documents the occurrences of rare species in Texas. Documented occurrences of the black-tailed prairie dog and western spotted skunk have occurred in the vicinity of the proposed project features.

A biological survey of the project area, to determine whether populations of threatened or endangered species, or potential habitats used by listed species occur in the area to be affected, should be conducted if this strategy is selected. A determination on whether any impacts or effects to listed species may occur would then be made. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning. The installation of wells and collection pipelines and distribution pipelines should be planned so that sensitive habitats, cultural resources, and other environmentally sensitive areas are avoided.

5.46.3.2 Permitting Issues

The City of Seminole already owns land where wells would be drilled within this area. The City of Seminole would need to acquire permits from the Llano Estacado Underground Water Conservation District, and the design and construction of public water supply wells, water transmission facilities, and disposal of concentrate must be approved by TCEQ.

5.46.3.3 Other

Wells would be placed on properties where the City of Seminole owns the water rights, which includes the rights to surface improvements to extract and convey the groundwater. The City of Seminole would need to negotiate work with surface owners to accommodate the surface operations and plans.

Since a test drilling program has already been completed, optimal siting of the well may already be complete.

E. County Plans

5.47 Bailey County Water Supply Plan

Table 5-52 lists each WUG in Bailey County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-52. Bailey County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Muleshoe	1,996	1,849	Projected surplus
County-Other	14	93	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	No Mining demand
Irrigation	(2,317)	0	Projected shortage – see plan below
Livestock	0	181	Projected surplus

ac-ft/yr = acre-feet per year

5.47.1 City of Muleshoe

The City of Muleshoe obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Muleshoe; however, additional conservation is recommended to achieve a per capita water use goal of 140 gallons per capita per day (gpcd).

5.47.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following water management strategies are recommended for the City of Muleshoe.

a. Additional Water Conservation
    - Date to be Implemented: 2030
    - Unit Cost: $477/ ac-ft

b. Additional Groundwater Development (Ogallala Aquifer)
    - Date to be Implemented: 2040
    - Total Project Cost: $959,000
    - Unit Cost: $333/ac-ft

Table 5-53. Recommended Plan Costs by Decade for the City of Muleshoe

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*2,043*	*2,020*	*1,996*	*1,962*	*1,915*	*1,849*
Conservation						
Supply From Plan Element (ac-ft/yr)	26	52	51	50	49	49
Annual Cost ($/yr)	$12,414	$24,829	$24,351	$23,874	$23,396	$23,396
Projected Surplus/(Shortage) after Conservation	*2,069*	*2,072*	*2,047*	*2,012*	*1,964*	*1,898*
Additional Groundwater Development (Ogallala Aquifer)						
Supply From Plan Element (ac-ft/yr)	–	240	240	240	240	240
Annual Cost ($/yr)	–	$80,000	$80,000	$13,000	$13,000	$13,000
Unit Cost ($/ac-ft)	–	$333	$333	$54	$54	$54

ac-ft/yr = acre-feet per year

5.47.2 County-Other

Bailey County-Other obtains water supply from the Ogallala Aquifer. The water supply entities for Bailey County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.47.3 Manufacturing

There is no projected manufacturing demand in Bailey County.

5.47.4 Steam-Electric

There is no projected steam-electric demand in Bailey County.

5.47.5 Mining

There is no projected mining demand in Bailey County.

5.47.6 Irrigation

Bailey County irrigation obtains its water supply from groundwater from the Ogallala Aquifer and reuse water supplies available within Bailey County. Bailey County Irrigation has a projected need beginning in 2030 and continuing through 2050. The water management strategies contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.47.6.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Bailey County irrigation.

a. Irrigation Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $619/ac-ft

Table 5-54. Recommended Plan Costs by Decade for Bailey County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(845)*	*(4,452)*	*(2,317)*	*0*	*0*	*0*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	2,909	3,327	2,622	1,916	1,727	1,646
Annual Cost ($/yr)	$1,801,250	$2,060,075	$1,623,540	$1,186,385	$1,069,357	$1,019,202
Projected Surplus/(Shortage) after Conservation	*2,064*	*(1,125)*	*305*	*1,916*	*1,727*	*1,646*

ac-ft/yr = acre-feet per year

5.47.7 Livestock

Bailey County livestock obtains water supply from the Ogallala Aquifer. The projected water supply for Baily County Livestock is adequate to meet the projected demands and not shortages are projected. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.48 Briscoe County Water Supply Plan

Table 5-55 lists each WUG in Briscoe County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-55. Briscoe County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Quitaque	255	270	Projected surplus
City of Silverton	49	67	Projected surplus
County-Other	71	97	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	No Mining demand
Irrigation	0	0	No projected shortage - see plan below
Livestock	21	0	Projected surplus

ac-ft/yr = acre-feet per year

5.48.1 City of Quitaque

The City of Quitaque obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Quitaque; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.48.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Quitaque.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-56. Recommended Plan Costs by Decade for the City of Quitaque

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*243*	*250*	*255*	*259*	*265*	*270*
Conservation						
Supply From Plan Element (ac-ft/yr)	2	3	3	3	2	2
Annual Cost ($/yr)	$955	$1,432	$1,432	$1,432	$955	$955
Projected Surplus/(Shortage) after Conservation	*245*	*253*	*258*	*262*	*267*	*272*

ac-ft/yr = acre-feet per year

5.48.2 City of Silverton

The City of Silverton obtains its water supply from surface water from Lake Mackenzie. The City has groundwater wells in addition to its surface water; however, there was assumed to be no supply from groundwater in calculating the needs for the city. There are no projected shortages for the City of Silverton; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.48.2.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Silverton.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-57. Recommended Plan Costs by Decade for the City of Silverton

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*37*	*44*	*49*	*55*	*61*	*67*
Conservation						
Supply From Plan Element (ac-ft/yr)	2	4	–	–	–	–
Annual Cost ($/yr)	$955	$1,910	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*39*	*48*	*49*	*55*	*61*	*67*

ac-ft/yr = acre-feet per year

5.48.3 County-Other

Briscoe County-Other obtains its water supply from surface water from a Run-of-River right associated with Caprock Canyons State Park and groundwater from an undifferentiated aquifer located in Briscoe County. There are no projected shortages for the Briscoe County-Other; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.48.3.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Briscoe County-Other.

a. Additional Water Conservation
   - Date to be Implemented: 2030
   - Unit Cost: $477/ac-ft

Table 5-58. Recommended Plan Costs by Decade for Briscoe County-Other

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*55*	*65*	*71*	*79*	*87*	*97*
Conservation						
Supply From Plan Element (ac-ft/yr)	4	6	6	5	5	4
Annual Cost ($/yr)	$1,910	$2,865	$2,865	$2,387	$2,387	$1,910
Projected Surplus/(Shortage) after Conservation	*59*	*71*	*77*	*84*	*92*	*101*

ac-ft/yr = acre-feet per year

5.48.4 Manufacturing

There is no projected manufacturing demand in Briscoe County.

5.48.5 Steam-Electric

There is no projected steam-electric demand in Briscoe County.

5.48.6 Mining

There is no projected mining demand in Briscoe County.

5.48.7 Irrigation

Briscoe County irrigation obtains its water supply from groundwater from the Ogallala Aquifer, Seymour Aquifer, and other minor aquifers within Briscoe County and surface water supplies from run-of-river water rights. Briscoe County Irrigation does not have a projected need during the planning period; however, the LERWPG recommends water conservation for all irrigation users within the planning region. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs that may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.48.7.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Briscoe County Irrigation.

a. Irrigation Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $619/ac-ft

Table 5-59. Recommended Plan Costs by Decade for Briscoe County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*0*	*0*	*0*	*0*	*0*	*0*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	891	977	745	512	435	384
Annual Cost ($/yr)	$551,706	$604,958	$461,303	$317,030	$269,352	$237,772
Projected Surplus/(Shortage) after Conservation	*891*	*977*	*745*	*512*	*435*	*384*

ac-ft/yr = acre-feet per year

5.48.8 Livestock

Briscoe County livestock obtains water supply from the Ogallala Aquifer and other minor aquifers located in Briscoe County. The water supply entities for Briscoe County Livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.49 Castro County Water Supply Plan

Table 5-60 lists each WUG in Castro County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-60. Castro County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) 2050 (ac-ft/yr)	Surplus/(Shortage) 2080 (ac-ft/yr)	Comment
City of Dimmitt	3,119	3,139	Projected surplus
Hart Municipal Water System	462	467	Projected surplus
City of Nazareth	451	440	Projected surplus
County-Other	36	98	Projected surplus
Manufacturing	9	0	Projected surplus
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	No Mining demand
Irrigation	(53,100)	970	Projected shortage - see plan below.
Livestock	0	326	Projected surplus

ac-ft/yr = acre-feet per year

5.49.1 City of Dimmitt

The City of Dimmitt obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Dimmitt; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.49.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Dimmitt.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-61. Recommended Plan Costs by Decade for the City of Dimmitt

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*3,092*	*3,104*	*3,119*	*3,127*	*3,134*	*3,139*
Conservation						
Supply From Plan Element (ac-ft/yr)	21	41	38	36	34	32
Annual Cost ($/yr)	$10,027	$19,576	$18,144	$17,189	$16,234	$15,279
Projected Surplus/(Shortage) after Conservation	*3,113*	*3,145*	*3,157*	*3,163*	*3,168*	*3,171*

ac-ft/yr = acre-feet per year

5.49.2 Hart Municipal Water System

The Hart Municipal Water System obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the Hart Municipal Water System and no changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.49.3 City of Nazareth

The City of Nazareth obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Nazareth; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.49.3.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Nazareth.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-62. Recommended Plan Costs by Decade for the City of Nazareth

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*454*	*452*	*451*	*448*	*445*	*440*
Conservation						
Supply From Plan Element (ac-ft/yr)	2	5	5	5	5	5
Annual Cost ($/yr)	$955	$2,387	$2,387	$2,387	$2,387	$2,387
Projected Surplus/(Shortage) after Conservation	*456*	*457*	*456*	*453*	*450*	*445*

ac-ft/yr = acre-feet per year

5.49.4 County-Other

Castro County-Other obtains water supply from the Ogallala Aquifer. The water supply entities for Castro County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.49.5 Manufacturing

Castro County manufacturing obtains water supply from the Ogallala Aquifer. The water supply entities for Castro County manufacturing do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.49.6 Steam-Electric

There is no projected steam-electric demand in Castro County.

5.49.7 Mining

There is no projected mining demand in Castro County.

5.49.8 Irrigation

Castro County irrigation obtains its water supply from groundwater from the Ogallala Aquifer and reuse water supplies available within Castro County. Castro County Irrigation has a projected need beginning in 2030 and continuing through 2050. The water management strategies contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.49.8.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Castro County Irrigation.

a. Irrigation Water Conservation
   - Date to be Implemented: 2020
   - Unit Cost: $619/ac-ft

Table 5-63. Recommended Plan Costs by Decade for Castro County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(83,995)*	*(92,078)*	*(53,100)*	*0*	*0*	*970*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	12,628	13,986	7,835	1,686	801	329
Annual Cost ($/yr)	$7,819,246	$8,660,119	$4,851425	$1,043,970	$495,978	$203,717
Projected Surplus/(Shortage) after Conservation	*(71,367)*	*(76,092)*	*(45,265)*	*1,688*	*801*	*1,236*

ac-ft/yr = acre-feet per year

5.49.9 Livestock

Castro County Livestock obtains water supply from the Ogallala Aquifer and the Dockum Aquifer. The water supply entities for Castro County Livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.50 Cochran County Water Supply Plan

Table 5-64 lists each WUG in Cochran County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-64. Cochran County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) 2050 (ac-ft/yr)	Surplus/(Shortage) 2080 (ac-ft/yr)	Comment
Morton PWS	322	380	Projected surplus
City of Whiteface	255	262	Projected surplus
County-Other	33	84	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	No projected surplus/shortage
Irrigation	(23,303)	(11,703)	Projected shortage - see plan below
Livestock	5	0	Projected surplus

ac-ft/yr = acre-feet per year; PWS = public water system

5.50.1 Morton Public Water System

Morton Public Water System (PWS) obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the Morton PWS; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.50.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and TWDB, the following WMS is recommended for the Morton PWS.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-65. Recommended Plan Costs by Decade for the Morton PWS

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*281*	*302*	*322*	*341*	*360*	*380*
Conservation						
Supply From Plan Element (ac-ft/yr)	8	15	13	12	10	9
Annual Cost ($/yr)	$3,820	$7,162	$6,207	$5,720	$4,775	$4,297
Projected Surplus/(Shortage) after Conservation	*289*	*317*	*335*	*353*	*370*	*389*

ac-ft/yr = acre-feet per year

5.50.2 City of Whiteface

The City of Whiteface obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Whiteface; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.50.2.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Whiteface.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-66. Recommended Plan Costs by Decade for the City of Whiteface

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*248*	*253*	*255*	*257*	*260*	*262*
Conservation						
Supply From Plan Element (ac-ft/yr)	2	3	3	3	2	2
Annual Cost ($/yr)	$955	$1,432	$1,432	$1,432	$955	$955
Projected Surplus/(Shortage) after Conservation	*250*	*256*	*258*	*260*	*262*	*264*

ac-ft/yr = acre-feet per year

5.50.3 County-Other

Cochran County-Other obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for Cochran County-Other; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.50.3.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Cochran County-Other.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-67. Recommended Plan Costs by Decade for Cochran County-Other

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*0*	*16*	*33*	*49*	*67*	*84*
Conservation						
Supply From Plan Element (ac-ft/yr)	6	11	9	8	7	6
Annual Cost ($/yr)	$2,865	$5,252	$4,297	$3,820	$3,342	$2,865
Projected Surplus/(Shortage) after Conservation	*6*	*27*	*42*	*57*	*74*	*111*

ac-ft/yr = acre-feet per year

5.50.4 Manufacturing

There is no projected manufacturing demand in Cochran County.

5.50.5 Steam-Electric

There is no projected steam-electric demand in Cochran County.

5.50.6 Mining

Cochran County mining obtains water supply from the Ogallala Aquifer. The water supply entities for Cochran County mining do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.50.7 Irrigation

Cochran County irrigation obtains its water supply from groundwater from the Ogallala Aquifer and reuse water supplies available within Cochran County. Cochran County Irrigation has a projected need beginning in 2020 (in the Brazos Basin portion of the County only) and continuing throughout the remainder of the planning period. The WMSs contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.50.7.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Cochran County Irrigation.

a. Irrigation Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $619/ac-ft

Table 5-68. Recommended Plan Costs by Decade for Cochran County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(35,798)*	*(29,594)*	*(23,303)*	*(16,579)*	*(13,777)*	*(11,703)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	4,057	4,843	4,065	3,288	2,943	2,691
Annual Cost ($/yr)	$2,512,091	$2,998,781	$2,517,044	$2,035,927	$1,822,303	$1,666,265
Projected Surplus/(Shortage) after Conservation	*(31,741)*	*(24,751)*	*(19,240)*	*(13,291)*	*(10,834)*	*(9,012)*

ac-ft/yr = acre-feet per year

5.50.8 Livestock

Cochran County livestock obtains water supply from the Ogallala Aquifer. The water supply entities for Cochran County livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.51 Crosby County Water Supply Plan

Table 5-69 lists each WUG in Crosby County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-69. Crosby County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Crosbyton	197	247	Projected surplus
City of Lorenzo	769	808	Projected surplus
City of Ralls	45	100	Project surplus
County-Other	22	51	Projected surplus
Manufacturing	0	0	Projected supply equals demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	78	0	Projected surplus
Irrigation	0	0	Projected supply equals demand
Livestock	11	0	Projected surplus

ac-ft/yr = acre-feet per year

5.51.1 City of Crosbyton

The City of Crosbyton obtains its water supply from groundwater from the Ogallala Aquifer (both self-supplied and purchased from the WRMWD). There are no projected shortages for the City of Crosbyton; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.51.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Crosbyton.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $449/ac-ft

Table 5-70. Recommended Plan Costs by Decade for the City of Crosbyton

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*164*	*179*	*197*	*213*	*230*	*247*
Conservation						
Supply From Plan Element (ac-ft/yr)	2	-	-	-	-	-
Annual Cost ($/yr)	$897	-	-	-	-	-
Projected Surplus/(Shortage) after Conservation	*166*	*179*	*197*	*213*	*230*	*247*

ac-ft/yr = acre-feet per year

5.51.2 City of Lorenzo

The City of Lorenzo obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Lorenzo; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.51.2.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Lorenzo.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-71. Recommended Plan Costs by Decade for the City of Lorenzo

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*745*	*756*	*769*	*782*	*794*	*808*
Conservation						
Supply From Plan Element (ac-ft/yr)	4	7	6	4	–	–
Annual Cost ($/yr)	$1,910	$3,342	$2,865	$1,910	–	–
Projected Surplus/(Shortage) after Conservation	*749*	*763*	*775*	*786*	*794*	*808*

ac-ft/yr = acre-feet per year

5.51.3 City of Ralls

The City of Ralls obtains its water supply from groundwater from the Ogallala Aquifer (both self-supplied and purchased from the WRMWD). There are no projected shortages for the City of Ralls. Additional conservation was considered; however, the entity’s current per capita use rate is below the selected target rate of 140 gpcd.

5.51.4 County-Other

Crosby County-Other obtains water supply from the Ogallala Aquifer (both self-supplied and purchased from WRMWD), the Dockum Aquifer, and other aquifers located in Crosby County. The water supply entities for Crosby County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.51.5 Manufacturing

Crosby County manufacturing obtains water supply from the Ogallala Aquifer. The water supply entities for Crosby County manufacturing do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.51.6 Steam-Electric

There is no projected steam-electric demand in Crosby County.

5.51.7 Mining

Crosby County mining obtains its water supply from groundwater from the Ogallala Aquifer. Crosby County mining does not show any additional water need during the planning period. No changes is water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.51.8 Irrigation

Crosby County irrigation obtains its water supply from groundwater from the Ogallala Aquifer, Dockum Aquifer and other minor aquifers within Crosby County and reuse water supplies available within Crosby County. There are also surface water rights associated with irrigation in the Brazos Basin portion of the county; however, these rights do not have a firm yield. Crosby County irrigation does not have a projected need during the planning period; however, the LERWPG recommends water conservation for all irrigation users within the planning region. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.51.8.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Crosby County Irrigation.

a. Irrigation Water Conservation
    - Date to be Implemented: 2030
    - Unit Cost: $619/ac-ft

Table 5-72. Recommended Plan Costs by Decade for Crosby County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*0*	*0*	*0*	*0*	*0*	*0*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	3,014	4,220	3,432	2,644	2,132	1,813
Annual Cost ($/yr)	$1,866,266	$2,613,020	$2,125,091	$1,637,162	$1,320,133	$1,122,608
Projected Surplus/(Shortage) after Conservation	*3,014*	*4,220*	*3,432*	*2,644*	*2,132*	*1,813*

ac-ft/yr = acre-feet per year

5.51.9 Livestock

Crosby County livestock obtains water supply from the Ogallala Aquifer, Dockum Aquifer and other minor aquifers located in Crosby County. The water supply entities for Crosby County livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.52 Dawson County Water Supply Plan

Table 5-73 lists each WUG in Dawson County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-73. Dawson County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Lamesa	(161)	(201)	Projected shortage – see plan below
City of O'Donnell			See Lynn County
County-Other	1	4	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	95	3,489	Projected surplus
Irrigation	0	(581)	Projected shortage - see plan below
Livestock	5	0	Projected surplus

ac-ft/yr = acre-feet per year

5.52.1 City of Lamesa

The City of Lamesa obtains its water supply from groundwater from the Ogallala Aquifer (both self-supplied and purchased from CRMWA) and surface water from Lake Meredith purchased from CRMWA. The City of Lamesa is projected to have water shortages beginning in 2040.

5.52.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMSs are recommended for the City of Lamesa.

a. Additional Water Conservation
    - Date to be Implemented: 2030
    - Unit Cost: $477/ac-ft
b. CRMWA Replace Well Capacity
    - Date to be Implemented: 2040
    - Unit Cost: $110/ac-ft
c. CRMWA Expand Roberts County & CRMWA II Capacity
    - Date to be Implemented: 2030
    - Unit Cost: $1,054/ac-ft
d. CRMWA Brush Control
    - Date to be Implemented: 2030
    - Unit Cost: $40/ac-ft
e. CRMWA Linear Well Field Along Existing Transmission System
    - Date to be Implemented: 2050
    - Unit Cost: $536/ac-ft
f. CRMWA Desalination of Lake Meredith Water
    - Date to be Implemented: 2040
    - Unit Cost: $3,325/ac-ft
g. CRMWA Supplies from Aquifer Storage and Recovery
    - Date to be Implemented: 2030
    - Unit Cost: $355/ac-ft

Table 5-74. Recommended Plan Costs by Decade for the City of Lamesa

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*78*	*(69)*	*(161)*	*(225)*	*(214)*	*(201)*
Conservation						
Supply From Plan Element (ac-ft/yr)	45	86	81	75	70	64
Annual Cost ($/yr)	$21,486	$41,063	$38,675	$35,810	$33,423	$30,558
Projected Surplus/(Shortage) after Conservation	*123*	*17*	*(80)*	*(150)*	*(144)*	*(137)*
Supply from CRMWA Replace Well Capacity						
Supply From Plan Element (ac-ft/yr)	–	28	71	162	217	230
Annual Cost ($/yr)	–	$3,080	$7,700	$1,560	$2,020	$2,050
Unit Cost ($/ac-ft)	–	$110	$110	$10	$10	$10
Supply from CRMWA Expand Roberts County & CRMWA II Capacity						
Supply From Plan Element (ac-ft/yr)	263	415	480	485	453	457
Annual Cost ($/yr)	$277,202	$437,410	$109,920	$111,065	$103,737	$104,653
Unit Cost ($/ac-ft)	$1,054	$1,054	$229	$229	$229	$229
Supply from CRMWA Brush Control						
Supply From Plan Element (ac-ft/yr)	10	16	18	20	20	21
Annual Cost ($/yr)	$400	$640	$720	$800	$800	$840
Unit Cost ($/ac-ft)	$40	$40	$40	$40	$40	$40
Supply from CRMWA Linear Well Field Along Existing Transmission System						
Supply From Plan Element (ac-ft/yr)	–	–	21	23	24	25
Annual Cost ($/yr)	–	–	$11,256	$12,328	$2,184	$2,275
Unit Cost ($/ac-ft)	–	–	$536	$536	$91	$91
Supply from CRMWA Desalination of Lake Meredith Water						
Supply From Plan Element (ac-ft/yr)	–	22	37	52	66	79
Annual Cost ($/yr)	–	$73,150	$123,025	$101,140	$128,370	$153,655
Unit Cost ($/ac-ft)	–	$3,325	$3,325	$1,945	$1,945	$1,945
CRMWA Aquifer Storage and Recovery (ASR)						
Supply From Plan Element (ac-ft/yr)	–	100	100	100	100	100
Annual Cost ($/yr)	–	$35,500	$35,500	$15,900	$15,900	$15,900

ac-ft/yr = acre-feet per year

5.52.2 City of O’Donnell

See Lynn County for the water supply plan for the City of O’Donnell.

5.52.3 County-Other

Dawson County-Other obtains water supply from the Ogallala Aquifer. The water supply entities for Dawson County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity’s current per capita use rate is below the selected target rate of 140 gpcd.

5.52.4 Manufacturing

There is no projected manufacturing demand in Dawson County.

5.52.5 Steam-Electric

There is no projected steam-electric demand in Dawson County.

5.52.6 Mining

Dawson County mining obtains water supply from the Ogallala Aquifer. The water supply entities for Dawson County mining do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.52.7 Irrigation

Dawson County irrigation obtains its water supply from groundwater from the Ogallala Aquifer. Dawson County Irrigation has a projected need beginning in 2070 (Colorado River Basin portion only) and continuing throughout the remainder of the planning period. The WMSs contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.52.7.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Dawson County Irrigation.

a. Irrigation Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $619/ac-ft

Table 5-75. Recommended Plan Costs by Decade for Dawson County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*0*	*0*	*0*	*0*	*(495)*	*(581)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	3,310	4,635	4,635	4,635	4,389	4,156
Annual Cost ($/yr)	$2,049,549	$2,869,988	$2,869,988	$2,869,988	$2,717,665	$2,573,392
Projected Surplus/(Shortage) after Conservation	*3,310*	*4,635*	*4,635*	*4,635*	*3,894*	*3,575*

ac-ft/yr = acre-feet per year

5.52.8 Livestock

Dawson County livestock obtains water supply from the Ogallala Aquifer. The water supply entities for Dawson County Livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.53 Deaf Smith County Water Supply Plan

Table 5-76 lists each WUG in Deaf Smith County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-76. Deaf Smith County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) 2050 (ac-ft/yr)	Surplus/(Shortage) 2080 (ac-ft/yr)	Comment
City of Hereford	3,255	2,988	Projected surplus
County-Other	97	398	Projected surplus
Manufacturing	186	0	Projected surplus
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	No Mining demand
Irrigation	(17,547)	(205)	Projected shortage – see plan below
Livestock	244	0	Projected surplus

ac-ft/yr = acre-feet per year

5.53.1 City of Hereford

The City of Hereford obtains its water supply from groundwater from the Ogallala and Dockum Aquifers. There are no projected shortages for the City of Hereford; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.53.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Hereford.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $449/ac-ft

Table 5-77. Recommended Plan Costs by Decade for the City of Hereford

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*3,407*	*3,323*	*3,255*	*3,201*	*3,118*	*2,988*
Conservation						
Supply From Plan Element (ac-ft/yr)	86	172	167	161	156	154
Annual Cost ($/yr)	$38,577	$77,155	$74,912	$72,221	$69,978	$69,081
Projected Surplus/(Shortage) after Conservation	*3,493*	*3,495*	*3,422*	*3,362*	*3,274*	*3,142*

ac-ft/yr = acre-feet per year

5.53.2 County-Other

Deaf Smith County-Other obtains water supply from the Ogallala and Dockum Aquifers. The water supply entities for Deaf Smith County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.53.3 Manufacturing

Deaf Smith County manufacturing obtains its water supply from the Ogallala Aquifer. The water supply entities for Deaf Smith County manufacturing do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.53.4 Steam-Electric

There is no projected steam-electric demand in Deaf Smith County.

5.53.5 Mining

There is no projected mining demand in Deaf Smith County.

5.53.6 Irrigation

Deaf Smith County irrigation obtains its water supply from groundwater from the Ogallala Aquifer and reuse water supplies available within Deaf Smith County. Deaf Smith County Irrigation has a projected need beginning in 2030 and continuing throughout the remainder of the planning period. The WMSs contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs that may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.53.6.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Deaf Smith County Irrigation.

a. Irrigation Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $619/ac-ft

Table 5-78. Recommended Plan Costs by Decade for Deaf Smith County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(20,542)*	*(28,702)*	*(17,547)*	*(344)*	*(258)*	*(205)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	6,947	7,533	4,971	2,409	1,807	1,437
Annual Cost ($/yr)	$4,301,576	$4,664,427	$3,078,039	$1,491,651	$1,118,893	$889,789
Projected Surplus/(Shortage) after Conservation	*(13,595)*	*(21,169)*	*(12,576)*	*2,065*	*1,549*	*1,232*

ac-ft/yr = acre-feet per year

5.53.7 Livestock

Deaf Smith County livestock obtains water supply from the Ogallala Aquifer. The water supply entities for Deaf Smith County Livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.54 Dickens County Water Supply Plan

Table 5-79 lists each WUG in Dickens County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-79. Dickens County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
Red River Authority of Texas	12	16	Projected surplus in Region O – See the Region B plan for complete water supply plan
City of Spur	120	156	Projected surplus
County-Other	41	72	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	Projected supply equals demand
Irrigation	1,670	1,670	Projected surplus
Livestock	67	44	Projected surplus

ac-ft/yr = acre-feet per year

5.54.1 Red River Authority of Texas

See the Region B plan for the water supply plan for the Red River Authority of Texas.

5.54.2 City of Spur

The City of Spur obtains its water supply from groundwater from the Ogallala Aquifer purchased from the WRMWD. There are no projected shortages for the City of Spur; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.54.2.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Spur.

a. Additional Water Conservation
    - Date to be Implemented: 2030
    - Unit Cost: $477/ac-ft

Table 5-80. Recommended Plan Costs by Decade for the City of Spur

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*99*	*108*	*120*	*131*	*143*	*156*
Conservation						
Supply From Plan Element (ac-ft/yr)	3	6	2	–	–	–
Annual Cost ($/yr)	$1,432	$2,865	$955	–	–	–
Projected Surplus/(Shortage) after Conservation	*102*	*114*	*122*	*131*	*143*	*156*

ac-ft/yr = acre-feet per year

5.54.3 County-Other

Dickens County-Other obtains water supply from the Ogallala Aquifer and other minor aquifers within Dickens County. The water supply entities for Dickens County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.54.4 Manufacturing

There is no projected manufacturing demand in Dickens County.

5.54.5 Steam-Electric

There is no projected steam-electric demand in Dickens County.

5.54.6 Mining

Dickens County mining obtains water supply from the Ogallala Aquifer. The water supply entities for Dickens County mining do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.54.7 Irrigation

Dickens County irrigation obtains groundwater supply from the Ogallala Aquifer, Dockum Aquifer, and other minor aquifers located within Dickens County. There is also surface water rights associated with irrigation in Dickens County; however, these water rights do not have a firm yield. The water supply entities for Dickens County Irrigation do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.54.8 Livestock

Dickens County livestock obtains water supply from the Ogallala Aquifer, Dockum Aquifer, and other minor aquifers located in Dickens County. The water supply entities for Dickens County livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.55 Floyd County Water Supply Plan

Table 5-81 lists each WUG in Floyd County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-81. Floyd County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) 2050 (ac-ft/yr)	Surplus/(Shortage) 2080 (ac-ft/yr)	Comment
City of Floydada	1,567	1,591	Projected surplus
City of Lockney	382	428	Projected surplus
County-Other	23	61	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	1	0	Projected surplus
Irrigation	(1,480)	0	Projected shortage - see plan below.
Livestock	37	0	Projected surplus

ac-ft/yr = acre-feet per year

5.55.1 City of Floydada

The City of Floydada obtains its water supply from surface water from Lake Mackenzie and groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Floydada; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.55.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Floydada.

a. Additional Water Conservation
    - Date to be Implemented: 2030
    - Unit Cost: $477/ac-ft

Table 5-82. Recommended Plan Costs by Decade for the City of Floydada

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*1,538*	*1,555*	*1,567*	*1,577*	*1,585*	*1,591*
Conservation						
Supply From Plan Element (ac-ft/yr)	11	20	19	–	–	–
Annual Cost ($/yr)	$5,252	$9,549	$9,072	–	–	–
Projected Surplus/(Shortage) after Conservation	*1,549*	*1,575*	*1,586*	*1,577*	*1,585*	*1,591*

ac-ft/yr = acre-feet per year

5.55.2 City of Lockney

The City of Lockney obtains its water supply from surface water from Lake Mackenzie and groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Lockney and no changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.55.3 County-Other

Floyd County-Other obtains water supply from the Ogallala Aquifer. The water supply entities for Floyd County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.55.4 Manufacturing

There is no projected manufacturing demand in Floyd County.

5.55.5 Steam-Electric

There is no projected steam-electric demand in Floyd County.

5.55.6 Mining

Floyd County mining obtains water supply from the Ogallala Aquifer. The water supply entities for Floyd County mining do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.55.7 Irrigation

Floyd County irrigation obtains its water supply from groundwater from the Ogallala Aquifer, Dockum Aquifer and other minor aquifers within Floyd County, reuse water supplies available within Floyd County, and surface water from run-of-river rights located in the Red River Basin. Floyd County Irrigation has a projected need beginning in 2030 in the Red River Basin portion of the county. This additional water need continues until 2050. There are no projected irrigation needs in the Brazos Basin portion of the county. The WMSs contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.55.7.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Floyd County Irrigation.

a. Irrigation Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $619/ac-ft

Table 5-83. Recommended Plan Costs by Decade for Floyd County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(23,439)*	*(11,747)*	*(1,480)*	*0*	*0*	*0*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	4,631	5,158	3,998	2,839	2,495	2,267
Annual Cost ($/yr)	$2,867,511	$3,193,829	$2,475,558	$1,757,906	$1,544,902	$1,403,724
Projected Surplus/(Shortage) after Conservation	*(18,808)*	*(6,589)*	*2,518*	*0*	*0*	*0*

ac-ft/yr = acre-feet per year

5.55.8 Livestock

Floyd County livestock obtains water supply from the Ogallala Aquifer, Dockum Aquifer, and other minor aquifers located in Floyd County. The water supply entities for Floyd County livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.56 Gaines County Water Supply Plan

Table 5-84 lists each WUG in Gaines County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-84. Gaines County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Seagraves	734	818	Projected surplus
City of Seminole	(840)	(1,168)	Projected shortage – see plan below
County-Other	1,707	0	Projected surplus
Manufacturing	63	0	Projected surplus
Steam-Electric	0	0	No Steam-Electric demand
Mining	230	2,078	Projected surplus
Irrigation	(47,803)	(6,249)	Projected shortage - see plan below.
Livestock	8	0	Projected surplus

ac-ft/yr = acre-feet per year

5.56.1 City of Seagraves

The City of Seagraves obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Seagraves; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.56.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Seagraves.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-85. Recommended Plan Costs by Decade for the City of Seagraves

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*672*	*705*	*734*	*767*	*795*	*818*
Conservation						
Supply From Plan Element (ac-ft/yr)	8	8	–	–	–	–
Annual Cost ($/yr)	$3,820	$3,820	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*680*	*713*	*734*	*767*	*795*	*818*

ac-ft/yr = acre-feet per year

5.56.2 City of Seminole

The City of Seminole obtains its water supply from groundwater from the ETHP Aquifer. The city is projected to have a water shortage beginning in 2030 and lasting through the planning period. The water supply plan for the City is below.

5.56.2.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS's are recommended for the City of Seminole.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

b. Additional Groundwater Development (ETHP Aquifer)

- Date to be Implemented: 2030
- Total Project Cost: $42,649,000
- Unit Cost: $2,135/ac-ft

In addition to these recommended WMSs, brackish groundwater desalination from the Dockum Aquifer is an alternative strategy for the City of Seminole.

Table 5-86. Recommended Plan Costs by Decade for the City of Seminole

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(539)*	*(694)*	*(840)*	*(933)*	*(1,043)*	*(1,168)*
Conservation						
Supply From Plan Element (ac-ft/yr)	59	124	124	122	121	120
Annual Cost ($/yr)	$28,171	$59,206	$59,206	$58,252	$57,774	$57,297
Projected Surplus/(Shortage) after Conservation	*(380)*	*(570)*	*(716)*	*(811)*	*(922)*	*(1,048)*
Additional Groundwater Development (ETHP Aquifer)						
Supply From Plan Element (ac-ft/yr)	1,725	1,725	1,725	1,725	1,725	1,725
Annual Cost ($/yr)	$3,683,000	$3,683,000	$682,000	$682,000	$682,000	$682,000
Unit Cost ($/ac-ft)	$2,135	$2,135	$395	$395	$395	$395

ac-ft/yr = acre-feet per year

5.56.3 County-Other

Gaines County-Other obtains its water supply from groundwater from the Ogallala Aquifer. Gaines County-Other is projected to have adequate water supplies to meet projected demand during the planning period and no water shortages are projected. Conservation was considered; however, the entity’s current per capita use rate is below the selected target rate of 140 gpcd.

5.56.4 Manufacturing

Gaines County manufacturing obtains its water supply from groundwater from the Ogallala Aquifer. The water supply entities for Gaines County manufacturing do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.56.5 Steam-Electric

There is no projected steam-electric demand in Gaines County.

5.56.6 Mining

Gaines County mining obtains water supply from the Ogallala Aquifer. The water supply entities for Gaines County mining do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.56.7 Irrigation

Gaines County irrigation obtains its water supply from groundwater from the Ogallala Aquifer. Gaines County irrigation has a projected need beginning in 2030 and continuing throughout the remainder of the planning period. The WMSs contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.56.7.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and TWDB, the following WMS is recommended for Gaines County Irrigation.

a. Irrigation Water Conservation
   - Date to be Implemented: 2030
   - Unit Cost: $619/ac-ft

Table 5-87. Recommended Plan Costs by Decade for Gaines County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(81,492)*	*(83,803)*	*(47,803)*	*(5,995)*	*(6,126)*	*(6,249)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	13,611	17,266	13,450	9,635	9,014	8,581
Annual Cost ($/yr)	$8,427,919	$10,691,092	$8,328,228	$5,965,983	$5,581,461	$5,313,348
Projected Surplus/(Shortage) after Conservation	*(67,881)*	*(66,537)*	*(34,353)*	*3,640*	*2,888*	*2,332*

ac-ft/yr = acre-feet per year

5.56.8 Livestock

Gaines County livestock obtains water supply from the Ogallala Aquifer. The water supply entities for Gaines County livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.57 Garza County Water Supply Plan

Table 5-88 lists each WUG in Garza County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-88. Garza County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) 2050 (ac-ft/yr)	Surplus/(Shortage) 2080 (ac-ft/yr)	Comment
City of Post	318	415	Projected surplus
County-Other	53	87	Projected surplus
Manufacturing	2	2	Projected surplus
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	Projected supply equals demand
Irrigation	0	0	Projected supply equals demand
Livestock	9	0	Projected surplus

ac-ft/yr = acre-feet per year

5.57.1 City of Post

The City of Post obtains its water supply from groundwater from the Ogallala Aquifer (self-supplied and purchased from WRMWD and the City of Slaton). There is also a run-of-river right associated with Post Independent School District; however, this water right does not have a firm yield. There are no projected shortages for the City of Post and no changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.57.2 County-Other

Garza County-Other obtains its water supply from groundwater from the Ogallala and Dockum Aquifers as well as surface water from LAH purchased from the City of Lubbock. There are no projected shortages for Garza County-Other and no changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.57.3 Manufacturing

Garza County manufacturing obtains water supply from the Ogallala Aquifer (purchased from the City of Post). The water supply entities for Garza County Manufacturing do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.57.4 Steam-Electric

There is no projected steam-electric demand in Garza County.

5.57.5 Mining

Garza County mining obtains water supply from the Ogallala Aquifer. The water supply entities for Garza County mining do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.57.6 Irrigation

Garza County irrigation obtains groundwater supply from the Ogallala Aquifer, Dockum Aquifer, and other minor aquifers located within Garza County. The water supply entities for Garza County irrigation do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.57.7 Livestock

Garza County livestock obtains water supply from the Ogallala Aquifer, Dockum Aquifer, and other minor aquifers located in Garza County. The water supply entities for Garza County livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.58 Hale County Water Supply Plan

Table 5-89 lists each WUG in Hale County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-89. Hale County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) 2050 (ac-ft/yr)	Surplus/(Shortage) 2080 (ac-ft/yr)	Comment
City of Abernathy	1,028	790	Projected surplus
City of Hale Center	746	780	Projected surplus
Petersburg Municipal Water	376	411	Projected surplus
City of Plainview	3,789	3,997	Projected surplus
County-Other	237	409	Projected surplus
Manufacturing	90	0	Projected surplus
Steam-Electric	0	0	Projected supply equals demand
Mining	0	0	Projected supply equals demand
Irrigation	(57,801)	(16)	Projected shortage - see plan below.
Livestock	0	253	Projected surplus

ac-ft/yr = acre-feet per year

5.58.1 City of Abernathy

The City of Abernathy obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Abernathy; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.58.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Abernathy.

a. Additional Water Conservation
    - Date to be Implemented: 2030
    - Unit Cost: $477/ac-ft

Table 5-90. Recommended Plan Costs by Decade for the City of Abernathy

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*1,130*	*1,002*	*1,028*	*971*	*865*	*790*
Conservation						
Supply From Plan Element (ac-ft/yr)	19	39	39	40	41	44
Annual Cost ($/yr)	$9,072	$18,621	$18,621	$19,099	$19,576	$21,009
Projected Surplus/(Shortage) after Conservation	*1,149*	*1,041*	*1,067*	*1,011*	*906*	*834*

ac-ft/yr = acre-feet per year

5.58.2 City of Hale Center

The City of Hale Center obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Hale Center and no changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.58.3 Petersburg Municipal Water

The Petersburg Municipal Water System obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the Petersburg Municipal Water System; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.58.3.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the Petersburg Municipal Water System.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-91. Recommended Plan Costs by Decade for the Petersburg Municipal Water System

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*360*	*366*	*376*	*387*	*398*	*411*
Conservation						
Supply From Plan Element (ac-ft/yr)	6	11	10	9	8	7
Annual Cost ($/yr)	$2,865	$5,252	$4,775	$4,297	$3,820	$3,342
Projected Surplus/(Shortage) after Conservation	*366*	*377*	*386*	*396*	*406*	*418*

ac-ft/yr = acre-feet per year

5.58.4 City of Plainview

The City of Plainview obtains its water supply from groundwater from the Ogallala (both self-supplied and purchased from CRMWA) and surface water from Lake Meredith (purchased from CRMWA). There are no projected shortages for the City of Plainview; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.58.4.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following water management strategies are recommended for the City of Plainview.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $449/ac-ft

b. Water Supply for Industrial Facility Operations

- Date to be Implemented: 2030
- Unit Cost: $19,421/ac-ft
- Capital Cost: $153,647,000

c. CRMWA Replace Well Capacity

- Date to be Implemented: 2040
- Unit Cost: $110/ac-ft

d. CRMWA Expand Roberts County & CRMWA II Capacity

- Date to be Implemented: 2030
- Unit Cost: $1,054/ac-ft

e. CRMWA Brush Control

- Date to be Implemented: 2030
- Unit Cost: $40/ac-ft

f. CRMWA Linear Well Field Along Existing Transmission System

- Date to be Implemented: 2050
- Unit Cost: $536/ac-ft

g. CRMWA Desalination of Lake Meredith Water

- Date to be Implemented: 2040
- Unit Cost: $3,325/ac-ft

h. CRMWA Supplies from Aquifer Storage and Recovery

- Date to be Implemented: 2030
- Unit Cost: $355/ac-ft

i. City of Plainview Aquifer Storage and Recovery

- Date to be Implemented: 2030
- Unit Cost: $1,430/ac-ft
- Capital Cost: $8,857,000

j. City of Plainview Reuse (Phase I Only)

- Date to be Implemented: 2040
- Unit Cost: $2,511/ac-ft
- Capital Cost: $10,349,000

Table 5-92. Recommended Plan Costs by Decade for the City of Plainview

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*4,040*	*3,886*	*3,789*	*3,717*	*3,936*	*3,997*
Conservation						
Supply From Plan Element (ac-ft/yr)	105	204	194	184	–	–
Annual Cost ($/yr)	$47,100	$91,509	$87,024	$82,538	–	–
Projected Surplus/(Shortage) after Conservation	*4,145*	*4,090*	*3,983*	*3,901*	*3,936*	*3,997*
Supply from CRMWA Replace Well Capacity						
Supply From Plan Element (ac-ft/yr)	–	52	142	344	476	464
Annual Cost ($/yr)	–	$5,720	$15,620	$3,440	$4,760	$4,640
Unit Cost ($/ac-ft)	–	$110	$110	$10	$10	$10
Supply from CRMWA Expand Roberts County & CRMWA II Capacity						
Supply From Plan Element (ac-ft/yr)	463	776	965	1,069	1,064	1,037
Annual Cost ($/yr)	$488,002	$817,904	$220,985	$244,801	$243,656	$237,473
Unit Cost ($/ac-ft)	$1,054	$1,054	$229	$229	$229	$229
Supply from CRMWA Brush Control						
Supply From Plan Element (ac-ft/yr)	18	30	37	44	48	47
Annual Cost ($/yr)	$720	$1,200	$1,480	$1,760	$1,920	$1,880
Unit Cost ($/ac-ft)	$40	$40	$40	$40	$40	$40
Supply from CRMWA Linear Well Field Along Existing Transmission System						
Supply From Plan Element (ac-ft/yr)	–	–	43	51	57	56
Annual Cost ($/yr)	–	–	$23,048	$27,336	$5,187	$5,096
Unit Cost ($/ac-ft)	–	–	$536	$536	$91	$91
Supply from CRMWA Desalination of Lake Meredith Water						
Supply From Plan Element (ac-ft/yr)	–	42	74	115	154	179
Annual Cost ($/yr)	–	$139,650	$246,050	$223,675	$299,530	$348,155
Unit Cost ($/ac-ft)	–	$3,325	$3,325	$1,945	$1,945	$1,945
CRMWA Aquifer Storage and Recovery (ASR)						
Supply From Plan Element (ac-ft/yr)	–	200	500	500	500	500
Annual Cost ($/yr)	–	$71,000	$177,500	$79,500	$79,500	$79,500
City of Plainview Aquifer Storage and Recovery (ASR)						
Supply From Plan Element (ac-ft/yr)	–	987	987	987	987	987
Annual Cost ($/yr)	–	$1,411,000	$1,411,000	$788,000	$788,000	$788,000
Unit Cost ($/ac-ft)	–	$1,430	$1,430	$798	$798	$798
City of Plainview Reuse (Phase I Only)						
Supply From Plan Element (ac-ft/yr)	–	560	560	560	560	560
Annual Cost ($/yr)	–	$1,406,000	$1,406,000	$678,000	$678,000	$678,000
Unit Cost ($/ac-ft)	–	$2,511	$2,511	$1,211	$1,211	$1,211

ac-ft/yr = acre-feet per year

5.58.5 Seth Ward WSC

Seth Ward WSC obtains water supply from the Ogallala Aquifer. Seth Ward WSC does not show the need for additional water supply during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.58.6 County-Other

Hale County-Other obtains water supply from the Ogallala Aquifer. The water supply entities for Hale County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.58.7 Manufacturing

Hale County manufacturing obtains its water supply from groundwater from the Ogallala Aquifer. The water supply entities for Hale County Manufacturing do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.58.8 Steam-Electric

Hale County steam-electric obtains water supply from the Ogallala Aquifer. The water supply entities for Hale County Steam-Electric do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.58.9 Mining

Hale County mining obtains its water supply from groundwater from the Ogallala Aquifer. The water supply entities for Hale County Mining do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.58.10 Irrigation

Hale County irrigation obtains its water supply from groundwater from the Ogallala Aquifer and other minor aquifers located within Hale County, and reuse water supplies available within Hale County. Hale County Irrigation has a projected need beginning in 2030 and continuing throughout the remainder of the planning period (the water need in the Brazos Basin only continues through 2050). The WMSs contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation; however, this WMS is not included below as there is to quantifiable yield or cost for this WMS. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.58.10.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Hale County Irrigation.

a. Irrigation Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $619/ac-ft

Table 5-93. Recommended Plan Costs by Decade for Hale County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(101,843)*	*(113,449)*	*(57,801)*	*(48)*	*(24)*	*(16)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	10,489	12,591	7,169	1,746	1,271	988
Annual Cost ($/yr)	$6,494,779	$7,796,336	$4,439,038	$1,081,122	$787,002	$611,769
Projected Surplus/(Shortage) after Conservation	*(91,354)*	*(100,858)*	*(50,632)*	*4,698*	*1,247*	*972*

ac-ft/yr = acre-feet per year

5.58.11 Livestock

Hale County livestock obtains water supply from the Ogallala Aquifer and other minor aquifers located in Hale County. The water supply entities for Hale County livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.59 Hockley County Water Supply Plan

Table 5-94 lists each WUG in Hockley County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-94. Hockley County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Anton	735	738	Projected surplus
City of Levelland	2,301	2,092	Projected surplus
City of Sundown	570	631	Projected surplus
County-Other	19	71	Projected surplus
Manufacturing	153	0	Projected surplus
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	Projected supply equals demand
Irrigation	(9,477)	0	Projected shortage - see plan below.
Livestock	7	0	Projected surplus

ac-ft/yr = acre-feet per year

5.59.1 City of Anton

The City of Anton obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Anton and no changes in water supply are recommended.

Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.59.2 City of Levelland

The City of Levelland obtains its water supply from groundwater from the Ogallala Aquifer (both self-supplied and purchased from CRMWA) and surface water from Lake Meredith (purchased from CRMWA). There are no projected shortages for the City of Levelland; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.59.2.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMSs are recommended for the City of Levelland.

a. Additional Water Conservation
   - Date to be Implemented: 2030
   - Unit Cost: $449/ac-ft

b. CRMWA Replace Well Capacity
   - Date to be Implemented: 2040
   - Unit Cost: $110/ac-ft

c. CRMWA Expand Roberts County & CRMWA II Capacity
   - Date to be Implemented: 2030
   - Unit Cost: $1,054/ac-ft

d. CRMWA Brush Control
   - Date to be Implemented: 2030
   - Unit Cost: $40/ac-ft

e. CRMWA Linear Well Field Along Existing Transmission System
   - Date to be Implemented: 2050
   - Unit Cost: $536/ac-ft

f. CRMWA Desalination of Lake Meredith Water
   - Date to be Implemented: 2040
   - Unit Cost: $3,325/ac-ft

g. CRMWA Supplies from Aquifer Storage and Recovery
   - Date to be Implemented: 2030
   - Unit Cost: $355/ac-ft

Table 5-95. Recommended Plan Costs by Decade for the City of Levelland

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*2,765*	*2,486*	*2,301*	*2,159*	*2,124*	*2,092*
Conservation						
Supply From Plan Element (ac-ft/yr)	51	60	–	–	–	–
Annual Cost ($/yr)	$22,877	$26,915	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*2,816*	*2,546*	*2,301*	*2,159*	*2,124*	*2,092*
Supply from CRMWA Replace Well Capacity						
Supply From Plan Element (ac-ft/yr)	–	39	97	213	275	379
Annual Cost ($/yr)	–	$4,290	$10,670	$2,130	$2,750	$2,790
Unit Cost ($/ac-ft)	–	$110	$110	$10	$10	$10
Supply from CRMWA Expand Roberts County & CRMWA II Capacity						
Supply From Plan Element (ac-ft/yr)	384	587	661	662	615	624
Annual Cost ($/yr)	$404,736	$618,698	$151,369	$151,598	$140,835	$142,896
Unit Cost ($/ac-ft)	$1,054	$1,054	$229	$229	$229	$229
Supply from CRMWA Brush Control						
Supply From Plan Element (ac-ft/yr)	15	23	25	27	28	28
Annual Cost ($/yr)	$600	$920	$1,000	$1,080	$1,120	$1,120
Unit Cost ($/ac-ft)	$40	$40	$40	$40	$40	$40
Supply from CRMWA Linear Well Field Along Existing Transmission System						
Supply From Plan Element (ac-ft/yr)	–	–	29	32	33	34
Annual Cost ($/yr)	–	–	$15,544	$17,152	$3,003	$3,094
Unit Cost ($/ac-ft)	–	–	$536	$536	$91	$91
Supply from CRMWA Desalination of Lake Meredith Water						
Supply From Plan Element (ac-ft/yr)	–	32	51	71	89	107
Annual Cost ($/yr)	–	$106,400	$169,575	$138,095	$173,105	$208,115
Unit Cost ($/ac-ft)	–	$3,325	$3,325	$1,945	$1,945	$1,945
CRMWA Aquifer Storage and Recovery (ASR)						
Supply From Plan Element (ac-ft/yr)	–	100	500	500	500	500
Annual Cost ($/yr)	–	$35,500	$177,500	$79,500	$79,500	$79,500

ac-ft/yr = acre-feet per year

5.59.3 City of Sundown

The City of Sundown obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Sundown; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.59.3.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Sundown.

a. Additional Water Conservation
    - Date to be Implemented: 2030
    - Unit Cost: $477/ac-ft

Table 5-96. Recommended Plan Costs by Decade for the City of Sundown

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*541*	*551*	*570*	*587*	*608*	*631*
Conservation						
Supply From Plan Element (ac-ft/yr)	8	15	14	12	11	9
Annual Cost ($/yr)	$3,820	$7,162	$6,685	$5,730	$5,252	$4,297
Projected Surplus/(Shortage) after Conservation	*549*	*566*	*584*	*599*	*619*	*640*

ac-ft/yr = acre-feet per year

5.59.4 County-Other

Hockley County-Other obtains water supply from the Ogallala Aquifer. The water supply entities for Hockley County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

The City of Smyer has expressed an interest in building a pipeline to obtain CRMWA supply the City of Smyer has leased from the City of Levelland. This water is only available if the City of Levelland does not need the water. This additional supply would be used to improve the City of Smyer's water quality by reducing arsenic and fluoride concentrations and extend their water supply. This project is included as an alternative WMS in this plan.

5.59.5 Manufacturing

Hockley County manufacturing obtains water supply from the Ogallala Aquifer. The water supply entities for Hockley County manufacturing do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.59.6 Steam-Electric

There is no projected steam-electric demand in Hockley County.

5.59.7 Mining

Hockley County mining obtains water supply from the Ogallala Aquifer. The water supply entities for Hockley County mining do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.59.8 Irrigation

Hockley County irrigation obtains its water supply from groundwater from the Ogallala Aquifer and reuse water supplies available within Hockley County. Hockley County irrigation has a projected need beginning in 2030 in the Brazos River Basin and continuing through 2050. There is no projected need in the Colorado River Basin for Hockley County irrigation entities. The WMSs contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation; however, this WMS is not included below as there is to quantifiable yield or cost for this WMS. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.59.8.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and TWDB, the following WMS is recommended for Hockley County Irrigation.

a. Irrigation Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $619/ac-ft

Table 5-97. Recommended Plan Costs by Decade for Hockley County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(24,418)*	*(15,108)*	*(9,477)*	*0*	*0*	*0*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	5,605	5,817	4,712	3,605	3,319	3,145
Annual Cost ($/yr)	$3,470,611	$3,601,881	$2,917,666	$2,232,213	$2,055,122	$1,947,381
Projected Surplus/(Shortage) after Conservation	*(18,813)*	*(9,291)*	*(4,765)*	*3,605*	*3,319*	*3,145*

ac-ft/yr = acre-feet per year

5.59.9 Livestock

Hockley County Livestock obtains water supply from the Ogallala Aquifer and the Dockum Aquifer. The water supply entities for Hockley County Livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.60 Lamb County Water Supply Plan

Table 5-98 lists each WUG in Lamb County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-98. Lamb County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Amherst	154	155	Projected surplus
City of Earth	557	560	Projected surplus
City of Littlefield	1,604	1,587	Projected surplus
City of Olton	991	1,000	Projected surplus
City of Sudan	201	172	Projected surplus
County-Other	27	164	Projected surplus
Manufacturing	49	0	Projected surplus
Steam-Electric	0	0	Projected supply equals demand
Mining	0	0	Projected supply equals demand
Irrigation	(32,449)	0	Projected shortage – see plan below
Livestock	0	324	Projected surplus

ac-ft/yr = acre-feet per year

5.60.1 City of Amherst

The City of Amherst obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Amherst and no changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.60.2 City of Earth

The City of Earth obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Earth; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.60.2.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Earth.

a. Additional Water Conservation
    - Date to be Implemented: 2030
    - Unit Cost: $477/ac-ft

Table 5-99. Recommended Plan Costs by Decade for the City of Earth

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*547*	*553*	*557*	*560*	*561*	*560*
Conservation						
Supply From Plan Element (ac-ft/yr)	4	7	4	-	-	-
Annual Cost ($/yr)	$1,910	$3,342	$1,910	-	-	-
Projected Surplus/(Shortage) after Conservation	*551*	*560*	*561*	*560*	*561*	*560*

ac-ft/yr = acre-feet per year

5.60.3 City of Littlefield

The City of Littlefield obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Littlefield; however, the City has plans to add additional well capacity. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.60.3.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Littlefield.

a. Additional Groundwater Supply

- Date to be Implemented: 2040
- Project Cost: $2,093,000
- Unit Cost: $721/ac-ft

Table 5-100. Recommended Plan Costs by Decade for the City of Littlefied

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*1,573*	*1,593*	*1,604*	*1,610*	*1,605*	*1,587*
Additional Groundwater Supply (Ogallala Aquifer)						
Supply From Plan Element (ac-ft/yr)	–	240	240	240	240	240
Annual Cost ($/yr)	–	$173,000	$173,000	$26,000	$26,000	$26,000
Unit Cost ($/ac-ft)	–	$721	$721	$108	$108	$108

ac-ft/yr = acre-feet per year

5.60.4 City of Olton

The City of Olton obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Olton; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.60.4.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Olton.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-101. Recommended Plan Costs by Decade for the City of Olton

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*965*	*980*	*991*	*999*	*1,003*	*1,000*
Conservation						
Supply From Plan Element (ac-ft/yr)	10	19	17	16	15	14
Annual Cost ($/yr)	$4,775	$9,072	$8,117	$7,640	$7,162	$6,685
Projected Surplus/(Shortage) after Conservation	*975*	*999*	*1,008*	*1,015*	*1,018*	*1.014*

ac-ft/yr = acre-feet per year

5.60.5 City of Sudan

The City of Sudan obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Sudan; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.60.5.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Sudan.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-102. Recommended Plan Costs by Decade for the City of Sudan

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*211*	*207*	*201*	*194*	*185*	*172*
Conservation						
Supply From Plan Element (ac-ft/yr)	5	11	10	10	10	10
Annual Cost ($/yr)	$2,387	$5,252	$4,775	$4,775	$4,775	$4,775
Projected Surplus/(Shortage) after Conservation	*216*	*218*	*211*	*204*	*195*	*182*

ac-ft/yr = acre-feet per year

5.60.6 County-Other

Lamb County-Other obtains water supply from the Ogallala Aquifer (self-supplied and purchased from the City of Littlefield). The water supply entities for Lamb County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.60.7 Manufacturing

Lamb County manufacturing obtains water supply from the Ogallala Aquifer. The water supply entities for Lamb County Manufacturing do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.60.8 Steam-Electric

Lamb County steam-electric obtains water supply from the Ogallala Aquifer. The water supply entities for Lamb County steam-electric do not show any additional water need during the planning period. The LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

In Lamb County, Southwestern Public Service (SPS) Company's water use for steam-electric generation ranges from 11,000 to 13,000 ac-ft annually for both Tolk Station and Plant X. Both plants' water usage is 100 percent consumptive. Plant X's wastewater is conveyed and reused at Tolk Station, and Tolk Station wastewater is conveyed to evaporation ponds for disposal. At present usage rates, SPS projects that its water rights will be economically depleted (saturated thickness generally less than 40 feet) by 2024 to 2026, resulting in the need to retire both plants early.[228] Groundwater availability studies prepared by Lamb County steam-electric generation operators

[228] WSP, USA, 2019. 2019 Groundwater Modeling Results. Prepared for Xcel Energy.

indicate that Ogallala Aquifer supplies are insufficient to support status-quo plant operations through the originally planned retirement dates. Operators of these facilities have reduced operations to conserve groundwater to extend their operations until 2032.

5.60.9 Mining

Lamb County mining obtains its water supply from groundwater from the Ogallala Aquifer. The water supply entities for Lamb County mining do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.60.10 Irrigation

Lamb County irrigation obtains its water supply from groundwater from the Ogallala Aquifer and reuse water supplies available within Lamb County. Lamb County irrigation has a projected need beginning in 2030 and continuing through 2050. The water management strategies contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation; however, this WMS is not included below as there is to quantifiable yield or cost for this WMS. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.60.10.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Lamb County Irrigation.

a. Irrigation Water Conservation
    - Date to be Implemented: 2030
    - Unit Cost: $619/ac-ft

Table 5-103. Recommended Plan Costs by Decade for Lamb County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(60,818)*	*(73,776)*	*(32,449)*	*0*	*0*	*0*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	8,437	9,952	5,845	1,738	1,467	1,375
Annual Cost ($/yr)	$5,224,183	$6,162,270	$3,619,219	$1,076,168	$908,365	$851,399
Projected Surplus/(Shortage) after Conservation	*(52,381)*	*(63,824)*	*(26,604)*	*1,738*	*1,467*	*1,375*

ac-ft/yr = acre-feet per year

5.60.11 Livestock

Lamb County livestock obtains water supply from the Ogallala Aquifer. The water supply entities for Lamb County Livestock do not show a projected shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.61 Lubbock County Water Supply Plan

Table 5-104 lists each WUG in Lubbock County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-104. Lubbock County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2050 (ac-ft/yr)	2050 (ac-ft/yr)	
City of Abernathy			See Hale County Plan
City of Idalou	962	1,010	Projected surplus
City of Lubbock	(25,098)	(57,940)	Projected shortage – see plan below
City of New Deal	317	330	Projected surplus
City of Ransom Canyon	232	14	Projected surplus
City of Shallowater	71	(418)	Projected shortage – see plan below
City of Slaton	(450)	(478)	Projected shortage – see plan below
City of Wolfforth	(2,374)	(3,206)	Projected shortage - see plan below.
County-Other	3,067	38	Projected surplus
Manufacturing	145	0	Projected surplus
Steam-Electric	8,098	5,858	Projected surplus
Mining	1	0	Projected surplus
Irrigation	(15,413)	0	Projected shortage - see plan below.
Livestock	16	0	Projected surplus

ac-ft/yr = acre-feet per year

5.61.1 City of Abernathy

See Hale County Plan.

5.61.2 City of Idalou

The City of Idalou obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Idalou; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.61.2.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Idalou.

a. Additional Water Conservation
    - Date to be Implemented: 2030
    - Unit Cost: $477/ac-ft

Table 5-105. Recommended Plan Costs by Decade for the City of Idalou

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*933*	*949*	*962*	*979*	*995*	*1,010*
Conservation						
Supply From Plan Element (ac-ft/yr)	10	18	16	4	–	–
Annual Cost ($/yr)	$4,775	$8,594	$7,640	$1,910	–	–
Projected Surplus/(Shortage) after Conservation	*943*	*967*	*978*	*983*	*995*	*1,010*

ac-ft/yr = acre-feet per year

5.61.3 City of Lubbock

The City of Lubbock obtains its water supply from groundwater from the Ogallala Aquifer (both self-supplied and purchased from CRMWA) and surface water from Lake Alan Henry (self-supplied) and Lake Meredith (purchased from CRMWA). The City of Lubbock is projected to have a water supply shortage throughout the planning period. The recommended water supply plan is shown below. In addition to the recommended water supply plan shown below, the following projects are considered to be alternative water management strategies should one or more of the recommended projects not be developed:

- Brackish Supplemental Water Supply for Bailey County Well Field
- South Fork Discharge
- North Fork Diversion at CR 7300
- Post Reservoir
- Direct Potable Reuse to South Water Treatment Plant, and
- North Fork Diversion to Lake Alan Henry Pump Station.

5.61.3.1 Reuse

Lubbock currently treats an average of 20 mgd of wastewater. The city currently provides Xcel Energy up to 9 mgd of effluent to the Jones Power Plant to be used for cooling towers. The City has been making major upgrades to its SEWRP to prepare for potable reuse in the future. The city has plans to complete the upgrades to the SEWRP in the next 5 to 10 years so that 100 percent of the effluent is stream discharge quality.

In 2019, the City of Lubbock entered into a preliminary agreement with Palisade Pipeline to supply up to 6 mgd of effluent that has historically been disposed of through an expensive, complex land application process. This is the city's lowest quality effluent. Palisade Pipeline would be solely responsible for the reuse water through a Title 30 *TAC* Chapter 210 Authorization with the TCEQ. Currently Palisade Pipeline has not identified a buyer for the reuse water.

Palisade Pipeline's contract with the City of Lubbock will be limited to approximately 20 years or until the city needs to use the effluent for potable reuse. The contract with Xcel Energy will also expire in the next 25 years. The city is seeking to use its effluent for the most beneficial purposes, with its ultimate use as water for drinking. In the interim timeframe, other entities who need the reuse water are able to purchase the water, which will help fund the city's potable reuse projects in the future.

5.61.3.2 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following water management strategies are recommended for the City of Lubbock.

a. Additional Water Conservation
   - Date to be Implemented: 2030
   - Unit Cost: $396/ac-ft

b. CRMWA Replace Well Capacity)
   - Date to be Implemented: 2040
   - Unit Cost: $110/ac-ft

c. CRMWA Expand Roberts County & CRMWA II Capacity
   - Date to be Implemented: 2030
   - Unit Cost: $1,054/ac-ft

d. CRMWA Brush Control
   - Date to be Implemented: 2030
   - Unit Cost: $40/ac-ft

e. CRMWA Linear Well Field Along Existing Transmission System
   - Date to be Implemented: 2050
   - Unit Cost: $536/ac-ft

f. CRMWA Desalination of Lake Meredith Water
   - Date to be Implemented: 2040
   - Unit Cost: $3,325/ac-ft

g. Bailey County Well Field (BCWF) Capacity Maintenance
   - Date to be Implemented: 2020
   - Project Cost: $94,704,000
   - Unit Cost: $3,067/ac-ft

h. Lake Alan Henry Phase 2
   - Date to be Implemented: 2070
   - Project Cost: $103,152,000
   - Unit Cost: $2,206/ac-ft

i. Lake 7 Reuse
   - Date to be Implemented: 2040
   - Project Cost: $251,043,000
   - Unit Cost: $1,713/ac-ft

j. CRMWA Supplies to ASR

- Date to be Implemented: 2080
- Project Cost: $103,917,000
- Unit Cost: $906/ac-ft

k. Direct Potable Reuse to North Water Treatment Plant

- Date to be Implemented: 2030
- Project Cost: $125,890,000
- Unit Cost: $1,421/ac-ft

Table 5-106. Recommended Plan Costs by Decade for the City of Lubbock

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(7,341)*	*(14,616)*	*(25,098)*	*(37,251)*	*(48,197)*	*(57,940)*
Conservation						
Supply From Plan Element (ac-ft/yr)	1,353	2,931	3,066	767	–	–
Annual Cost ($/yr)	$536,177	$1,161,518	$1,215,017	$303,952	–	–
Projected Surplus/(Shortage) after Conservation	*(5,988)*	*(11,685)*	*(22,032)*	*(36,484)*	*(48,197)*	*(57,940)*
Supply from CRMWA Replace Well Capacity						
Supply From Plan Element (ac-ft/yr)	–	960	2,296	5,069	6,564	6,687
Annual Cost ($/yr)	–	$105,600	$252,230	$50,690	$65,640	$66,870
Unit Cost ($/ac-ft)	–	$110	$110	$10	$10	$10
Supply from CRMWA Expand Roberts County & CRMWA II Capacity						
Supply From Plan Element (ac-ft/yr)	9,918	14,425	15,611	15,724	14,682	14,944
Annual Cost ($/yr)	$10,453,572	$15,203,950	$3,574,919	$3,600,796	$3,362,178	$3,422,176
Unit Cost ($/ac-ft)	$1,054	$1,054	$229	$229	$229	$229
Supply from CRMWA Brush Control						
Supply From Plan Element (ac-ft/yr)	381	555	602	650	665	677
Annual Cost ($/yr)	$15,240	$22,200	$24,080	$26,000	$26,600	$27,080
Unit Cost ($/ac-ft)	$40	$40	$40	$40	$40	$40
Supply from CRMWA Linear Well Field Along Existing Transmission System						
Supply From Plan Element (ac-ft/yr)	–	–	691	756	785	813
Annual Cost ($/yr)	–	–	$370,376	$405,216	$71,435	$73,983
Unit Cost ($/ac-ft)	–	–	$536	$536	$91	$91
Supply from CRMWA Desalination of Lake Meredith Water						
Supply From Plan Element (ac-ft/yr)	–	777	1,204	1,690	2,127	2,573
Annual Cost ($/yr)	–	$2,583,525	4,003,300	3,287,050	4,137,015	5,004,485
Unit Cost ($/ac-ft)	–	$3,325	$3,325	$1,945	$1,945	$1,945
BCWF Capacity Maintenance						
Supply From Plan Element (ac-ft/yr)	2,431	2,431	2,431	2,431	2,431	2,431
Annual Cost ($/yr)	$7,457,000	$7,457,000	$794,000	$794,000	$794,000	$794,000
Unit Cost ($/yr)	$3,067	$3,067	$327	$327	$327	$327

Plan Element	2030	2040	2050	2060	2070	2080
Lake Alan Henry Phase 2						
Supply From Plan Element (ac-ft/yr)	–	5,100	5,100	5,100	5,100	5,100
Annual Cost ($/yr)	–	$11,249,000	$11,249,000	$3,991,000	$3,991,000	$3,991,000
Unit Cost ($/ac-ft)	–	$2,206	$2,206	$783	$783	$783
Lake 7 Reuse						
Supply From Plan Element (ac-ft/yr)	–	–	11,975	11,975	11,975	11,975
Annual Cost ($/yr)	–	–	$20,514,000	$20,514,000	$6,199,000	$6,199,000
Unit Cost ($/ac-ft)	–	–	$1,713	$1,713	$518	$518
CRMWA Supplies to ASR						
Supply From Plan Element (ac-ft/yr)	–	–	–	–	10,920	10,920
Annual Cost ($/yr)	–	–	–	–	$9,898,000	$9,898,000
Unit Cost ($/ac-ft)	–	–	–	–	$906	$906
Direct Potable Reuse to North Water Treatment Plant						
Supply From Plan Element (ac-ft/yr)	–	–	–	–	–	8,064
Annual Cost ($/yr)	–	–	–	–	–	$11,457,000
Unit Cost ($/ac-ft)	–	–	–	–	–	$1,421

ac-ft/yr = acre-feet per year

5.61.4 City of New Deal

The City of New Deal obtains its water supply from groundwater from the Ogallala Aquifer (both self-supplied and purchased from the City of Slaton). There are no projected shortages for the City of New Deal. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.61.5 City of Ransom Canyon

The City of Ransom Canyon obtains its water supply from groundwater from the Ogallala Aquifer (purchased from the City of Lubbock) and surface water from Lake Alan Henry (purchased from the City of Lubbock) and a run-of-river right; however, the water right does not have a firm yield. There are no projected shortages for the City of Ransom Canyon; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.61.5.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Ransom Canyon.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-107. Recommended Plan Costs by Decade for the City of Ransom Canyon

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*273*	*253*	*232*	*206*	*44*	*14*
Conservation						
Supply From Plan Element (ac-ft/yr)	8	16	16	16	17	17
Annual Cost ($/yr)	$3,820	$7,640	$7,640	$7,640	$8,117	$8,117
Projected Surplus/(Shortage) after Conservation	*281*	*269*	*248*	*222*	*61*	*31*

ac-ft/yr = acre-feet per year

5.61.6 City of Shallowater

The City of Shallowater obtains its water supply from groundwater from the Ogallala Aquifer (both self-supplied and purchased from the City of Lubbock). There are projected shortages for the City of Shallowater beginning in 2060. The water supply plan for the City is below. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.61.6.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS's are recommended for the City of Shallowater.

a. Additional Groundwater Development (ETHP Aquifer)

- Date to be Implemented: 2030
- Total Project Cost: $37,482,000
- Unit Cost: $2,608/ac-ft

Table 5-108. Recommended Plan Costs by Decade for the City of Shallowater

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*184*	*129*	*71*	*(3)*	*(333)*	*(418)*
Additional Groundwater Development (ETHP Aquifer)						
Supply From Plan Element (ac-ft/yr)	1,225	1,225	1,725	1,725	1,725	1,725
Annual Cost ($/yr)	$3,542,000	$3,542,000	$561,000	$561,000	$423,000	$423,000
Unit Cost ($/ac-ft)	$2,891	$2,891	$667	$667	$395	$395

ac-ft/yr = acre-feet per year

5.61.7 City of Slaton

The City of Slaton obtains its water supply from groundwater from the Ogallala Aquifer (both self-supplied and purchased from CRMWA) and surface water from Lake Meredith (purchased from CRMWA). There are projected shortages for the City of Slaton through the entire planning period. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd. The water supply plan for the City is shown below.

5.61.7.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following water management strategies are recommended for the City of Slaton.

a. CRMWA Replace Well Capacity

- Date to be Implemented: 2040
- Unit Cost: $110/ac-ft

b. CRMWA Expand Roberts County & CRMWA II Capacity

- Date to be Implemented: 2030
- Unit Cost: $1,054/ac-ft

c. CRMWA Brush Control

- Date to be Implemented: 2030
- Unit Cost: $40/ac-ft

d. CRMWA Linear Well Field Along Existing Transmission System

- Date to be Implemented: 2050
- Unit Cost: $536/ac-ft

e. CRMWA Desalination of Lake Meredith Water

- Date to be Implemented: 2040
- Unit Cost: $3,325/ac-ft

Table 5-109. Recommended Plan Costs by Decade for the City of Slaton

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(295)*	*(393)*	*(450)*	*(487)*	*(485)*	*(478)*
Supply from CRMWA Replace Well Capacity						
Supply From Plan Element (ac-ft/yr)	–	14	33	70	85	82
Annual Cost ($/yr)	–	$1,540	$3,630	$700	$850	$820
Unit Cost ($/ac-ft)	–	$110	$110	$10	$10	$10
Supply from CRMWA Expand Roberts County & CRMWA II Capacity						
Supply From Plan Element (ac-ft/yr)	146	212	228	217	191	183
Annual Cost ($/yr)	$153,884	$223,448	$52,212	$49,693	$43,739	$41,907
Unit Cost ($/ac-ft)	$1,054	$1,054	$229	$229	$229	$229
Supply from CRMWA Brush Control						
Supply From Plan Element (ac-ft/yr)	6	8	9	9	9	8
Annual Cost ($/yr)	$240	$320	$360	$360	$360	$320
Unit Cost ($/ac-ft)	$40	$40	$40	$40	$40	$40
Supply from CRMWA Linear Well Field Along Existing Transmission System						
Supply From Plan Element (ac-ft/yr)	–	–	10	10	10	10
Annual Cost ($/yr)	–	–	$5,360	$5,360	$910	$910
Unit Cost ($/ac-ft)	–	–	$536	$536	$91	$91
Supply from CRMWA Desalination of Lake Meredith Water						
Supply From Plan Element (ac-ft/yr)	–	11	18	23	28	32
Annual Cost ($/yr)	–	$36,575	$59,850	$44,735	$54,460	$62,240
Unit Cost ($/ac-ft)	–	$3,325	$3,325	$1,945	$1,945	$1,945

ac-ft/yr = acre-feet per year

5.61.8 City of Wolfforth

The City of Wolfforth obtains its water supply from groundwater from the Ogallala Aquifer. The City of Wolfforth is projected to have a water supply shortage beginning in 2040 and continuing throughout the planning period. The recommended water supply plan is shown below.

5.61.8.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following water management strategies are recommended for the City of Wolfforth.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $449/ac-ft

b. Additional Groundwater Development (Ogallala Aquifer)

- Date to be Implemented: 2040
- Project Cost: $28,373,000
- Unit Cost: $3,730/ac-ft

Table 5-110. Recommended Plan Costs by Decade for the City of Wolfforth

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*120*	*(1,395)*	*(2,374)*	*(2,747)*	*(3,031)*	*(3,206)*
Conservation						
Supply From Plan Element (ac-ft/yr)	69	181	-	-	-	-
Annual Cost ($/yr)	$30,952	$81,192	-	-	-	-
Projected Surplus/(Shortage) after Conservation	*189*	*(1,214)*	*(2,374)*	*(2,747)*	*(3,031)*	*(3,206)*
Additional Groundwater Development (Ogallala Aquifer)						
Supply From Plan Element (ac-ft/yr)	—	800	800	800	800	800
Annual Cost ($/yr)	—	$2,984,000	$2,984,000	$988,000	$988,000	$988,000
Unit Cost ($/yr)	—	—	$2,021	$2,021	$794	$794

ac-ft/yr = acre-feet per year

5.61.9 County-Other

Lubbock County-Other obtains water supply from the Ogallala Aquifer (both self-supplied and purchased from the City of Lubbock) and surface water from Lake Alan Henry (purchased from the City of Lubbock). The water supply entities for Lubbock County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.61.10 Manufacturing

Lubbock County manufacturing obtains its water supply from groundwater from the Ogallala Aquifer. The water supply entities for Lubbock County Manufacturing do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.61.11 Steam-Electric

Lubbock County steam-electric obtains water supply from the Ogallala Aquifer and reuse water purchased from the City of Lubbock. The water supply entities for Lubbock County steam-electric do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.61.12 Mining

Lubbock County mining obtains its water supply from groundwater from the Ogallala Aquifer. Lubbock County mining is not projected to have a water shortage during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.61.13 Irrigation

Lubbock County irrigation obtains its water supply from groundwater from the Ogallala Aquifer and reuse water supplies available within Lubbock County. Lubbock County irrigation has a projected need beginning in 2030 and continuing through 2050. The water management strategies contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation; however, this WMS is not included below as there is to quantifiable yield or cost for this WMS. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.61.13.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Lubbock County Irrigation.

a. Irrigation Water Conservation
    - Date to be Implemented: 2030
    - Unit Cost: $619/ac-ft

Table 5-111. Recommended Plan Costs by Decade for Lubbock County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(27,093)*	*(32,040)*	*(15,415)*	*0*	*0*	*0*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	6,668	8,545	6,998	5,451	5,256	5,106
Annual Cost ($/yr)	$4,128,820	$5,291,056	$4,333,155	$3,375,254	$3,254,511	$3,161,631
Projected Surplus/(Shortage) after Conservation	*(20,425)*	*(23,495)*	*(8,417)*	*5,451*	*5,256*	*5,106*

ac-ft/yr = acre-feet per year

5.61.14 Livestock

Lubbock County livestock obtains water supply from the Ogallala Aquifer. The water supply entities for Lubbock County livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.62 Lynn County Water Supply Plan

Table 5-112 lists each WUG in Lynn County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-112. Lynn County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) 2050 (ac-ft/yr)	Surplus/(Shortage) 2080 (ac-ft/yr)	Comment
City of O'Donnell	73	67	Projected surplus
Tahoka Public Water System	269	267	Projected surplus
County-Other	14	42	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	Projected supplies equal demand
Irrigation	0	(849)	Projected shortage – see plan below
Livestock	4	0	Projected surplus

ac-ft/yr = acre-feet per year

5.62.1 City of O'Donnell

The City of O'Donnell obtains its water supply from groundwater from the Ogallala Aquifer (both self-supplied and purchased from CRMWA) and surface water from Lake Meredith (purchased from CRMWA). There are no projected shortages for the City of O'Donnell; however, additional supply from the CRMWA is included in the water supply plan for the City. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.62.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and TWDB, the following water management strategies are recommended for the City of O'Donnell.

a. CRMWA Replace Well Capacity

- Date to be Implemented: 2040
- Unit Cost: $110/ac-ft

b. CRMWA Expand Roberts County & CRMWA II Capacity

- Date to be Implemented: 2030
- Unit Cost: $1,054/ac-ft

c. CRMWA Brush Control

- Date to be Implemented: 2030
- Unit Cost: $40/ac-ft

d. CRMWA Linear Well Field Along Existing Transmission System

- Date to be Implemented: 2050
- Unit Cost: $536/ac-ft

e. CRMWA Desalination of Lake Meredith Water

- Date to be Implemented: 2040
- Unit Cost: $3,325/ac-ft

Table 5-113. Recommended Plan Costs by Decade for the City of O'Donnell

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*91*	*80*	*73*	*67*	*67*	*67*
Supply from CRMWA Replace Well Capacity						
Supply From Plan Element (ac-ft/yr)	–	2	5	10	13	12
Annual Cost ($/yr)	–	$220	$550	$100	$130	$120
Unit Cost ($/ac-ft)	–	$110	$110	$10	$10	$10
Supply from CRMWA Expand Roberts County & CRMWA II Capacity						
Supply From Plan Element (ac-ft/yr)	20	29	33	32	28	28
Annual Cost ($/yr)	$21,080	$30,566	$7,557	$7,328	$6,412	$6,412
Unit Cost ($/ac-ft)	$1,054	$1,054	$229	$229	$229	$229
Supply from CRMWA Brush Control						
Supply From Plan Element (ac-ft/yr)	1	1	1	1	1	1
Annual Cost ($/yr)	$40	$40	$40	$40	$40	$40
Unit Cost ($/ac-ft)	$40	$40	$40	$40	$40	$40
Supply from CRMWA Linear Well Field Along Existing Transmission System						
Supply From Plan Element (ac-ft/yr)	–	–	1	2	2	2
Annual Cost ($/yr)	–	–	$536	$1,072	$182	$182
Unit Cost ($/ac-ft)	–	–	$536	$536	$91	$91
Supply from CRMWA Desalination of Lake Meredith Water						
Supply From Plan Element (ac-ft/yr)	–	2	2	3	4	5
Annual Cost ($/yr)	–	$6,650	$6,650	$5,835	$7,780	$9,725
Unit Cost ($/ac-ft)	–	$3,325	$3,325	$1,945	$1,945	$1,945

ac-ft/yr = acre-feet per year

5.62.2 Tahoka Public Water System

The Tahoka Public Water System obtains its water supply from groundwater from the Ogallala Aquifer (both self-supplied and purchased from CRMWA) and surface water from Lake Meredith (purchased from CRMWA). There are no projected shortages for the Tahoka Public Water System; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.62.2.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following water management strategies are recommended for the Tahoka Public Water System.

a. Additional Water Conservation
   - Date to be Implemented: 2030
   - Unit Cost: $477/ac-ft

b. CRMWA Replace Well Capacity
   - Date to be Implemented: 2040
   - Unit Cost: $110/ac-ft

c. CRMWA Expand Roberts County & CRMWA II Capacity
   - Date to be Implemented: 2030
   - Unit Cost: $1,054/ac-ft

d. CRMWA Brush Control
   - Date to be Implemented: 2030
   - Unit Cost: $40/ac-ft

e. CRMWA Linear Well Field Along Existing Transmission System
   - Date to be Implemented: 2050
   - Unit Cost: $536/ac-ft

f. CRMWA Desalination of Lake Meredith Water
   - Date to be Implemented: 2040
   - Unit Cost: $3,325/ac-ft

Table 5-114. Recommended Plan Costs by Decade for the Tahoka Public Water System

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*330*	*292*	*269*	*256*	*261*	*267*
Conservation						
Supply From Plan Element (ac-ft/yr)	10	18	–	–	–	–
Annual Cost ($/yr)	$4,775	$8,594	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*340*	*310*	*269*	*256*	*261*	*267*
Supply from CRMWA Replace Well Capacity						
Supply From Plan Element (ac-ft/yr)	–	6	16	35	45	46
Annual Cost ($/yr)	–	$660	$1,760	$350	$450	$460
Unit Cost ($/ac-ft)	–	$110	$110	$10	$10	$10
Supply from CRMWA Expand Roberts County & CRMWA II Capacity						
Supply From Plan Element (ac-ft/yr)	63	96	108	109	101	102
Annual Cost ($/yr)	$66,402	$101,184	$24,732	$24,961	$23,129	$23,358
Unit Cost ($/ac-ft)	$1,054	$1,054	$229	$229	$229	$229
Supply from CRMWA Brush Control						
Supply From Plan Element (ac-ft/yr)	2	4	4	4	5	5
Annual Cost ($/yr)	$80	$160	$160	$160	$200	$200
Unit Cost ($/ac-ft)	$40	$40	$40	$40	$40	$40
Supply from CRMWA Linear Well Field Along Existing Transmission System						
Supply From Plan Element (ac-ft/yr)	–	–	5	5	5	6
Annual Cost ($/yr)	–	–	$2,680	$2,680	$455	$546
Unit Cost ($/ac-ft)	–	–	$536	$536	$91	$91
Supply from CRMWA Desalination of Lake Meredith Water						
Supply From Plan Element (ac-ft/yr)	–	5	8	12	15	18
Annual Cost ($/yr)	–	$16,625	$26,600	$23,340	$29,175	$35,010
Unit Cost ($/ac-ft)	–	$3,325	$3,325	$1,945	$1,945	$1,945

ac-ft/yr = acre-feet per year

5.62.3 County-Other

Lynn County-Other obtains water supply from the Ogallala Aquifer. The water supply entities for Lynn County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.62.4 Manufacturing

There is no projected manufacturing demand in Lynn County.

5.62.5 Steam-Electric

There is no projected steam-electric demand in Lynn County.

5.62.6 Mining

Lynn County mining obtains its water supply from groundwater from the Ogallala Aquifer. Lynn County mining is not projected to have a water shortage during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.62.7 Irrigation

Lynn County irrigation obtains its water supply from groundwater from the Ogallala Aquifer and reuse water supplies available within Lynn County. There are surface water rights associated with irrigation in Lynn County; however they do not have a firm yield. Lynn County irrigation has a projected need beginning in 2060 in the Colorado River Basin. There are no projected needs for irrigation in the Brazos River Basin. The water management strategies contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation; however, this WMS is not included below as there is to quantifiable yield or cost for this WMS. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.62.7.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Lynn County Irrigation.

a. Irrigation Water Conservation
  - Date to be Implemented: 2030
  - Unit Cost: $619/ac-ft

Table 5-115. Recommended Plan Costs by Decade for Lynn County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*0*	*0*	*0*	*(449)*	*(692)*	*(849)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	3,641	5,097	5,084	5,072	4,888	4,761
Annual Cost ($/yr)	$2,254,504	$3,156,058	$3,148,008	$3,140,578	$3,026,645	$2,948,007
Projected Surplus/(Shortage) after Conservation	*3,641*	*5,097*	*5,084*	*4,623*	*4,196*	*3,912*

ac-ft/yr = acre-feet per year

5.62.8 Livestock

Lynn County livestock obtains water supply from the Ogallala Aquifer. The water supply entities for Lynn County livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.63 Motley County Water Supply Plan

Table 5-116 lists each WUG in Motley County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-116. Motley County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) 2050 (ac-ft/yr)	Surplus/(Shortage) 2080 (ac-ft/yr)	Comment
City of Matador	633	636	Projected surplus
Red River Authority of Texas	6	7	Projected surplus in Region O – see the Region B plan for the water supply plan for the Red River Authority of Texas.
County-Other	33	35	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	Projected supply equals demand
Irrigation	2,858	2,858	Projected surplus
Livestock	84	67	Projected surplus

ac-ft/yr = acre-feet per year

5.63.1 City of Matador

The City of Matador obtains its water supply from groundwater from the Seymour Aquifer and other minor aquifers within Motley County. There are no projected shortages for the City of Matador; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.63.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Matador.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-117. Recommended Plan Costs by Decade for the City of Matador

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*612*	*624*	*633*	*634*	*635*	*636*
Conservation						
Supply From Plan Element (ac-ft/yr)	4	7	7	6	6	6
Annual Cost ($/yr)	$1,910	$3,342	$3,342	$2,865	$2,865	$2,865
Projected Surplus/(Shortage) after Conservation	*616*	*631*	*640*	*640*	*641*	*642*

ac-ft/yr = acre-feet per year

5.63.2 Red River Authority of Texas

See the Region B Plan for the water supply plan for the Red River Authority of Texas.

5.63.3 County-Other

Motley County-Other obtains water supply from the Seymour Aquifer and other minor aquifers located within Motley County. The water supply entities for Motley County-Other show a projected surplus during the planning period however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.63.3.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the Motley County-Other.

a. Additional Water Conservation
   - Date to be Implemented: 2030
   - Unit Cost: $477/ac-ft

Table 5-118. Recommended Plan Costs by Decade for Motley County-Other

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*22*	*28*	*33*	*34*	*34*	*35*
Conservation						
Supply From Plan Element (ac-ft/yr)	2	4	4	1	-	-
Annual Cost ($/yr)	$955	$1,910	$1,910	$477	-	-
Projected Surplus/(Shortage) after Conservation	*24*	*32*	*37*	*35*	*34*	*35*

ac-ft/yr = acre-feet per year

5.63.4 Manufacturing

There is no projected manufacturing demand in Motley County.

5.63.5 Steam-Electric

There is no projected steam-electric demand in Motley County.

5.63.6 Mining

Motley County mining obtains water supply from the Ogallala Aquifer and the Seymour Aquifer. The water supply entities for Motley County mining do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.63.7 Irrigation

Motley County Irrigation obtains groundwater supply from the Ogallala Aquifer, Dockum Aquifer, Seymour Aquifer, and other minor aquifers located within Motley County. There are also surface water rights associated with irrigation in Motley County. The water supply entities for Motley County Irrigation do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.63.8 Livestock

Motley County Livestock obtains water supply from the Ogallala Aquifer, Dockum Aquifer, and other minor aquifers located in Motley County. The water supply entities for Motley County Livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.64 Parmer County Water Supply Plan

Table 5-119 lists each WUG in Parmer County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-119. Parmer County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Bovina	373	500	Projected surplus
City of Farwell	382	215	Projected surplus
City of Friona	1,329	1,158	Projected surplus
County-Other	155	482	Projected surplus
Manufacturing	270	0	Projected surplus
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	No Mining demand
Irrigation	(37,184)	(800)	Projected shortage – see plan below
Livestock	0	385	Projected surplus

ac-ft/yr = acre-feet per year

5.64.1 City of Bovina

The City of Bovina obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Bovina; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.64.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Bovina.

a. Additional Water Conservation
    - Date to be Implemented: 2030
    - Unit Cost: $477/ac-ft

Table 5-120. Recommended Plan Costs by Decade for the City of Bovina

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*314*	*339*	*373*	*409*	*450*	*500*
Conservation						
Supply From Plan Element (ac-ft/yr)	7	12	9	2	–	–
Annual Cost ($/yr)	$3,342	$5,730	$4,297	$955	–	–
Projected Surplus/(Shortage) after Conservation	*321*	*351*	*382*	*411*	*450*	*500*

ac-ft/yr = acre-feet per year

5.64.2 City of Farwell

The City of Farwell obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Farwell; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.64.2.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Farwell.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-121. Recommended Plan Costs by Decade for the City of Farwell

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*461*	*423*	*382*	*337*	*283*	*215*
Conservation						
Supply From Plan Element (ac-ft/yr)	10	22	23	23	25	26
Annual Cost ($/yr)	$4,775	$10,504	$10,982	$10,982	$11,937	$12,414
Projected Surplus/(Shortage) after Conservation	*471*	*445*	*405*	*360*	*308*	*241*

ac-ft/yr = acre-feet per year

5.64.3 City of Friona

The City of Friona obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Friona; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.64.3.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Friona.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-122. Recommended Plan Costs by Decade for the City of Friona

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*1,411*	*1,372*	*1,329*	*1,284*	*1,228*	*1,158*
Conservation						
Supply From Plan Element (ac-ft/yr)	19	40	40	14	–	–
Annual Cost ($/yr)	$9,072	$19,099	$19,099	$6,685	–	–
Projected Surplus/(Shortage) after Conservation	*1,160*	*1,412*	*1,369*	*1,298*	*1,228*	*1,158*

ac-ft/yr = acre-feet per year

5.64.4 County-Other

Parmer County-Other obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for entities within Parmer County-Other; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.64.4.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Parmer County-Other.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-123. Recommended Plan Costs by Decade for Parmer County-Other

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*0*	*69*	*155*	*249*	*355*	*482*
Conservation						
Supply From Plan Element (ac-ft/yr)	12	21	16	11	5	–
Annual Cost ($/yr)	$5,730	$10,027	$7,640	$5,252	$2,387	–
Projected Surplus/(Shortage) after Conservation	*12*	*90*	*171*	*260*	*360*	*482*

ac-ft/yr = acre-feet per year

5.64.5 Manufacturing

Parmer County Manufacturing obtains water supply from the Ogallala Aquifer. The water supply entities for Parmer County Manufacturing do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.64.6 Steam-Electric

There is no projected Steam-Electric demand in Parmer County.

5.64.7 Mining

There is no projected Mining demand in Parmer County.

5.64.8 Irrigation

Parmer County Irrigation obtains its water supply from groundwater from the Ogallala Aquifer and reuse water supplies available within Parmer County. There are also surface water rights associated with irrigation in Parmer County; however, these rights do not have a firm yield. Parmer County Irrigation has a projected need beginning in 2030 in the Brazos River Basin which continues through the planning period. There is also a projected irrigation need in 2040 in the Red River Basin. The water management strategies contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation; however, this WMS is not included below as there is to quantifiable yield or cost for this WMS. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.64.8.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Parmer County Irrigation.

a. Irrigation Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $619/ac-ft

Table 5-124. Recommended Plan Costs by Decade for Parmer County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(69,215)*	*(70,848)*	*(37,184)*	*(2,318)*	*(1,376)*	*(800)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	6,941	8,425	4,895	1,364	982	735
Annual Cost ($/yr)	$4,297,864	$5,216,753	$3,030,980	$844,588	$608,054	$455,111
Projected Surplus/(Shortage) after Conservation	*(62,274)*	*(52,423)*	*(32,289)*	*(954)*	*(394)*	*(65)*

ac-ft/yr = acre-feet per year

5.64.9 Livestock

Parmer County Livestock obtains water supply from the Ogallala Aquifer and Dockum Aquifer. The water supply entities for Parmer County Livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.65 Swisher County Water Supply Plan

Table 5-125 lists each WUG in Swisher County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-125. Swisher County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) 2050 (ac-ft/yr)	Surplus/(Shortage) 2080 (ac-ft/yr)	Comment
City of Happy	395	395	Projected surplus
City of Tulia	1,220	1,321	Projected surplus
County-Other	14	31	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	No Mining demand
Irrigation	(6,018)	(516)	Projected shortage – see plan below
Livestock	240	0	Projected surplus

ac-ft/yr = acre-feet per year

5.65.1 City of Happy

The City of Happy obtains its water supply from groundwater from the Dockum Aquifer. There are no projected shortages for the City of Happy and no changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.65.2 City of Tulia

The City of Tulia obtains its water supply from groundwater from the Ogallala and Dockum Aquifers and surface water from Lake Mackenzie. There are no projected shortages for the City of Tulia; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.65.2.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Tulia.

a. Additional Water Conservation
    - Date to be Implemented: 2030
    - Unit Cost: $477/ac-ft

Table 5-126. Recommended Plan Costs by Decade for the City of Tulia

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*1,151*	*1,182*	*1,220*	*1,252*	*1,285*	*1,321*
Conservation						
Supply From Plan Element (ac-ft/yr)	17	31	28	–	–	–
Annual Cost ($/yr)	$8,117	$14,802	$13,369	–	–	–
Projected Surplus/(Shortage) after Conservation	*1,168*	*1,213*	*1,248*	*1,252*	*1,285*	*1,321*

ac-ft/yr = acre-feet per year

5.65.3 County-Other

Swisher County-Other obtains water supply from the Ogallala Aquifer. The water supply entities for Swisher County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.65.4 Manufacturing

There is no projected manufacturing demand in Swisher County.

5.65.5 Steam-Electric

There is no projected steam-electric demand in Swisher County.

5.65.6 Mining

There is no projected mining demand in Swisher County.

5.65.7 Irrigation

Swisher County irrigation obtains its water supply from groundwater from the Ogallala Aquifer and the Dockum Aquifer. Swisher County irrigation has a projected need beginning in 2030 and continuing throughout the remainder of the planning period in the Brazos River Basin. There is also an irrigation need in 2040 and 2050 in the Red River Basin. The water management strategies contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation; however, this WMS is not included below as there is to quantifiable yield or cost for this WMS. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.65.7.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Swisher County Irrigation.

a. Irrigation Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $619/ac-ft

Table 5-127. Recommended Plan Costs by Decade for Swisher County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(159)*	*(7,735)*	*(6,018)*	*(825)*	*(664)*	*(516)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	3,221	3,665	2,644	1,623	1,303	1,090
Annual Cost ($/yr)	$1,994,440	$2,269,365	$1,637,162	$1,004,960	$806,816	$674,927
Projected Surplus/(Shortage) after Conservation	*3,062*	*(4,070)*	*(3,374)*	*798*	*639*	*574*

ac-ft/yr = acre-feet per year

5.65.8 Livestock

Swisher County livestock obtains water supply from the Ogallala Aquifer. The water supply entities for Swisher County livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.66 Terry County Water Supply Plan

Table 5-128 lists each WUG in Terry County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-128. Terry County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Brownfield	29	(159)	Projected shortage – see plan below
County-Other	19	113	Projected surplus
Manufacturing	3	0	Projected surplus
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	Projected supply equals demand
Irrigation	0	(1,798)	Projected shortage – see plan below
Livestock	0	73	Projected surplus

ac-ft/yr = acre-feet per year

5.66.1 City of Brownfield

The City of Brownfield obtains its water supply from groundwater from the Ogallala (both self-supplied and purchased from CRMWA) and surface water from Lake Meredith (purchased from CRMWA). The City of Brownfield is projected to have a water supply shortage beginning in 2060 and continuing through the planning period.

5.66.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following water management strategies are recommended for the City of Brownfield.

a. Additional Water Conservation
   - Date to be Implemented: 2030
   - Unit Cost: $477/ac-ft

b. Additional Groundwater Supply (Ogallala Aquifer)
   - Date to be Implemented: 2050
   - Project Cost: $633,000
   - Unit Cost: $331/ac-ft

c. CRMWA Replace Well Capacity
   - Date to be Implemented: 2040
   - Unit Cost: $110/ac-ft

d. CRMWA Expand Roberts County & CRMWA II Capacity
   - Date to be Implemented: 2030
   - Unit Cost: $1,054/ac-ft

e. CRMWA Brush Control
   - Date to be Implemented: 2030
   - Unit Cost: $40/ac-ft

f. CRMWA Linear Well Field Along Existing Transmission System

- Date to be Implemented: 2050
- Unit Cost: $536/ac-ft

g. CRMWA Desalination of Lake Meredith Water

- Date to be Implemented: 2040
- Unit Cost: $3,325/ac-ft

Table 5-129. Recommended Plan Costs by Decade for the City of Brownfield

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*337*	*156*	*29*	*(81)*	*(118)*	*(159)*
Conservation						
Supply From Plan Element (ac-ft/yr)	36	4	–	–	–	–
Annual Cost ($/yr)	$17,189	$1,910	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*373*	*160*	*29*	*(81)*	*(118)*	*(159)*
Additional Groundwater Development (Ogallala Aquifer)						
Supply From Plan Element (ac-ft/yr)	–	–	–	160	160	160
Annual Cost ($/yr)	–	–	–	$53,000	$53,000	$9,000
Unit Cost ($/ac-ft)	–	–	–	$331	$331	$56
Supply from CRMWA Replace Well Capacity						
Supply From Plan Element (ac-ft/yr)	–	28	71	162	217	230
Annual Cost ($/yr)	–	$3,080	$7,810	$1,620	$2,170	$2,300
Unit Cost ($/ac-ft)	–	$110	$110	$10	$10	$10
Supply from CRMWA Expand Roberts County & CRMWA II Capacity						
Supply From Plan Element (ac-ft/yr)	262	413	482	502	487	514
Annual Cost ($/yr)	$276,148	$435,302	$110,378	$114,958	$111,523	$117,706
Unit Cost ($/ac-ft)	$1,054	$1,054	$229	$229	$229	$229
Supply from CRMWA Brush Control						
Supply From Plan Element (ac-ft/yr)	10	16	19	21	22	23
Annual Cost ($/yr)	$400	$640	$760	$840	$880	$920
Unit Cost ($/ac-ft)	$40	$40	$40	$40	$40	$40
Supply from CRMWA Linear Well Field Along Existing Transmission System						
Supply From Plan Element (ac-ft/yr)	–	–	21	24	26	28
Annual Cost ($/yr)	–	–	$11,256	$12,864	$2,366	$2,548
Unit Cost ($/ac-ft)	–	–	$536	$536	$91	$91
Supply from CRMWA Desalination of Lake Meredith Water						
Supply From Plan Element (ac-ft/yr)	–	22	37	54	70	89
Annual Cost ($/yr)	–	$73,150	$123,025	$105,030	$136,150	$173,105
Unit Cost ($/ac-ft)	–	$3,325	$3,325	$1,945	$1,945	$1,945
CRMWA Aquifer Storage and Recovery (ASR)						
Supply From Plan Element (ac-ft/yr)	–	100	200	200	200	200
Annual Cost ($/yr)	–	$35,500	$71,000	$31,800	$31,800	$31,800

ac-ft/yr = acre-feet per year

5.66.2 County-Other

Terry County-Other obtains water supply from the Ogallala Aquifer. The water supply entities for Terry County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity’s current per capita use rate is below the selected target rate of 140 gpcd.

5.66.3 Manufacturing

Terry County manufacturing obtains water supply from the Ogallala Aquifer. The water supply entities for Terry County manufacturing do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.66.4 Steam-Electric

There is no projected steam-electric demand in Terry County.

5.66.5 Mining

Terry County mining obtains its water supply from groundwater from the Ogallala Aquifer. The water supply entities for Terry County mining do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.66.6 Irrigation

Terry County irrigation obtains its water supply from groundwater from the Ogallala Aquifer. Terry County irrigation has a projected need beginning in 2060 in the Colorado River Basin. There are no projected irrigation water needs in the Brazos River Basin during the planning period. The water management strategies contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation; however, this WMS is not included below as there is to quantifiable yield or cost for this WMS. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.66.6.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Terry County Irrigation.

a. Irrigation Water Conservation
   - Date to be Implemented: 2030
   - Unit Cost: $619/ac-ft

Table 5-130. Recommended Plan Costs by Decade for Terry County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*0*	*0*	*0*	*(204)*	*(1,809)*	*(1,798)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	5,131	6,067	6,067	6,067	5,929	5,768
Annual Cost ($/yr)	$3,177,111	$3,756,681	$3,756,681	$3,756,681	$3,671,232	$3,571,540
Projected Surplus/(Shortage) after Conservation	*5,131*	*6,067*	*6,067*	*5,863*	*4,120*	*3,970*

ac-ft/yr = acre-feet per year

5.66.7 Livestock

Terry County livestock obtains water supply from the Ogallala Aquifer. The water supply entities for Terry County livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

5.67 Yoakum County Water Supply Plan

Table 5-131 lists each WUG in Yoakum County and their corresponding surplus or shortage in years 2050 and 2080. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-131. Yoakum County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Denver City	3,807	3,655	Projected surplus
City of Plains	762	772	Projected surplus
County-Other	38	0	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	Projected supply equals demand
Mining	0	0	Projected supply equals demand
Irrigation	(16,585)	0	Projected shortage – see plan below
Livestock	8	0	Projected surplus

ac-ft/yr = acre-feet per year

5.67.1 City of Denver City

The City of Denver City obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Denver City; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.67.1.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Denver City.

a. Additional Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $477/ac-ft

Table 5-132. Recommended Plan Costs by Decade for the City of Denver City

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*3,923*	*3,863*	*3,807*	*3,758*	*3,708*	*3,655*
Conservation						
Supply From Plan Element (ac-ft/yr)	35	72	71	70	68	67
Annual Cost ($/yr)	$16,711	$34,378	$33,900	$33,423	$32,468	$31,991
Projected Surplus/(Shortage) after Conservation	*3,958*	*3,935*	*3,878*	*3,828*	*3,776*	*3,722*

ac-ft/yr = acre-feet per year

5.67.2 City of Plains

The City of Plains obtains its water supply from groundwater from the Ogallala Aquifer. There are no projected shortages for the City of Plains; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

5.67.2.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Plains.

a. Additional Water Conservation
    - Date to be Implemented: 2030
    - Unit Cost: $477/ac-ft

Table 5-133. Recommended Plan Costs by Decade for the City of Plains

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*798*	*778*	*762*	*763*	*767*	*772*
Conservation						
Supply From Plan Element (ac-ft/yr)	9	18	18	17	16	15
Annual Cost ($/yr)	$16,711	$34,378	$33,900	$33,423	$32,468	$31,991
Projected Surplus/(Shortage) after Conservation	*807*	*796*	*780*	*780*	*783*	*787*

ac-ft/yr = acre-feet per year

5.67.3 County-Other

Yoakum County-Other obtains water supply from the Ogallala Aquifer. The water supply entities for Yoakum County-Other show a projected surplus during the planning period. No changes in water supply are recommended. Additional conservation was considered; however, the entity’s current per capita use rate is below the selected target rate of 140 gpcd.

5.67.4 Manufacturing

There is no projected manufacturing demand in Yoakum County.

5.67.5 Steam-Electric

Yoakum County steam-electric obtains water supply from the Ogallala Aquifer. The water supply entities for Yoakum County steam-electric do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.67.6 Mining

Yoakum County mining obtains its water supply from groundwater from the Ogallala Aquifer. The water supply entities for Yoakum County mining do not show any additional water need during the planning period. No changes in water supply are recommended; however, the LERWPG recommends that water conservation practices be applied where economically efficient water savings can be realized.

5.67.7 Irrigation

Yoakum County irrigation obtains its water supply from groundwater from the Ogallala Aquifer. Yoakum County irrigation has a projected need beginning in 2030 and continuing through 2050. The water management strategies contained in the water supply plan will not meet the total irrigation water supply need. In additional to water conservation, the LERWPG also acknowledges that using playa lakes for recharge may provide additional water supplies to irrigation; however, this WMS is not included below as there is to quantifiable yield or cost for this WMS. The LERWPG understands that as irrigation shortages grow, that there could be unmet irrigation water needs which may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

5.67.7.1 Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Yoakum County Irrigation.

a. Irrigation Water Conservation

- Date to be Implemented: 2030
- Unit Cost: $619/ac-ft

Table 5-134. Recommended Plan Costs by Decade for Yoakum County Irrigation

Plan Element	2030	2040	2050	2060	2070	2080
Projected Surplus/(Shortage) (ac-ft/yr)	*(23,136)*	*(28,019)*	*(16,585)*	*0*	*0*	*0*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	5,249	6,278	4,675	3,072	2,805	2,630
Annual Cost ($/yr)	$3,250,176	$3,887,332	$2,894,756	$1,902,180	$1,736,854	$1,628,494
Projected Surplus/(Shortage) after Conservation	*(17,887)*	*(21,741)*	*(11,910)*	*0*	*0*	*0*

ac-ft/yr = acre-feet per year

5.68 Livestock

Yoakum County livestock obtains water supply from the Ogallala Aquifer. The water supply entities for Yoakum County livestock do not show a water shortage during the planning period. The LERWPG recommends that all livestock operations be diligent in their water use, implementing water conservation practices as economically feasible. Costs to implement BMPs vary from site to site and the LERWPG recognizes that livestock producers will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing livestock water conservation strategies.

F. Management Supply Factor for Major Water Providers

Based on TWDB regional planning guidance, a management supply factor is to be provided for each MWP. The management supply factor is defined as current supplies plus supplies from WMSs divided by the total demands. This management supply factor, commonly referred to as a safety factor, represents the margin of safety should supplies decrease or demand increase.

There are several factors that could affect the ability of a water provider to provide for projected needs, including the following.

- Climate change reduces the supply available from existing sources;
- The region experiences a drought more severe than the previous DOR, which would reduce the supply available;
- One or more proposed management strategies cannot be developed or is developed more slowly than anticipated; and
- Existing supplies become unusable due to invasive species, contamination, or other factors.

The management supply factors for the MWPs in the Llano Estacado Planning Area are shown in Table 5-135. The supply factors shown are just for the MWPs' service area within the Llano Estacado Planning Area.

Table 5-135. Management Supply Factors for Major Water Providers

Major Water Provider	Management Supply Factor					
	2020	2030	2040	2050	2060	2070
Canadian River MWA	0.87	0.99	0.99	0.99	0.99	0.99
City of Lubbock	0.97	1.29	1.70	1.64	1.82	1.92
Mackenzie MWA	7.98	7.98	7.98	7.98	7.98	7.98
White River MWD	1.00	1.00	1.00	1.00	1.00	1.00
Red River Authority	1.00	1.00	1.00	1.00	1.00	1.00

G. WMS Implementation Status

House Bill 1565 of the 88th Texas Legislature requires a description of the implementation status of certain types of recommended WMSs. The one recommended WMS in the region that requires this description is the City of Lubbock's Lake 7 Reuse WMS. A description of the WMS implementation and its anticipated timeline is provided in Section 5.2 and in Appendix J.

6

Impacts of Regional Water Plan and Consistency with Resource Protection

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Chapter 6: Impacts of Regional Water Plan and Consistency with Resource Protection

[31 TAC §357.33(c), 31 TAC §357.34(e), 31 TAC §357.40, 31 TAC §357.41, and 31 TAC §357.43(b)(2)]

The guidelines for 2026 Texas Water Development Board (TWDB) regional water plan development include describing major impacts of recommended and alternative water management strategies on key parameters of water quality identified by the regional water planning group (RWPG). This also includes consideration of third-party social and economic impacts associated with voluntary redistribution of water from rural and agricultural areas, and effects of ground and surface water relationships on water resources of the state. Furthermore, 2026 TWDB regional water plans should consider statutory provisions regarding inter-basin transfers of surface water, including summation of water needs in basins of origin and receiving basins, as well as how the regional water plan is consistent with protection of natural resources. The regional water plan development was guided by the principle that the designated water quality and related water uses as shown in the state water quality management plan shall be improved or maintained.

6.1 Impacts of Water Management Strategies on Key Water Quality Parameters in the State

The Llano Estacado Regional Water Planning Group (LERWPG) identified key parameters of water quality to consider for water management strategies in the 2026 Llano Estacado Regional Water Plan (LERWP). The selection of significant water quality parameters are based on water quality concerns identified in research and studies completed within the Llano Estacado Region, water user concerns expressed during LERWPG meetings, the Brazos River Authority's Basin Highlights Report[229], the Colorado River Basin Highlights Report[230], and the Canadian and Red River Basin Highlights Report[231] completed as part of the Texas Clean Rivers Program (CRP), and water quality studies conducted for water management strategies included in previous and current plans. The LERWPG has identified the following key water quality parameters to consider for recommended water management strategies (WMSs):

- Chlorides,
- Sulfates,
- Total dissolved solids (TDS),
- Total suspended solids (TSS),
- Dissolved oxygen,
- pH range,

[229] https://www.brazos.org/Portals/0/crpPDF/BasinHighlightsReport-2019.pdf

[230] https://www.lcra.org/water/quality/texas-clean-rivers-program/Documents/2018_BasinHighlights_Report_FINAL.pdf

[231] http://rra.texas.gov/publications/crp/crp2016/FY2016%20BHR.pdf

- Indicator bacteria (Escherichia coli or fecal coliform),
- Temperature,
- Nitrates,
- Total phosphorous, and
- Total nitrogen-ammonia.

The major impacts of recommended WMSs on these key parameters of water quality are described in greater detail in the respective WMS summaries (Part D). These identified water quality concerns present challenges that may need to be overcome before the WMS can be used as a water supply. For water quality parameters that cannot be fully addressed due to lack of available information or inconclusive water quality studies, the WMS evaluations include recommendations for further studies prior to implementation.

6.2 Impacts of Moving Water from Agricultural and Rural Areas

The implementation of WMSs recommended in the 2026 LERWP and evaluated in Chapter 5 is not expected to have impacts on water supplies that are used for agricultural purposes. Most of the recommended WMSs for municipal water user groups (WUGs) will be developed using existing water rights. Moving large volumes of water from agricultural and rural areas to other users would have a negative impact on the agricultural communities in the region; however, no significant movement of water is recommended in the 2026 LERWP. Declining water supplies available to irrigated agriculture would result in reduced numbers of irrigated acres and irrigation application rates, adversely affecting producers and the local and regional economy.

6.3 Impacts to Navigation of Implementing the 2026 Llano Estacado Regional Water Plan

In accordance with Section 10 of the Rivers and Harbors Act of 1899, navigable waters are those waters that are subject to the ebb and flow of the tide and/or are presently being used or have been used in the past for use to transport interstate or foreign commerce. In the Llano Estacado Planning Area, the major rivers include the Colorado, Brazos, and Red rivers. None of these rivers is considered navigable within the Llano Estacado Planning Area. Therefore, the 2026 LERWP does not have an impact on navigation.

6.4 Impacts of the Plan on Threats to Agricultural Resources

Agricultural resources are an important component of the Llano Estacado Planning Area as this region is heavily reliant on agriculture to support the economy. The greatest water needs identified in the 2026 LERWP are associated with irrigated agriculture. The plan assumes that irrigation agriculture demands will decline over time due to reductions in available supply and increased conservation measures. In addition to these reductions, the LERWPG recommended additional water conservation to meet a portion of the water needs identified for irrigated agriculture. This will help to conserve and preserve limited water sources for future use. This strategy will reduce the projected deficit in the heavily irrigated counties and preserve water supplies for future use in counties with no identified needs.

6.5 Impacts of the Plan on Threats to Natural Resources

The Llano Estacado area contains many natural resources and the WMSs recommended in this plan are intended to protect those resources, while still meeting the projected water needs of the region.

6.5.1 Threatened and Endangered Species

The abundance and diversity of wildlife in the Llano Estacado Region is influenced by vegetation and topography, with areas of greater habitat diversity having the potential for more wildlife species. The presence or potential occurrence of threatened or endangered species is an important consideration in planning and implementing any water resource project or WMS. Both state and federal governments have identified species that need protection as detailed in Chapter 1. The proposed infrastructure strategies in the 2026 LERWP can be designed to avoid and/or minimize impacts to threatened and endangered species. Most of the recommended strategies include developing or expanding groundwater, which has flexibility in the placement of wells and pipelines. The recommended conservation strategies in the 2026 LERWP will continue to preserve surface water for wildlife.

6.5.2 Public Lands

No recommended strategies in the 2026 LERWP will require water supply projects to be located within public lands. Implementation of WMSs should not directly impact these lands.

6.5.3 Oil and Gas Production

The oil and gas industry represent an important economic base for the region. The projected water demands reflect the increased water needs for production of local energy reserves. The 2026 LERWP identifies sufficient water to meet these needs. None of the recommended WMSs is expected to impact oil or gas production in the region.

6.6 Hydrologic Effects of Implementing the 2026 Llano Estacado Regional Water Plan

Hydrologic effects on surface water and groundwater resources can occur when new water supply projects are constructed and implemented. This section describes the hydrologic effects of the implementation of recommended water management strategies in the 2026 LERWP.

6.6.1 Groundwater

Recommended WMSs involving additional development of groundwater would increase groundwater usage by entities in the Llano Estacado Region. The development of groundwater by WMSs recommended in the 2026 plan is likely to be concentrated in a few areas that could experience noticeable declines locally in groundwater levels. However, none of the WMSs increase projected groundwater pumpage beyond the modeled available groundwater (MAG) established by county and aquifer. Thus, projected groundwater conditions are expected to be within the desired future conditions (DFCs) and within a range that the local groundwater conservation districts consider manageable.

6.6.2 Surface Water

In the 2026 LERWP, one new reservoir, the City of Lubbock's Jim Bertram Lake 7, is considered a recommended WMS. To quantify the effects of implementation of the reservoir through the year 2080, water availability modeling (WAM) was used. Surface water effects were quantified using the Texas Commission on Environmental Quality (TCEQ) Brazos WAM Run 3 (Brazos WAM), which, based on the TWDB planning guidelines, is the standard tool used to evaluate surface water management strategies in the region. The Brazos WAM assumptions include no return flows (unless included as a specific component to a strategy), as-permitted reservoir contents, and the environmental flow standards adopted by TCEQ for the Brazos Basin.

The cumulative effects of the plan can be quantified by comparing conditions prior to implementation of the plan (base condition) to conditions with the reservoir in place. The base condition to compare to conditions with the plan in place was computed by the Brazos WAM under the Run 3 assumptions. The base condition assumes full use of water rights, and conservation or transfers of water will not impact the assumption of full use of water rights. Under the Brazos River Authority (BRA) System Operations permit, Jim Bertram Lake 7 was operated junior to the proposed appropriation because this strategy will receive a priority date from TCEQ that is senior to Lake 7.

The effects of Lake 7 on regulated streamflow were evaluated by comparing descriptive streamflow statistics for the base condition with those from the plan condition at the selected evaluation locations. Figure 6-1 presents these comparisons for regulated streamflow at the Brazos River at Seymour. Regulated flow is the total streamflow remaining in the stream after all existing water rights have been exercised and other water management activities have taken place. It represents the total flow passing a location (model control point) after all water rights have appropriated the flows to which they are entitled.

The effects of implementing Jim Bertram Lake 7 will have slight effects on streamflows in the Brazos Basin. Locations below new reservoirs or reservoirs with augmented supplies will generally experience reduced streamflows, although generally not to significant levels. The detrimental effects of these reductions can be minimized with proper consideration of reservoir pass-through requirements to maintain flows necessary to meet the needs of the environment. Implementation of recommended WMSs in the 2026 LERWP will not cause significantly different streamflows.

Overall, the strategies recommended in the 2026 LERWP will have limited negative effects on the environment. The largest localized impact is from one new reservoir. In the 2026 LERWP, Jim Bertram Lake 7 is the only new reservoir included as a recommended WMS and has minimal effects on streamflow and the environment.

Jim Bertram Lake 7 will inundate 774 acres, reducing wildlife habitat and cultivated farmland as documented in the Chapter 5 WMS evaluations. Permitting for the WMS will require mitigation land of at least equal ecological value, reducing the negative environmental consequences of the WMS. Streamflows immediately downstream from the WMS will decrease but permit requirements will specify reservoir pass-through flows necessary to maintain ecological health in the downstream receiving stream.

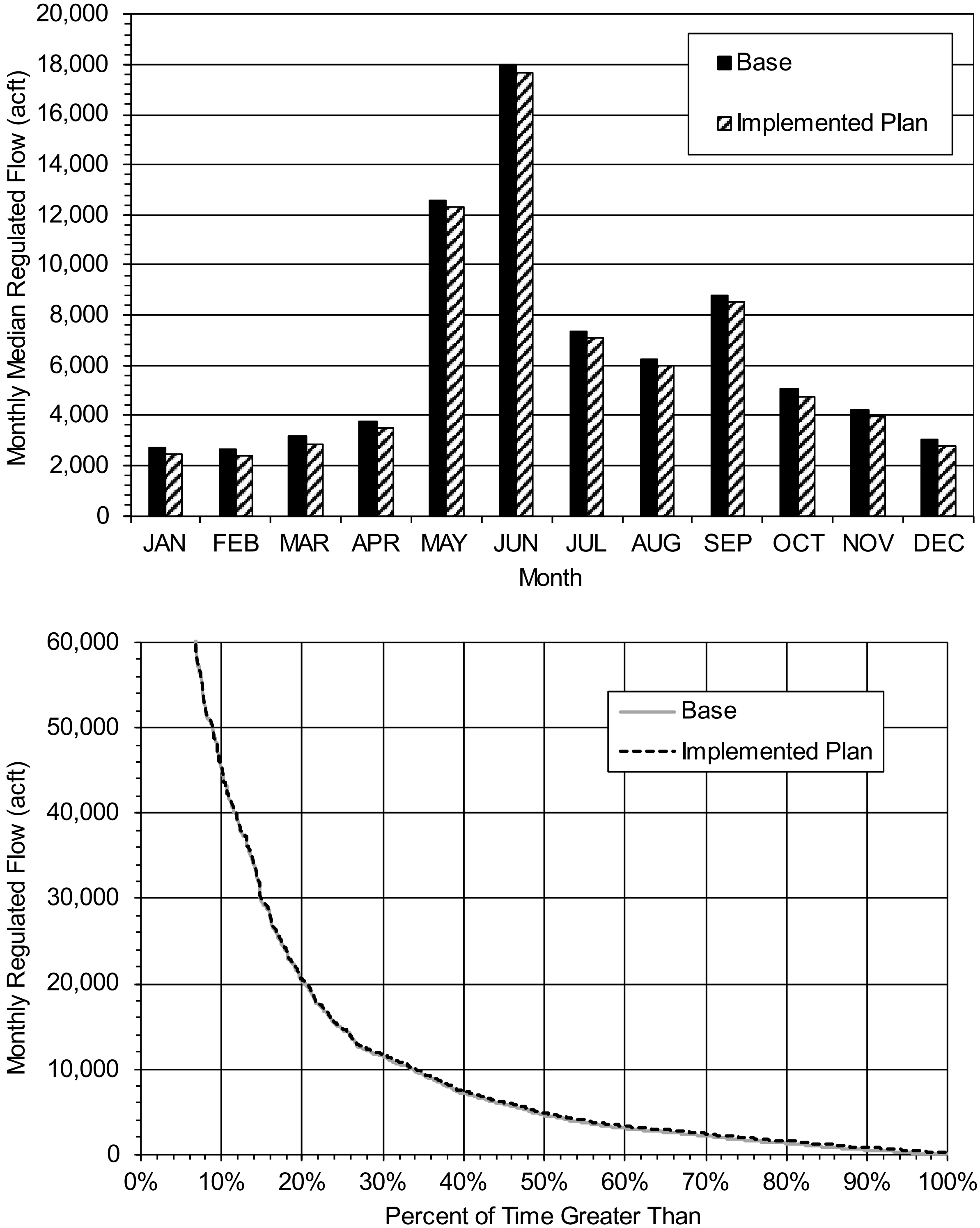

Figure 6-1. Comparisons for Regulated Streamflow at the Brazos River at Seymour

6.7 Groundwater and Surface Water Interrelationships Impacting Water Resources of the State

The LERWPG recognizes the importance of considering groundwater and surface water interaction when managing water resources and evaluating development of future water supplies. The LERWPG encourages groundwater conservation districts (GCDs) and groundwater management areas (GMAs) to consider protection of springs and groundwater-surface water interaction during when considering new DFCs.

6.8 Consistency with Protection of Water Resources, Agricultural Resources, and Natural Resources

The 2026 LERWP is consistent with long-term protection of the state's water resources, agricultural resources, and natural resources, and was developed based on guidance principles outlined in the Texas Administrative Code (TAC) Chapter 358 - State Water Planning Guidelines. The 2026 LERWP was produced with an understanding of the importance of orderly development, management, and conservation of water resources, and is consistent with all laws applicable to water use for the state and regional water planning areas (RWPAs). Furthermore, the plan was developed according to principles governing surface water and groundwater rights. For groundwater, the 2026 LERWP also recognizes principles for groundwater use in Texas and the authority of GCDs and GMAs within the Llano Estacado Region. The modeled available groundwater (MAG) estimates developed by the TWDB based on DFCs developed by GCDs and GMAs were used to determine groundwater availability. The LERWPG recognizes the need to protect groundwater quality.

The 2026 LERWP identifies actions and policies necessary to meet the Llano Estacado Region's near and long-term water needs by developing and recommending WMSs to meet needs with reasonable cost, good water quality, and sufficient protection of agricultural and natural resources of the state. The LERWPG recommended WMSs that considered public interest of the state, major water providers (MWPs), protection of existing water rights, and opportunities that encourage voluntary transfers of water resources while balancing economic, social, and ecological viability. When needs could not be met economically with WMSs, the TWDB performed a socioeconomic impact analysis to estimate the economic loss associated with not meeting these needs (electronic Appendix F - Final Plan only).

The 2026 LERWP considered environmental information resulting from site-specific studies and ongoing water development projects when evaluating WMSs. The WMSs have the potential of impacting instream flows. For the 2026 plan, recommended WMSs either originate from neighboring regions or groundwater and surface water projects that are expected to have minimal to no cumulative adverse effect on instream flows. A list of endangered and threatened species in the Llano Estacado Region for each county was obtained from the U.S. Fish and Wildlife Service (USFWS) and discussed in Chapter 1. Possible habitats for endangered and threatened species were considered for each WMS (Chapter 5). In addition, the 2026 plan consists of initiatives to respond to drought conditions and includes drought contingency measures by regional entities (Chapter 7).

6.9 Consistency with Protection of Agricultural Resources

Agricultural resources are a vital part of the Llano Estacado Region economy. In the semi-arid Llano Estacado Region, irrigating farmers supplement precipitation with irrigation from groundwater to increase crop yields and to raise livestock. It is estimated that irrigated crop land and livestock accounts for approximately 96 percent of the total water used in the Llano Estacado Region.

The projected irrigation water supply need in 2030 is 552,793 ac-ft/yr, decreasing to 22,717 ac-ft/yr in 2080, primarily due to decreasing irrigation demands during the planning period. The LERWPG recommends six irrigation conservation measures to reduce water use and the resulting projected need. These agricultural water conservation strategies are recommended for all 21 counties in the Llano Estacado Region. Achievement of these conservation goals would preserve the limited groundwater supplies for the future use.

6.10 Consistency with Protection of Natural Resources

In the Llano Estacado Region, the principal uses of water for natural resources are for the recovery of crude petroleum, for sand and gravel washing, for sand used in the hydraulic fracturing process in the recovery of crude petroleum, and recreation such as hunting and fishing. Water use associated with oil and gas exploration (mining) in the Llano Estacado Region is projected to peak in 2030 and then decline as this area sees less exploration and drilling activity and more production activity that uses less water.

The decline in mining demands indicates sufficient water supplies will be available to meet these demands and heavy use of groundwater supplies in the region will result in minimal impacts to hunting and fishing. Additionally, none of the recommended WMSs is anticipated to impact oil and gas production or hunting and fishing resources.

6.11 Consistency with State Water Planning Guidelines

The LERWP is in compliance with state water planning regulations, including portions of 31 TAC 357 and 358. The LERWPG conducted meetings during the 2026 planning cycle, with meetings open to the public and decisions based on accurate, objective, and reliable information. The LERWPG coordinated water planning and management activities with local, regional, state, and federal agencies, and participated in interregional communication with the Panhandle Region (Region A) and Brazos G Region (Region G) to identify common needs and worked together with Region A and Region G to develop interregional strategies in an open, equitable, and efficient manner. The Llano Estacado Region considered recommendations of stream segments with unique ecological value by the Texas Parks and Wildlife Department (TPWD) and sites of unique value for reservoirs. At this time, the LERWPG recommends that no stream segments with unique ecological value be designated. The LERWPG developed policy recommendations for the 2026 LERWP, including protection of water quality, reconsideration of agricultural demand estimates, groundwater management, request for additional studies for water supply projects, and continued funding for regional water planning efforts. The LERWPG policy recommendations are included in Chapter 8.

6.12 Summary of Unmet Water Needs

Agricultural resources are an important component of the region as it is heavily reliant on agriculture to support the economy. The greatest water needs identified in the LERWP are associated with irrigated agriculture. The 2026 LERWP assumes that irrigation agriculture demands will decline over time due to reductions in available supply and increased conservation measures. In addition to these reductions, the LERWPG recommended additional water conservation to meet a portion of the water needs identified for irrigated agriculture. This will help to conserve and preserve limited water sources for future use. This strategy will reduce the projected deficit (Table 6-1) in the heavily irrigated counties and preserve water supplies for future use in counties with no identified needs.

Table 6-1. Unmet Needs in the Llano Estacado Region

Water User Group	Annual Water Need (acre-feet per year)					
	2030	2040	2050	2060	2070	2080
Irrigation	548,265	586,823	315,949	22,234	20,693	16,834

7

Drought Response Information, Activities, and Recommendations

Chapter 7: Drought Response Information, Activities, and Recommendations

[31 TAC §357.42]

Droughts are of great importance to the planning and management of water resources in Texas. Drought generally means periods of less than average precipitation over a certain period. Associated definitions include meteorological drought (abnormally dry weather), agricultural drought (adverse impact on crop or range production), and hydrologic drought (below-average water content in aquifers and/or reservoirs). Drought is generally when there is less than 75 percent of normal precipitation. Therefore, droughts, especially the drought of record (DOR), are of great importance for planning and water management.

Although droughts can occur in all climatic zones, they have the greatest potential to become catastrophic in dry or arid regions such as the High Plains. Mild droughts commonly occur over short periods in Texas; however, there is no certain way to predict how long or severe a drought will be while it is occurring. This uncertainty necessitates planning and preparation for worst-case scenarios in drought-prone areas such as the Llano Estacado Region. Planning and preparation includes understanding historical droughts and drought patterns. With growing water demands, planning is even more important to prevent shortages, deterioration of water quality, and lifestyle/financial impacts on water suppliers and users.

7.1 Drought Indicators

Several drought indicators have been developed to assess the effect of a drought through parameters such as severity, duration, and spatial extent. There are numerous ways that the "worst drought" can be defined. Therefore, it is important to consider multiple indices. The Palmer Drought Severity Index (PDSI), historic reservoir storage volumes, surface water modeling, and groundwater aquifer decline are drought indices that can be incorporated into planning efforts and are discussed in more detail below.

One of the best tools in drought preparedness is a thorough understanding of the DOR, or the worst drought to occur for a particular area during the available period of hydrologic data. However, there are many ways that the "worst drought" can be defined (degree of dryness/severity, duration, relative soil moisture content, agricultural impacts, socioeconomic impacts, etc.). Regional water planning focuses on hydrological drought, which is typically the type of drought associated with the largest shortfalls in surface and/or subsurface water supply. The frequency and severity of hydrological drought is often defined on a watershed or river basin scale, although it could be different from one area to the next, even within a planning region.

7.1.1 Palmer Drought Severity Index

The PDSI, first published in 1965[232], was one of the first comprehensive efforts using precipitation and temperature for estimating moisture. Using monthly temperature and precipitation data along with the moisture capacity of soils, the PDSI accounts for previous months' water balances to more accurately track drought over time. The National Oceanic and Atmospheric Administration (NOAA) publishes weekly and monthly PDSI maps by climate division for the contiguous United States, going as far back as 1895. This availability makes it a widely used and robust tool to monitor long-term droughts. PDSI values can range from -10 to 10, with negative values indicating dry conditions. The approximate ranges are shown in Table 7-1.

Table 7-1. PDSI Value Ranges

PDSI Value Range	Drought/Moisture Level
Less than -4	Extreme Drought
-4 to -3	Severe Drought
-3 to -2	Moderate Drought
-2 to 2	Mid-Range
2 to 3	Moderately Moist
3 to 4	Very Moist
Greater than 4	Extremely Moist

NOAA[233] divides Texas into ten climate divisions by representing areas with consistent climatological characteristics (Figure 7-1). Figure 7-2 shows the climate divisions within the Llano Estacado Region, which lies primarily within Climate Division 1 (High Plains), but also intersects Division 2 (Low Rolling Plains) to the east. It is necessary to consider these divisions as drought indices are calculated based on characteristics of each climate division.

Figure 7-3 and Figure 7-4 show annual PDSI values[234] for Divisions 1 and 2. During the 1950s and again in the 2010s, the PDSI was less than -4, indicating extreme drought. The PDSI indicates that conditions in 2011 were the most severe and that drought conditions in the 1950s lasted the longest with seven consecutive years with a PDSI value less than zero. The PDSI also indicates that the droughts in the 1950s and the 2010s were extreme for the Llano Estacado Region. However, the PDSI alone does not provide enough information to determine which drought event should be considered the DOR.

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[232] Palmer, W. C, 1965: Meteorological Drought. Res. Paper No.45, 58pp, Dept. of Commerce, Washington, D.C.

[233] NOAA: U.S. Climate Divisions, National Climatic Data Center, www.ncdc.noaa.gov/monitoring-references/maps/us-climate-divisions.php

[234] NOAA: National Environmental Satellite, Data, and Information Service [database], National Climatic Data Center, Retrieved from https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/divisional

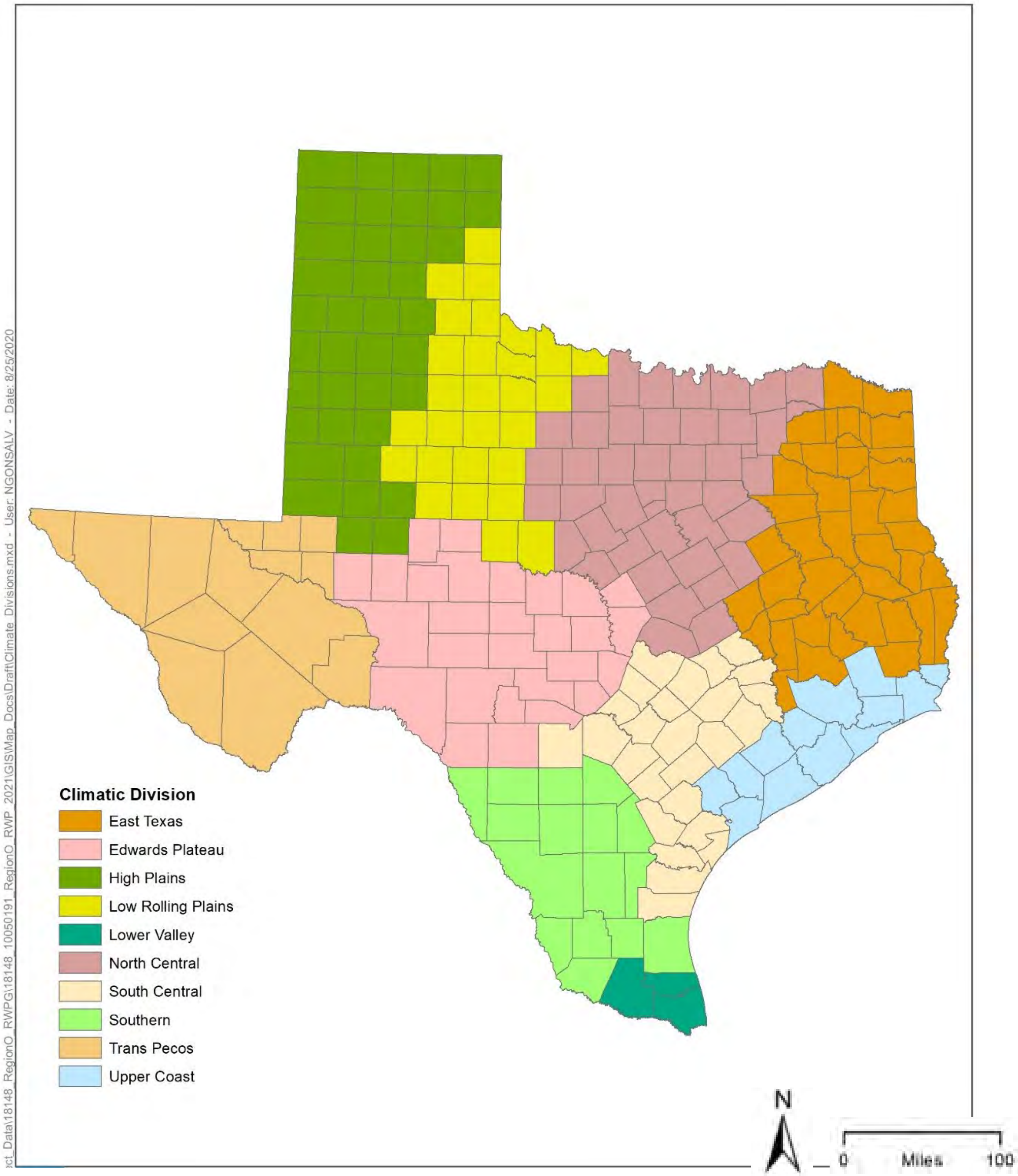

Figure 7-1. NOAA Climate Divisions in Texas

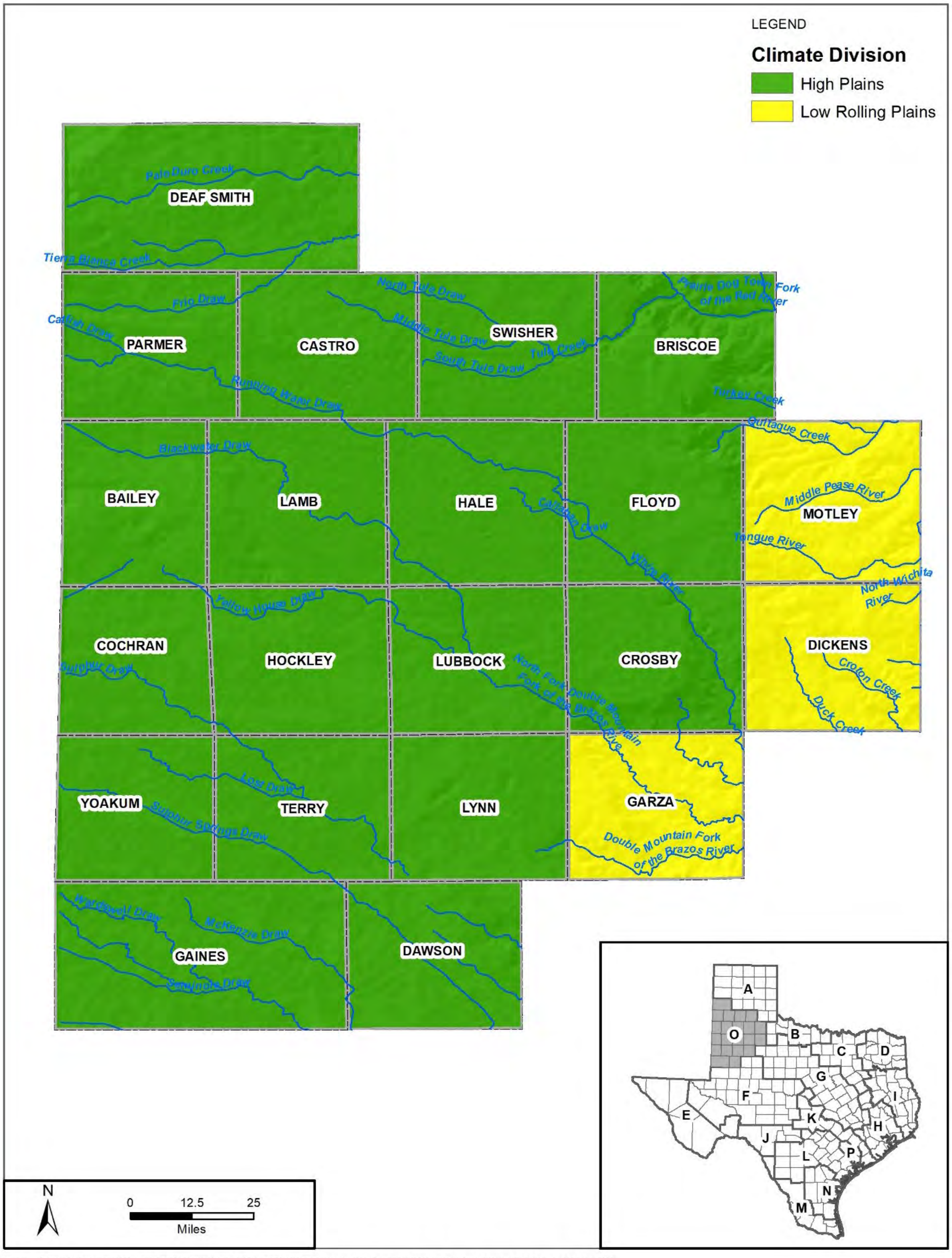

Figure 7-2. Climate Division within the Llano Estacado Region

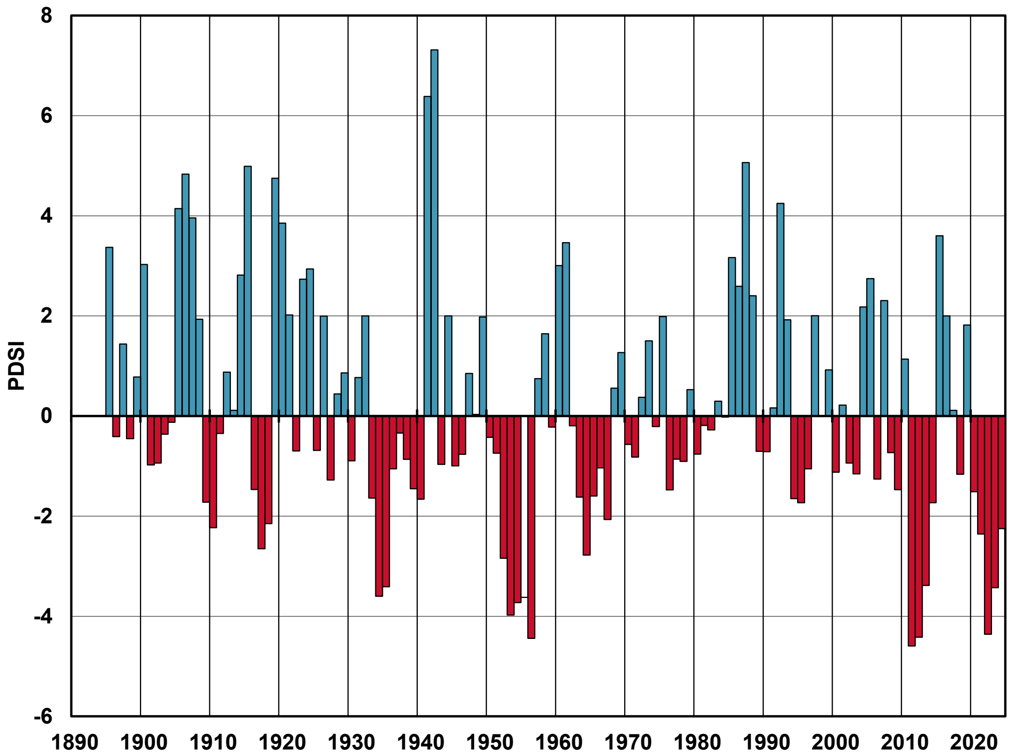

Figure 7-3. Palmer Drought Severity Index: Division 1

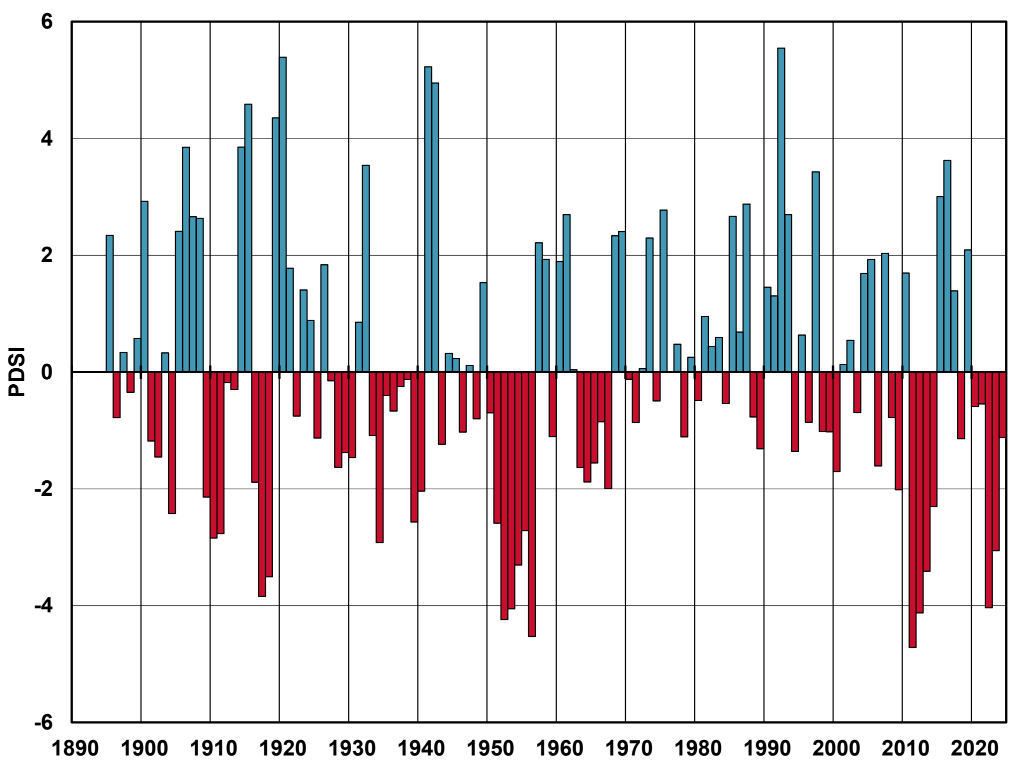

Figure 7-4. Palmer Drought Severity Index: Division 2

7.1.2 Historic Reservoir Storage Volumes

Development of surface water supply sources has been limited in the Llano Estacado Region simply because the area has few significant flowing streams. Four water storage projects are located in or near the Llano Estacado Region. These four water storage projects are Lake Alan Henry (LAH), Lake Meredith, Lake Mackenzie, and White River Lake.

The historical reservoir storage volumes for the four water storage projects are shown in Figure 7-5, Figure 7-6, Figure 7-7, and Figure 7-8. The lakes have rarely exceeded their conservation capacities. The lake storage volumes dropped to low values during the 2010s drought. Although these lakes did not exist in the 1950s, given that the 1950s drought lasted longer than the 2010s drought, reservoir storage volumes for these conditions would have likely dropped to near zero.

The conservation capacities of LAH and White River Lake changed due to the results of volumetric surveys. For LAH, the Brazos River Authority (BRA) states that the area of the lake is 2,884 acres at conservation pool elevation. The results of the Texas Water Development Board (TWDB) 2005 Survey indicate LAH has a volume of 94,808 acre-feet (ac-ft) and encompasses 2,741 acres at conservation pool elevation, 2,220 feet above mean sea level. The TWDB 2005 survey indicates a 5 percent, or 143-acre loss in surface area at the conservation pool elevation[235]. The 2017 TWDB volumetric survey indicates Alan Henry Reservoir has a total reservoir capacity of 96,207 acre-feet and encompasses 2,800 acres at conservation pool elevation (2,220.0 feet above mean sea level, NGVD29).[236] Comparison of the 2005 and 2017 volumetric survey results indicate Alan Henry Reservoir is losing an average of 231 acre-feet of capacity per year.

Upon completion of White River Lake, the capacity of the lake was calculated to be 38,650 ac-ft. Of this total, 650 ac-ft was dead storage, which resulted in 38,000 ac-ft of conservation storage. Sediment filled the lower 7.6 feet of the lake. The estimated reduction in storage capacity is 13,141 ac-ft, or 29 percent less than that previously conceived on the permit, results in a conservation capacity of 25,509 ac-ft. Due to potential sediment movement and improved data and calculation techniques, the conservation capacity was revised. The resulting effective conservation storage volume for White River Lake is therefore estimated to be 29,880 ac-ft[237].

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[235] TWDB. 2006. http://www.twdb.texas.gov/hydro_survey/alanhenry/2005-07/AlanHenry2005_FinalReport.pdf

[236] TWDB. 2017. https://www.twdb.texas.gov/surfacewater/surveys/completed/files/AlanHenry/2017-08/AlanHenry2017_FinalReport.pdf

[237] TWDB. 2003. http://www.twdb.texas.gov/hydro_survey/whiteriver/1992-10/WhiteRiver1993_FinalReport.pdf

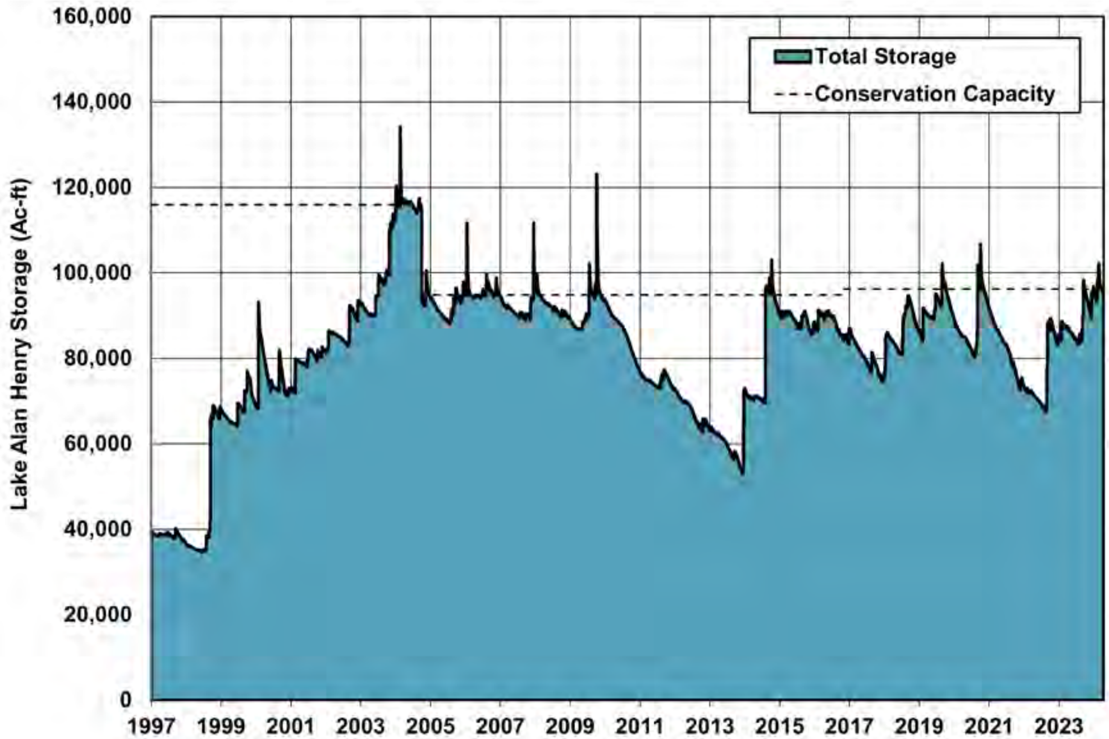

Figure 7-5. Lake Alan Henry Storage

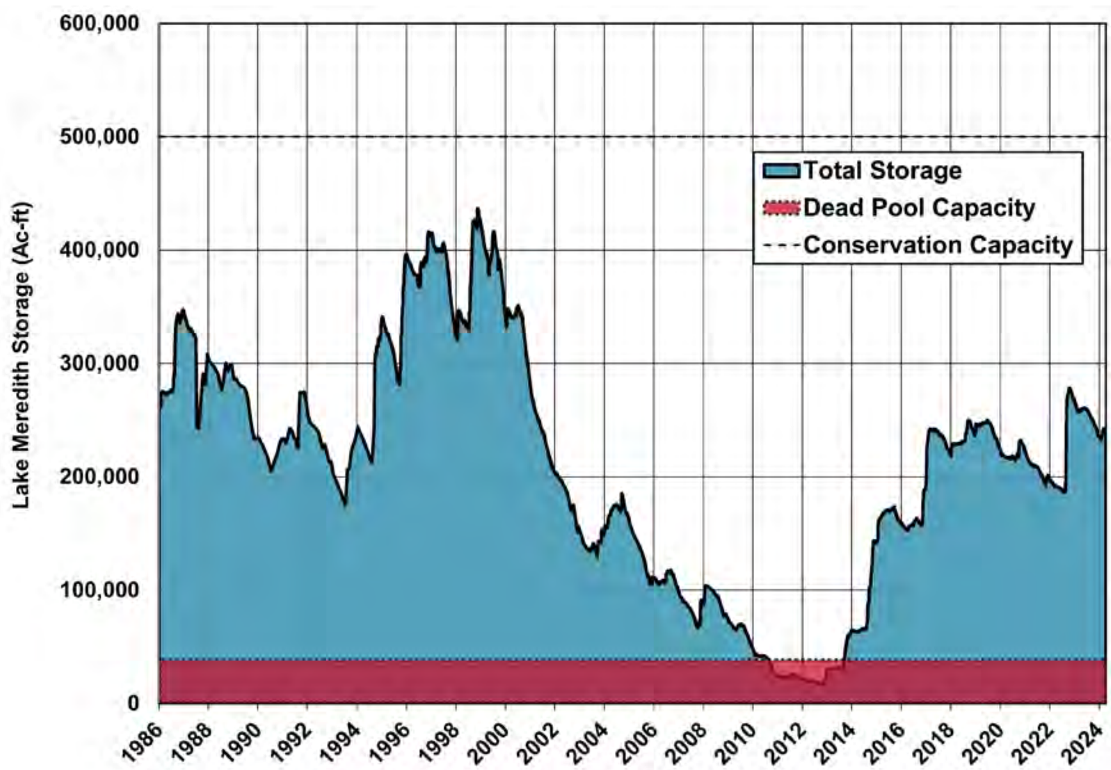

Figure 7-6. Lake Meredith Storage

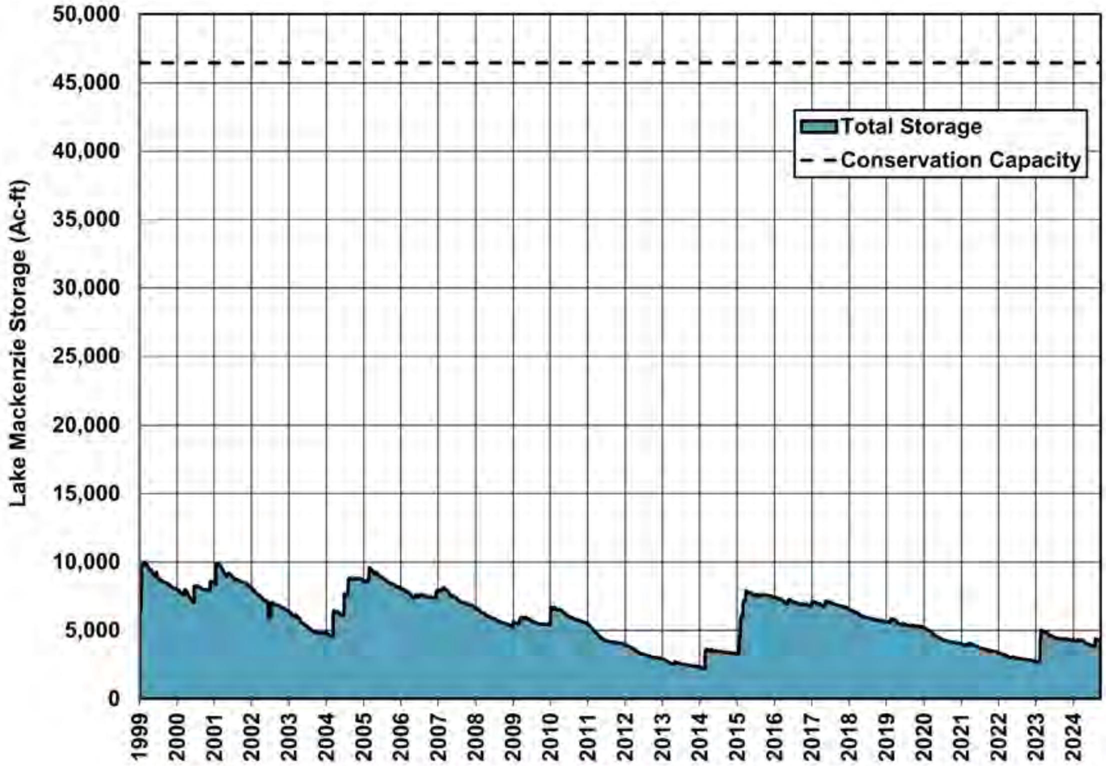

Figure 7-7. Lake Mackenzie Storage

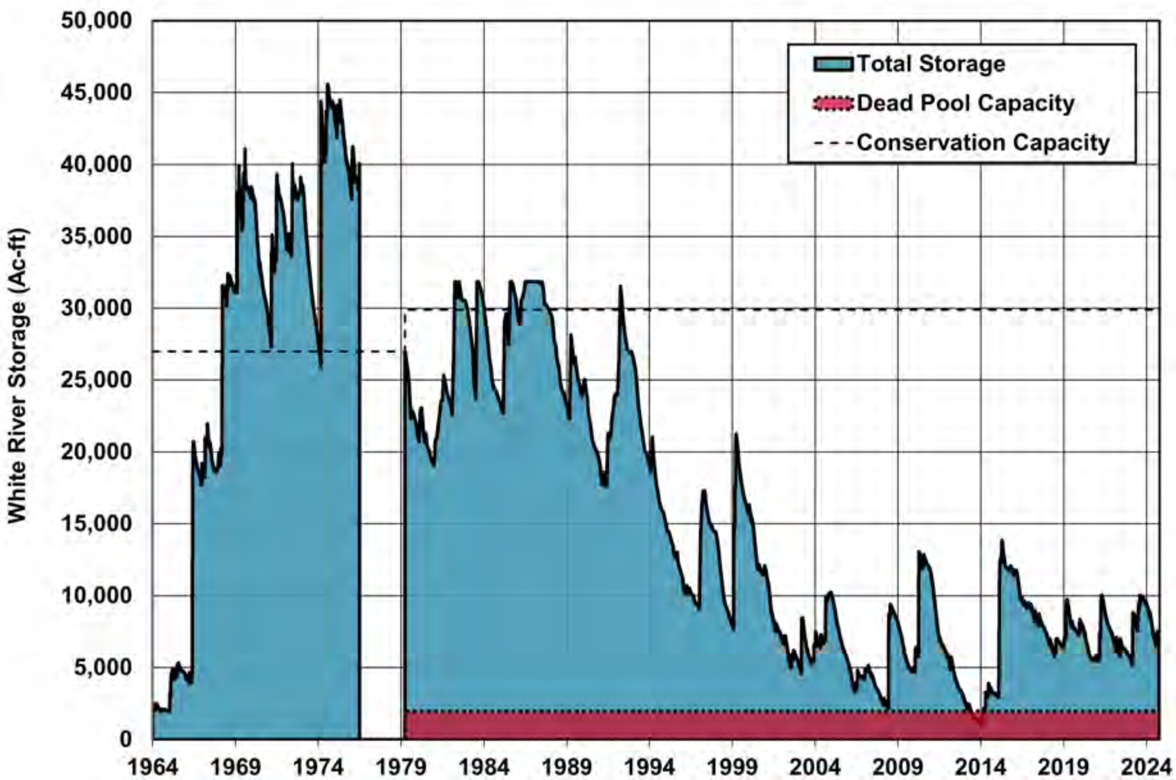

Figure 7-8. White River Lake Storage

7.1.3 Surface Water Modeling

Engineers and planners often use surface water models to demonstrate the effects of historical droughts on water supply. Surface water effects are more readily observed than groundwater effects. Reservoir supplies that were not in place during historic droughts can be assessed using historic hydrology and these modeling tools.

The primary tool used in regional planning in Texas to observe the performance of reservoirs under historic drought conditions is the Texas Commission on Environmental Quality (TCEQ) water availability model (WAM). The WAM is the same tool used to determine the available flow, firm yield, and safe yield of surface water projects in the 2025 LERWP. The Brazos River Basin WAM (Brazos WAM) includes hydrologic information from 1940 to 2018 and supports the use of the 1950s drought for most reservoirs in the Brazos River Basin.

RiverWare modeling software is a related tool developed by the Center for Advanced Decision Support for Water and Environmental Systems used to model the LAH Reservoir and uses hydrology through 2016. The model was used to estimate yield and summarize three periods when drought conditions existed. Table 7-2 shows the firm, 1-year, 18-month, and 2-year safe yields for the 1950s, 1990s and 2010s[238]. This analysis indicates a predicted decline to low yields during these periods.

Table 7-2. Summary of LAH Yields (acre-feet/year)

Yield Basis	1950's (Nov 1942 - Sep 1955)	1990's (Jul 1992 - May 2001)	2010's (Aug 2010 - May 2015)
Firm	22,725	22,210	20,800
1-Year Safe	19,650	18,770	16,125
18-Month Safe	18,325	17,320	14,400
2-Year Safe	17,200	16,100	13,000

7.1.4 Groundwater Aquifer Levels

Groundwater data is another way engineers and planners look at the effects of drought and the corresponding long-term, drought-induced water use on water supply. In the Llano Estacado Region, groundwater makes up a significant portion of the area's water supply. Therefore, it can be useful to analyze drought with respect to the groundwater system to provide a more complete picture of the connection between drought and the Llano Estacado Region's water supply.

In most observation wells, groundwater levels, or heads, fluctuate continuously based on a number of stresses, including precipitation, evaporation, surface water levels, and pumping. As such, a time series of groundwater heads can provide important information on how a particular aquifer will respond to pumping based on drought, or the severity of drought within an aquifer. Five wells with long-term records located within the Llano Estacado Region were selected as representative of the long-term decline in water levels (Figure 7-9).

[238] HDR, Inc., Update of Lake Alan Henry Yield and 5-Year Projections, City of Lubbock Water Supply Support, August 2015.

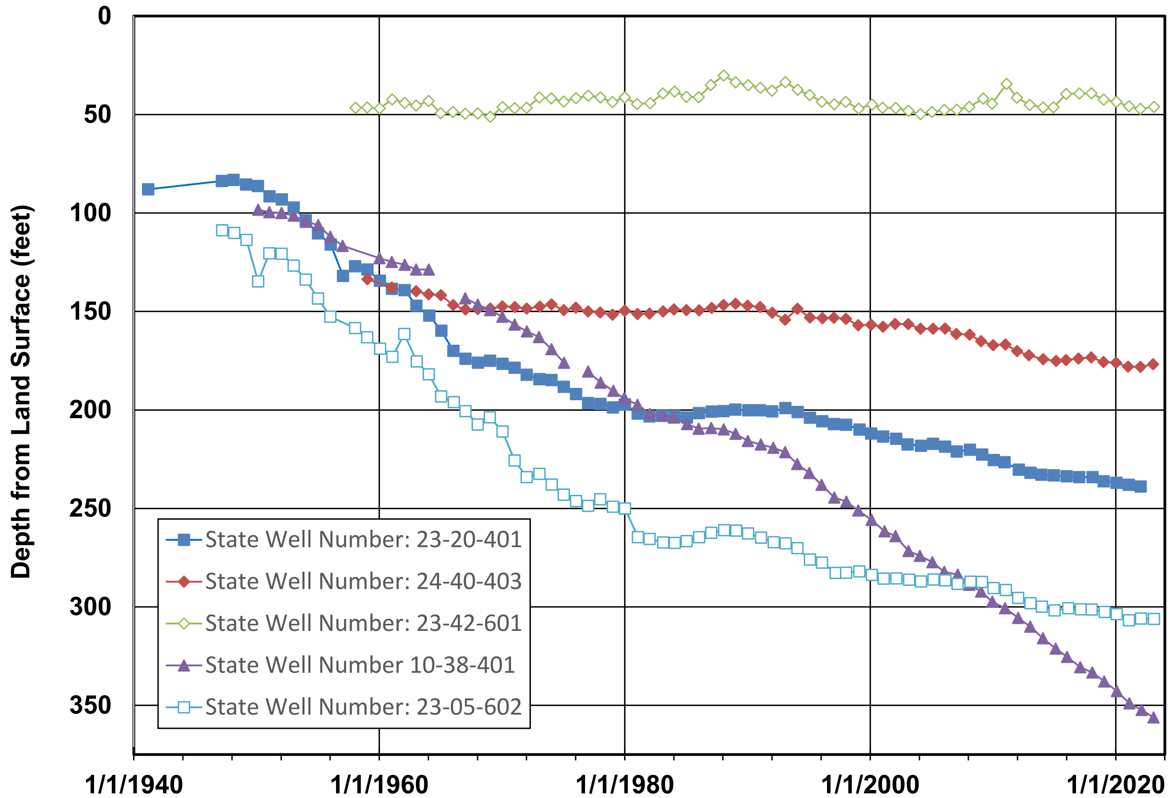

Figure 7-9. Representative Wells with Long-term Records Demonstrating Declining Water Levels

7.1.5 Climate

Most of the planning region is identified as a cold, steppe climate (BSk) under the Köppen climate classification system[239]. This climate is characterized by large variations in the magnitude of ranges in daily temperature extremes, low relative humidity, and irregularly spaced rainfall of moderate amounts. The predominant feature of this climate is dry with mild winters[240]; annual evaporation typically exceeds precipitation in these areas[241]. A summary of climatological conditions for the region is provided in Table 7-3.

[239] Kottek, M.J., Grieser, C., Beck, B., Rubel, F., 2006. World Map of the Köppen-Geiger climate classification updated. Meteorol. Z., 15, 259-263.

[240] Larson, T.J., Bomar, G.W. 1983. Climatic atlas of Texas. Texas Water Development Board, LP-192.

[241] Bailey, R.G. 1980. Description of the ecoregions of the United States. U.S. Department of Agriculture, Miscellaneous Publication 1391.

Table 7-3. Historical Climatological Data (1945 to 2024) for the Llano Estacado Region[242] [243]

County	Precipitation			Temperature					Annual Net Lake Surface Evaporation (inches)
	Mean Annual (inches)	Wettest Month	Driest Month	Mean Annual (°F)	Mean Daily Minimum		Mean Daily Maximum		
					Jan (°F)	July (°F)	Jan (°F)	July (°F)	
Bailey	17	Aug	Feb	57	21	63	53	92	46
Briscoe	20	June	Jan	59	24	66	52	92	45
Castro	19	June	Feb	57	21	63	51	91	46
Cochran	17	July	Feb	59	23	64	54	92	47
Crosby	21	May	Jan	60	25	67	53	93	46
Dawson	17	June	Jan	61	26	67	55	94	50
Deaf Smith	18	Aug	Jan	57	21	63	51	92	46
Dickens	21	May	Jan	62	27	69	55	95	47
Floyd	20	June	Jan	59	24	67	52	93	45
Gaines	16	Sept	Dec	61	27	66	56	94	55
Garza	20	May	Jan	63	28	70	55	95	46
Hale	18	June	Feb	59	24	66	52	91	45
Hockley	18	Sept	Feb	59	24	65	54	93	47
Lamb	17	June	Feb	58	22	64	53	92	46
Lubbock	18	May	Dec	61	26	68	54	93	46
Lynn	19	May	Jan	61	26	67	55	93	46
Motley	22	June	Jan	62	28	70	54	95	44
Parmer	18	August	Feb	57	22	63	51	91	46
Swisher	20	June	Jan	58	22	65	51	92	45
Terry	18	May	Dec	60	26	66	54	93	47
Yoakum	16	Sept	Jan	60	25	65	54	93	47

°F = degrees Fahrenheit

In an average year, 70 to 80 percent of the annual precipitation total occurs during the warm season (May through October). A summary of the mean monthly precipitation as a percentage of mean annual precipitation is presented in Table 7-4. Monthly rainfall quantities ordinarily decline markedly in the colder months of the year, when frequent periods of cold, dry air from North American Polar Regions surge southward and cut off the supply of moisture from the Gulf of America.

[242] PRISM Climate Group - Northwest Alliance for Computation Science and Engineering, 2019. Historical Past and Recent Years Datasets for Precipitation and Temperature. http://www.prism.oregonstate.edu/

[243] Texas Water Development Board, 2019. Water Data for Texas: Lake Evaporation and Precipitation. https://waterdatafortexas.org/lake-evaporation-rainfall

Table 7-4. Percentage of Mean Annual Precipitation Occurring by Month (1945 to 2024) [244]

County	Percentage of Mean Annual Precipitation											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bailey	3%	3%	4%	5%	13%	15%	14%	16%	13%	9%	4%	3%
Briscoe	3%	3%	5%	7%	15%	17%	10%	12%	11%	8%	4%	3%
Castro	3%	3%	4%	5%	13%	17%	13%	14%	12%	9%	4%	3%
Cochran	3%	3%	4%	5%	12%	13%	15%	15%	13%	9%	4%	3%
Crosby	3%	4%	5%	7%	14%	13%	11%	11%	13%	10%	5%	4%
Dawson	3%	4%	5%	6%	13%	14%	11%	10%	16%	10%	5%	4%
Deaf Smith	3%	3%	5%	5%	12%	15%	15%	16%	11%	9%	4%	3%
Dickens	3%	4%	5%	7%	15%	13%	11%	11%	12%	10%	5%	3%
Floyd	3%	3%	5%	7%	15%	16%	11%	11%	13%	9%	4%	3%
Hale	4%	4%	5%	5%	13%	12%	13%	11%	15%	10%	5%	4%
Hockley	3%	4%	4%	7%	14%	13%	11%	11%	13%	10%	5%	4%
Gaines	3%	3%	4%	6%	15%	16%	12%	12%	12%	9%	4%	3%
Garza	3%	3%	4%	5%	13%	14%	13%	13%	14%	9%	4%	4%
Lamb	3%	3%	4%	5%	13%	16%	13%	14%	12%	9%	4%	3%
Lubbock	3%	3%	5%	6%	15%	15%	12%	11%	13%	9%	4%	3%
Lynn	4%	4%	4%	6%	15%	14%	12%	10%	13%	10%	5%	4%
Motley	3%	4%	5%	8%	14%	15%	10%	11%	12%	9%	5%	4%
Parmer	3%	3%	4%	5%	12%	15%	14%	15%	11%	9%	4%	3%
Swisher	3%	3%	5%	6%	14%	17%	12%	13%	10%	9%	4%	3%
Terry	3%	3%	4%	5%	15%	15%	13%	11%	13%	10%	4%	3%
Yoakum	3%	3%	4%	5%	12%	13%	14%	14%	15%	10%	4%	4%

Mean annual precipitation in the region ranges from a low of approximately 16 inches in southwestern Gaines and Yoakum Counties to a high of approximately 22 inches in eastern Motley County. The magnitude of annual precipitation generally increases moving from the west to the east across the region. An illustration of mean annual precipitation is presented in Figure 7-10. Minimum and maximum annual precipitation totals across the region are provided in Figure 7-11 and Figure 7-12, respectively. Precipitation is the only reoccurring/renewable water supply for the Llano Estacado Region. Precipitation meets about 60 percent of urban landscape water and irrigated crop demands and contributes the water available for surface reservoirs, rangeland and dryland crop production, wildlife, and natural recharge to the region's aquifers.

Less than 1 percent of the precipitation escapes from the region in the form of runoff in streams or rivers. The remainder of runoff is collected in approximately 14,000 playa basins located within the Llano Estacado Region[245]. Playas comprise approximately 2 percent of the total land surface within the region. Most playa basins are ephemeral, holding water only during and for a short period after rains, unless augmented by irrigation tailwater. Agricultural activities converted most of the playas into production with some of the playas planted to crops, some left fallow, and some grazed. This conversion also modified approximately 70 percent of the playas to have pits for recovering rainfall runoff for irrigation or creating a water reserve for grazing livestock or wildlife when the bulk of the water collected in the basin from rainfall runoff has soaked into the soil or evaporated. Values for

[244] PRISM Climate Group - Northwest Alliance for Computation Science and Engineering, 2019. Historical Past and Recent Years Datasets for Precipitation and Temperature. http://www.prism.oregonstate.edu/

[245] Guthery, F.S., F.C. Bryant, B. Kramer, A. Stoecker, and M. Dvoracek, "Playa Assessment Study", U.S. Water and Power Resources Service, Southwest Region, Amarillo, Texas, 1981.

annual net lake surface evaporation range from a high of 54 inches per year for the southern portion of the region to a low of 45 inches per year in the north.

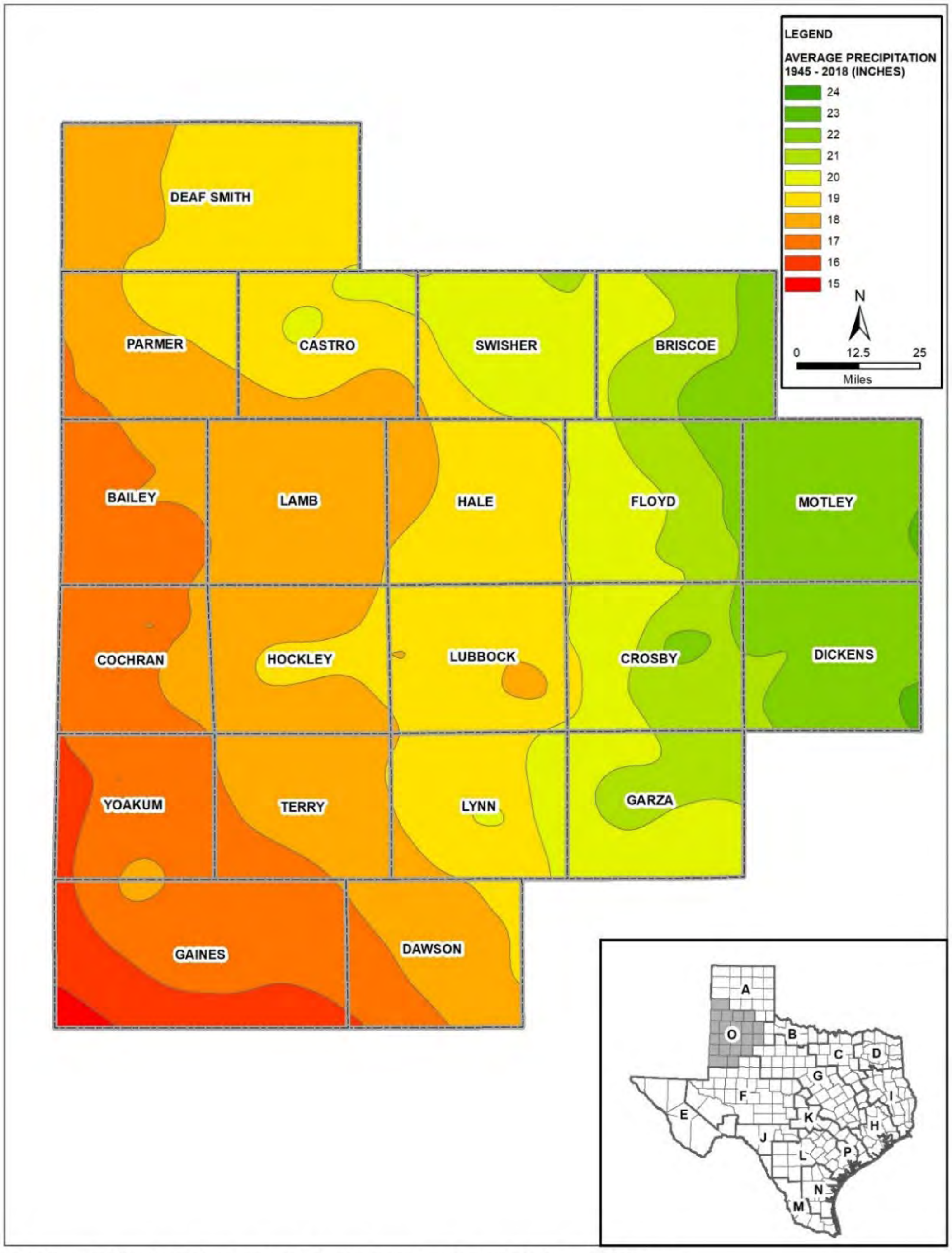

Figure 7-10. Average Annual Precipitation of the Llano Estacado Region 1945-2018[246]

[246] PRISM Climate Group - Northwest Alliance for Computation Science and Engineering, 2019. Historical Past and Recent Years Datasets for Precipitation and Temperature. http://www.prism.oregonstate.edu/

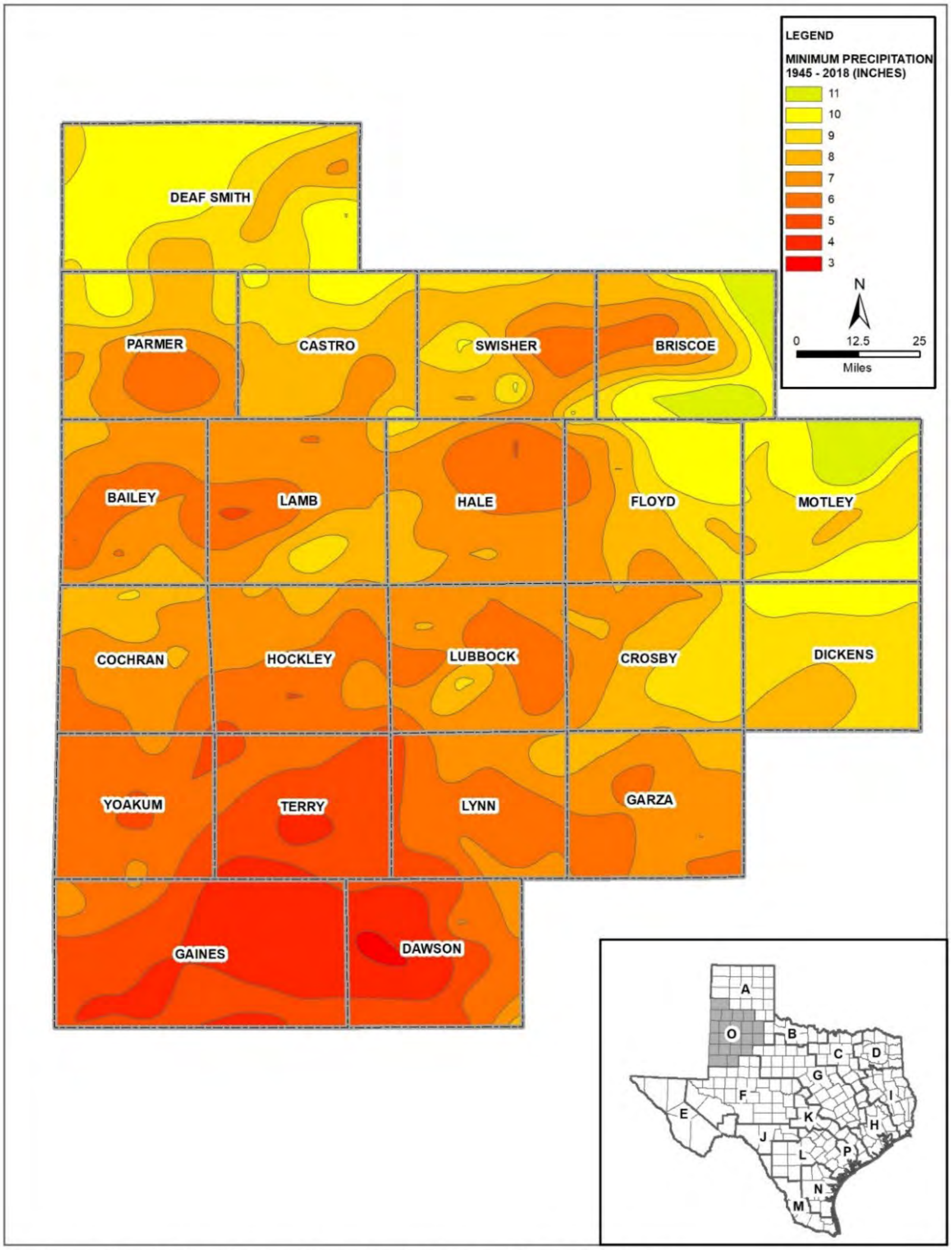

Figure 7-11. Minimum Annual Precipitation of the Llano Estacado Region: 1945-2018 [247]

[247] PRISM Climate Group - Northwest Alliance for Computation Science and Engineering, 2019. Historical Past and Recent Years Datasets for Precipitation and Temperature. http://www.prism.oregonstate.edu/

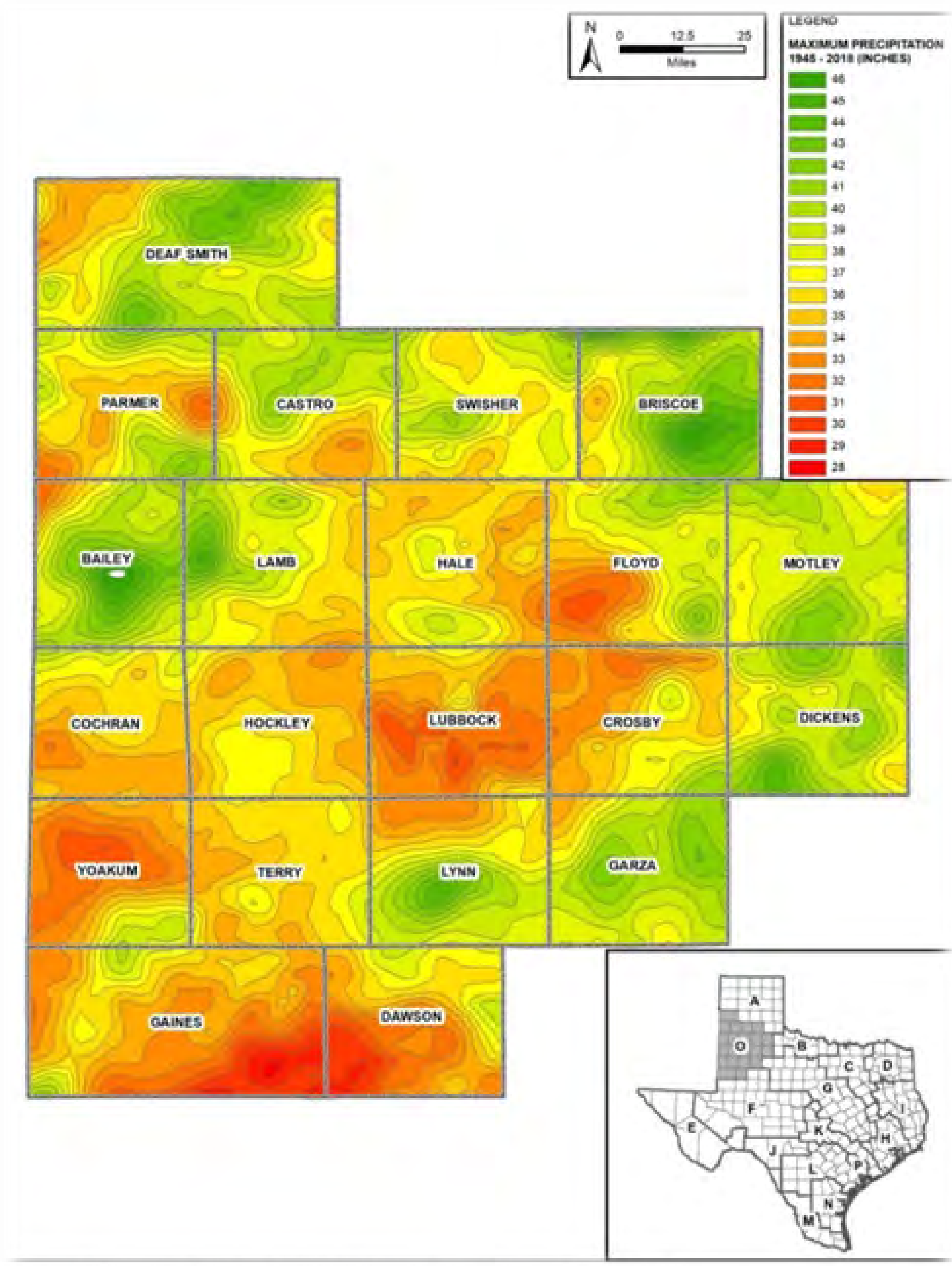

Figure 7-12. Maximum Annual Precipitation of the Llano Estacado Region: 1945-2018 [248]

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[248] PRISM Climate Group - Northwest Alliance for Computation Science and Engineering, 2019. Historical Past and Recent Years Datasets for Precipitation and Temperature. http://www.prism.oregonstate.edu/

7.2 Droughts of Record in the Llano Estacado Region

7.2.1 Drought of Record

In terms of severity and duration, the devastating drought of the 1950s is considered the DOR for most of Texas. By 1956, 244 of the 254 counties in the state were considered disaster areas. At that time, the 1950s drought included the second, third, and eighth driest years on record (1956, 1954, and 1951, respectively). This drought lasted almost a decade in many places and affected numerous states across the nation. The 1950s drought served as a catalyst for Texas' water supply planning effort and has been used by water resource engineers and managers as a benchmark drought for water supply planning.

7.2.2 Recent Droughts

The Llano Estacado Region has experienced two recent droughts centered around 1996 and 2011 that were significant enough to be used for planning.

Drought indicators do not show the 1990s drought to be an extreme drought, but it was a period of decreased moisture.

The 2010s drought (2010 through 2015) is the most recent drought. In 2011, severely decreased precipitation resulted in substantial declines in streamflow throughout Texas. Record high temperatures also occurred June through August leading to an increase in evaporation rates. The evaporation was so great that by August 4, 2011, state climatologist John Nielson-Gammon declared 2011 to be the worst 1-year drought on record in Texas[249]. The 2011 water year statewide annual precipitation was 11.27 inches, more than 2 inches less than the previous record low of 13.91 inches in 1956. In Lubbock, the total precipitation recorded was 5.86 inches[250].

More recently in 2018, the region faced another period of low rainfall and high temperatures. The ninth warmest year on record for the region was in 2018. Precipitation was intermittent and sparce through the spring and summer in many areas. During 2018, Lubbock recorded 15.27 inches of precipitation (much of it occurring in the fall), which was the 41st driest in the historical record, almost 4 inches below average. Therefore, many entities, including the cities of Lubbock and Wolfforth, enacted mandatory water use restrictions. Some entities, including Lubbock, now have mandatory water use restrictions in place during the summer months regardless of drought conditions. Each entity in the Llano Estacado Planning Region will implement mandatory water use restrictions, as needed, during times of drought to help curtail water use and to extend the supply of water available to them.

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[249] Winters, K.E., 2013, A historical perspective on precipitation, drought severity, and streamflow in Texas during 1951-56 and 2011: U.S. Geological Survey Scientific Investigations Report 2013-5113, p. 1 http://pubs.usgs.gov/sir/2013/5113

[250] https://www.weather.gov/lub/events-2011-20111231-summary

7.3 Current Drought Preparations and Response

7.3.1 Current Drought Preparations and Responses

Predicting the timing, severity, and length of a drought is an inexact science; however, it is safe to assume that it is an inevitable component of the Texas climate. For this reason, it is critical to plan for these occurrences with policy outlining adjustments to the use, allocation, and conservation of water in response to drought conditions. Drought and other circumstances that interrupt the reliable supply or water quality of a source often lead to water shortages. During a drought, there generally is a greater demand on the already decreased supply as individuals attempt to maintain landscape vegetation through irrigation because less rainfall is available. This can further exacerbate a water supply shortage situation.

TCEQ requires public wholesale water providers (WWPs), retail public water suppliers serving 3,300 connections or more, and irrigation districts to submit drought contingency plans (DCPs). In accordance with the requirements of Texas Administrative Code (TAC) §288(b), DCPs must be updated every 5 years and adopted by retail public water providers. The TCEQ defines a DCP as "A strategy or combination of strategies for temporary supply and demand management responses to temporary and potentially recurring water supply shortages and other water supply emergencies."[251] According to a TCEQ handbook[252], the underlying philosophy of drought contingency planning is that

- while often unpreventable, short-term water shortages and other water supply emergencies can be anticipated;
- the potential risks and impacts of drought or other emergency conditions can be considered and evaluated in advance of an actual event; and, most importantly,
- response measures and best management practices (BMPs) can be determined with implementation procedures defined, again in advance, to avoid, minimize, or mitigate the risks and impacts of drought-related shortages and other emergencies.

Model DCPs are available on TCEQ's website; however, it is not possible to create a single DCP that will adequately address local concerns for every entity throughout Texas. The conditions that define a water shortage can be very location specific and depend on the water supply source. For example, some communities rely on the level of LAH, yet others rely on various groundwater aquifer systems that are considered at risk under location-specific conditions. While the approach to planning may be different between entities, DCPs should include the following:

- Specific, quantified targets for water use reductions,
- Drought response stages,
- Triggers to begin and end each stage,
- Supply management measures,
- Demand management measures,

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[251] http://www.twdb.texas.gov/conservation/training/archives/more-than-a-drop-workshop/doc/5_%20TCEQ%20Rules.pdf

[252] TCEQ. 2005. Handbook for Drought Contingency Planning for Retail Public Water Suppliers, Austin, Texas. April 2005.

- Descriptions of drought indicators,
- Notification procedures,
- Enforcement procedures,
- Procedures for granting exceptions,
- Public input to the plan,
- Ongoing public education,
- Adoption of plan, and
- Coordination with regional water planning groups.

7.3.2 Overall Assessment of Local Drought Contingency Plans

For water suppliers such as those in the Llano Estacado Region, the primary goal of DCP development is to have a plan that can provide an uninterrupted supply of water in an amount that can satisfy essential human needs. A secondary but also important goal is to minimize negative impacts on quality of life, the economy, and the local environment. In order to meet these goals, action needs to be taken in an expedient, pre-determined procedure, requiring that an approved DCP be in place before drought conditions occur.

In accordance with TAC, most Llano Estacado Region entities have developed DCPs or water conservation plans (WCPs) to be implemented when local shortages occur. The Llano Estacado Region was able to obtain DCPs for multiple water user groups (WUGs) and WWPs. These plans identify multiple triggers for initiation and termination of drought stages, responses to be implemented, and reduction targets based on each stage. The plans also include information regarding public notification procedures and enforcement measures. Some WUGs or WWPs have included a method of granting a variance should the need arise.

7.3.3 Summary of Existing Triggers and Responses

Through timely implementation of drought response measures, it is possible to meet the goals of the DCP by avoiding, minimizing, or mitigating risks and impacts of water shortages and drought. In order to accomplish this, DCPs are built around a collection of drought responses and triggers based on various drought stages. Stages are generally similar for DCPs but can vary from entity to entity. Stage one will normally represent mild water shortage conditions, and the severity of the situation will increase through the stages until emergency water conditions are reached and, in some cases, a water allocation stage is determined.

The Llano Estacado Regional Water Planning Group (LERWPG) compiled stage, trigger, and response information for 17 DCPs/WCPs in the region, including those from WWPs, WUGs, and county-other suppliers. Compliance in most of the DCPs in the region is voluntary under Stage I and mandatory under Stage II and Stage III. Most entities included a Stage IV and a few plans specify a Stage V and/or Stage VI scenario. Target reductions, triggers, and responses are included for most stages. As summary of these in the DCPs/WCPs can be found for Llano Estacado Region entities in Table 7-5.

In accordance with House Bill 807 (HB 807), passed by the 86th Texas Legislature in 2019, and codified in Texas Water Code (TWC) §16.053(e)(3)(E), “RWPGs [regional water planning groups] should identify unnecessary or counterproductive variations in specific drought response strategies, including outdoor watering restrictions, among user groups in the regional water planning area

(RWPA) that may confuse the public or otherwise impede drought response efforts," are to be identified in the Llano Estacado Region. In the Llano Estacado Region, the prevailing attitude is for conservation because of the constant threat of drought and the relatively low amount of precipitation received in the region. As the largest city in the region, the City of Lubbock sets an example throughout the planning area with its progressive conservation and drought planning.[253] In addition, water users in the region base their drought triggers uniformly on available supply. For example, drought triggers are not set on varying reservoir levels because of the lack of surface water in the region. Through the process of assessing the region's DCPs and existing drought triggers and responses, no unnecessary or counterproductive variations in specific drought response strategies were identified.

Table 7-5. Common Drought Response Measures

Entity Name	DCP/ WCP Date	Stage Number	Triggers									Responses								
			Contamination	Demand/Capacity Based	Failure	Groundwater Level	Production Rate	Reservoir Level	Supply Based	Wholesale Provider	Other	Assessment and Identification	Irrigation Schedule	Mandatory Reduction	Notification of Entities	Prohibited Use	Restrictions	Curtailment	Water Allocation	Other
City of Anton	4/1/2015	1	-	X	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	X
		2	-	X	-	-	-	-	X	-	-	-	X	-	-	X	X	-	-	-
		3	-	X	-	-	-	-	X	-	-	-	X	-	-	X	X	-	-	-
		4	-	X	-	-	-	-	X	-	-	-	X	-	-	X	X	-	-	-
		5	X	-	X	-	-	-	X	-	-	-	X	-	-	X	-	-	-	X
City of Brownfield	4/18/2019	1	-	-	-	-	-	-	X	-	X	-	X	-	-	-	-	-	-	X
		2	X	-	X	-	-	-	X	-	-	-	X	-	-	X	X	-	-	-
		3	X	X	-	-	-	-	X	-	-	-	X	-	-	X	X	-	-	-
City of Lamesa	3/19/2024	1	-	-	-	-	-	-	X	-	X	-	X	-	-	-	-	-	-	X
		2	-	-	-	-	-	-	X	-	X	-	X	-	-	X	X	-	-	-
		3	X	X	-	-	-	-	X	-	X	-	X	-	-	X	X	-	-	-
		4	-	-	-	-	-	-	X	-	X	-	X	-	-	X	X	-	-	-
		5	X	-	X	-	-	-	X	-	-	-	X	-	-	X	-	-	-	X
City of Levelland	8/5/2024	1	-	X	-	-	-	-	-	-	X	-	X	-	-	-	X	-	-	-
		2	-	X	-	-	-	-	-	-	X	-	X	-	-	X	X	-	-	-
		3	-	X	-	-	-	-	-	-	X	-	X	-	-	X	X	-	-	-
		4	-	X	-	-	-	-	-	-	X	-	X	-	-	X	X	-	-	-
		5	X	-	X	-	-	-	-	-	-	-		-	-	X	X	-	-	-
City of Littlefield	8/1/2014	1	-	X	-	-	-	-	X	-	X	-	X	-	-	-	-	-	-	X
		2	-	-	-	-	-	-	X	-	X	-	X	-	-	X	X	-	-	-
		3	-	X	X	-	-	-	X	-	X	-	X	-	-	X	X	-	-	-
		4	X	-	X	-	-	-	X	-	-	-	X	-	-	X	X	-	-	-
		5	-	X	X	-	-	-	X	-	X	-	X	-	-	X	-	-	-	X

[253] https://www.lubbockonline.com/news/20200131/lubbocks-stingy-water-usage-buying-time-on-infrastructure-projects

Entity Name	DCP/ WCP Date	Stage Number	Triggers									Responses									
			Contamination	Demand/Capacity Based	Failure	Groundwater Level	Production Rate	Reservoir Level	Supply Based	Wholesale Provider	Other	Assessment and Identification	Irrigation Schedule	Mandatory Reduction	Notification of Entities	Prohibited Use	Restrictions	Curtailment	Water Allocation	Other
City of Lubbock	4/23/2019	1	-	X	-	-	-	-	X	-	-	-	X	X	-	-	X	-	-	X
		2	-	X	-	-	-	-	X	-	-	-	X	X	-	-	X	-	-	X
		3	-	X	-	-	-	-	X	-	-	-	X	X	-	-	X	-	-	X
		4	X	X	X	-	-	X	X	-	-	-	X	X	-	X	X	-	-	X
City of New Deal	5/3/2017	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X
City of Olton	--	1	-	-	-	-	-	-	-	-	X	-	X	-	-	-	X	-	-	-
		2	-	-	-	-	X	-	-	-	-	-	X	-	-	X	X	-	-	-
		3	-	X	-	-	X	-	-	-	-	-	X	-	-	X	X	-	-	-
		4	-	X	-	-	X	-	-	-	-	-	X	-	-	X	X	-	-	-
		5	X	-	X	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-
		6	X	-	X	-	-	-	-	-	X	-	-	-	-	X	-	-	X	-
City of Plainview	4/23/2024	1	-	X	-	-	X	-	-	-	X	-	-	-	-	-	-	X	-	-
		2	-	X	X	-	X	-	-	-	X	-	X	-	-	-	X	-	-	-
		3	-	X	X	-	X	-	-	-	X	-	-	-	-	-	X	-	-	-
		4	X	-	-	-	-	-	-	-	X	-	X	-	-	X	-	-	-	X
City of Post	8/11/2009	1	-	X	-	-	X	-	-	-	X	-	X	-	-	-	-	-	-	X
		2	-	X	-	-	X	-	-	-	X	-	X	X	-	-	X	-	-	-
		3	-	X	-	-	X	-	-	-	X	-	-	-	-	X	X	-	-	-
		4	X	X	X	-	X	-	-	-	X	X	-	-	X	-	-	-	-	X
City of Ropesville	2/13/2019	1	-	-	-	-	X	-	X	-	-	-	X	-	-	-	-	-	-	X
		2	-	X	-	-	-	-	X	-	-	-	X	-	-	X	X	-	-	X
		3	-	X	-	-	-	-	-	-	-	-	X	-	-	-	X	-	-	-
		4	-	X	-	-	-	-	-	-	-	-	X	-	-	X	X	-	-	-
		5	X	-	X	-	-	-	X	-	-	-	X	-	-	X	X	-	-	-
		6	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-
City of Seagraves	4/1/2015	1	-	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	-	X
		2	-	X	-	-	X	-	X	-	-	-	X	-	-	X	X	-	-	-
		3	-	-	X	X	X	-	-	-	-	-	X	-	-	-	X	-	-	-
		4	-	-	-	-	-	X	-	-	-	-	X	-	-	X	X	-	-	-
		5	X	-	X	-	-	-	X	-	-	-	X	-	-	X	X	-	-	-
City of Seminole	5/16/2022	1	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
		2	-	X	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-
		3	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
		4	X	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
City of Shallowater	9/1/2018	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X

Entity Name	DCP/ WCP Date	Stage Number	Triggers									Responses								
			Contamination	Demand/Capacity Based	Failure	Groundwater Level	Production Rate	Reservoir Level	Supply Based	Wholesale Provider	Other	Assessment and Identification	Irrigation Schedule	Mandatory Reduction	Notification of Entities	Prohibited Use	Restrictions	Curtailment	Water Allocation	Other
City of Silverton	4/1/2014	1	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X
		2	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-
		3	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	-
		4	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X
City of Tahoka	9/8/2014	1	-	X	-	X	-	X	X	-	-	-	X	X	-	-	X	-	-	X
		2	-	X	X	X	-	-	X	-	-	-	X	X	-	-	X	-	-	X
		3	-	X	X	X	-	-	X	-	-	-	X	X	-	-	X	-	-	X
		4	X	X	X	-	-	X	X	-	-	-	X	X	-	X	-	-	-	X
Mackenzie Municipal Water Authority	3/19/2019	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X
Red River Authority of Texas	7/1/2019	1	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
		2	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
		3	-	X	-	-	X	-	-	-	-	-	-	-	X	-	-	X	-	-
		4	-	X	-	-	X	-	-	-	-	-	-	-	X	-	-	X	-	-
Valley Water Supply Corporation	10/4/2019	1	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X
		2	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-
		3	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-
White River Municipal Water District	8/19/2024	1	-	X	-	-	X	-	X	-	-	-	-	-	-	-	X	-	-	-
		2	-	X	-	-	X	-	X	-	-	-	X	-	X	X	X	-	-	-
		3	-	X	-	-	X	-	X	-	-	-	-	X	-	X	-	-	-	-
		4	X	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-

DCP = drought contingency plan; WCP = water conservation plan

7.4 Existing and Potential Emergency Interconnects

A regional planning goal is to provide a connected supply that meets or exceeds DOR demands for the next 50 years. However, it is also important to plan for emergency supplies in the event of a prolonged drought or an interruption/impairment of supply from an existing source. An interconnection between two collaborating municipal WUGs can serve as an alternative means of providing emergency drinking water in lieu of trucking in supply or other expensive options.

In compliance with TAC, Chapter 357 Regional Water Planning Guidelines, available information on existing major water infrastructure facilities that may be used for interconnections in event of an emergency shortage of water was collected. For the Llano Estacado Region, municipal WUGs and WWPs were sent a survey in July 2024 regarding their water supply and use (Appendix G). The survey was used as the method to collect emergency interconnections information.

As part of the survey, water providers were asked to confirm or update information regarding the existence of emergency interconnections integrated with their system, and the providers of the potential emergency supply. Of the 74 WUGs in Llano Estacado Region, 5 responded to the survey.

In accordance with TWC §16.053(r), the information gathered, such as specific connections, is considered confidential and was submitted to the executive administrator but not included in the regional plan. Some circumstances that would require the use of an emergency interconnect system to be operated could affect an entire body of water or aquifer, such as drought or contamination. It is important to know the source of the emergency interconnect provider's supply for this reason. The source to each provider was determined using the TCEQ Water Watch database and surface water (SW) or groundwater (GW) designation. Information on existing and potential interconnect supply capacity or location was not available from either source.

The DCPs do not include making emergency interconnections as planned responses to the drought trigger stages. Emergency interconnections would be an extraordinary response to extreme drought conditions.

A summary table of the existing and potential emergency interconnects in the Llano Estacado Region and the emergency provider's source of supply is presented in Table 7-6.

Table 7-6. Emergency Interconnects

Entity Receiving Supply	Entity Providing Supply	Providers Sources			
		Source #1	Source #2	Source #3	Source #4
Existing Emergency Connections					
Dickens	Spur (resale of White River Municipal Water District (MWD) water)	White River Reservoir	Ogallala Aquifer	-	-
Littlefield	Lubbock	Mix of Lubbock sources	Lake Alan Henry	Ogallala Aquifer	Purchased from CRMWA in Region A
Mackenzie MWD (supply for Silverton)	Tulia	Dockum Aquifer	Ogallala Aquifer	-	-
Seth Ward Water Supply Corporation (WSC)	Plainview	Ogallala Aquifer	-	-	-
Potential Emergency Connections					
Abernathy	CRMWA	Purchased from CRMWA in Region A	-	-	-
Abernathy	Shallowater	Ogallala Aquifer	Mix of Lubbock sources	Purchased from CRMWA in Region A	-
Amherst	Lubbock	Ogallala Aquifer	-	-	-
Amherst	Sudan	Ogallala Aquifer	-	-	-
Anton	Lubbock	Ogallala Aquifer	-	-	-
Dimmit	Hereford	Ogallala Aquifer	-	-	-
Dimmit	Friona	Ogallala Aquifer	-	-	-
Dimmit	Bovina	Ogallala Aquifer	-	-	-
Dimmit	Farwell	Ogallala Aquifer	-	-	-
Dougherty WSC	Floydada	Ogallala Aquifer	Mackenzie Reservoir	-	-
Earth / Springlake / Olton (Connection between systems)		Ogallala Aquifer	-	-	-
Farwell	Clovis, NM	Ogallala Aquifer	Kings River	-	-
Flomot	Dougherty WSC	Ogallala Aquifer	-	-	-
Grassland	Post	White River Reservoir	Ogallala Aquifer	Purchased from CRMWA in Region A	-
Hale Center	CRMWA	Purchased from CRMWA in Region A	-	-	-

Entity Receiving Supply	Entity Providing Supply	Providers Sources			
		Source #1	Source #2	Source #3	Source #4
Hale Center	Plainview	Purchased from CRMWA in Region A	-	-	-
Happy	Tulia	Dockum Aquifer	-	-	-
Hereford	Canyon	Ogallala Aquifer	-	-	-
Idalou	Lubbock	Mix of Lubbock sources	-	-	-
Justiceburg	South Garza Water Supply	Lake Alan Henry	-	-	-
Justiceburg	Lake Alan Henry Water District	Lake Alan Henry	-	-	-
Kress	CRMWA	Purchased from CRMWA in Region A	-	-	-
Kress	Tulia	Mackenzie Reservoir	Dockum Aquifer	Ogallala Aquifer	
Lorenzo	Idalou	Ogallala Aquifer	-	-	-
Morton / Whiteface (Connection between systems)		Ogallala Aquifer		-	-
Muleshoe	Lubbock	Ogallala Aquifer	-	-	-
Nazareth	Hart	Ogallala Aquifer	-	-	-
Petersburg	Lubbock, Plainview, Floydada	Ogallala Aquifer r	-	-	-
Plains / Denver City / Seagraves / Seminole (Connection between systems)		Ogallala Aquifer		-	-
Post/White River MWD	Lubbock	Lake Alan Henry	-	-	-
Post/White River MWD	Southland ISD	Ogallala Aquifer	-	-	-
Quitaque	Silverton, Turkey, or Floydada	Ogallala Aquifer	-	-	-
Roaring Springs	Matador	Other Aquifer	-	-	-
Ropesville	Meadow	Purchased from CRMWA in Region A	-	-	-
Ropesville	Wolfforth	Ogallala Aquifer	-	-	-
Shallowater	Lubbock	Mix of Lubbock sources	-	-	-
Slaton	Southland ISD	Ogallala Aquifer	-	-	-
Sudan	Lubbock	Ogallala Aquifer	-	-	-
Sundown	Whiteface	Ogallala Aquifer	-	-	-
Tulia/Mackenzie MWA	CRMWA	Purchased from CRMWA in Region A	-	-	-
Wellman	Brownfield	Ogallala Aquifer	Purchased from CRMWA in Region A	-	-

Entity Receiving Supply	Entity Providing Supply	Providers Sources			
		Source #1	Source #2	Source #3	Source #4
Whiteface	Levelland	Purchased from CRMWA in Region A	-	-	-
Wilson	Slaton	Purchased from CRMWA in Region A	-	-	-
Wilson	Tahoka	Purchased from CRMWA in Region A	-	-	-
Wolfforth	Lubbock	Mix of Lubbock sources	-	-	-

7.5 Emergency Response to Local Drought Conditions or Loss of Municipal Supply

The regional and state water plans aim to prepare entities for severe drought scenarios based on the DOR. However, entities may find themselves in a local drought or facing a loss of municipal supply. While rare, it is important to have a backup plan in case of infrastructure failure or water supply contamination. This is especially important for smaller entities that rely on a sole source of supply. While many entities and WWPs have DCPs, it is less common for small municipalities to have these emergency plans.

A WUG relying on groundwater is considered sole source if its entire supply comes from the same aquifer regardless of varying groundwater districts or combination of contractual and local development supplies. A WUG relying on surface water is considered sole source if their yield comes from one river intake or one reservoir, regardless of the number of contracts in place. A WUG with a supply contract was not considered sole-source due to system operations. WUGs with both groundwater and surface water supplies were not included, with the exception of county-other entities.

A broad range of emergency situations could result in a loss of reliable municipal supply, and it is not possible to plan one solution to meet any possible emergency. Accordingly, a range of possible responses were selected for each entity based on source type and location. A WUG using groundwater was analyzed for potential additional fresh water and brackish water wells, based on the existence of appropriate aquifers in the area. Modeled available groundwater (MAG) availability was not considered because the wells are assumed temporary over the course of an emergency.

Table 7-7 presents temporary emergency responses that may or may not require permanent infrastructure. For municipal WUGs, a nearby entity that could provide supply in the case of an isolated incident was identified. Existing interconnects for municipal WUGs including the 21 county-other WUGs are included in the analysis. The addition of a local groundwater well and trucking in water are considered as an emergency supply option for all municipal WUGs under severe circumstances. Entities providing municipal supplies to WUGs were assumed to have 180 days or less of municipal supply.

Table 7-7. Emergency Response to Local Drought Conditions or Loss of Municipal Supply for WUGs in the Llano Estacado Region

Entity				Potential Emergency Water Supply Sources							Implementation Requirements			
Water User Group	County	2030 Population	2030 Demand (Ac-ft/yr)	Release From Upstream Reservoir	Curtailment of Upstream/ Downstream Water Rights	Local Groundwater Well	Brackish Groundwater Desalination	Trucked-in Water	Supply from Nearby Entity	Existing Emergency Interconnect	Potential Entity Providing Supply	Other Local Entities Required to Participate/Coordinate	Emergency Agreements/ Arrangements Already in Place	Type of Infrastructure Required
ABERNATHY	HALE	3,134	728	-	-	X	-	X	X	-	CRMWA, SHALLOWATER	-	-	Well, Pipeline, Transportation
AMHERST	LAMB	653	81	-	-	X	-	X	X	-	LUBBOCK, SUDAN	-	-	Well, Pipeline, Transportation
ANTON	HOCKLEY	820	103	-	-	X	-	X	X	-	LUBBOCK	-	-	Well, Pipeline, Transportation
BOVINA	PARMER	1,466	25	-	-	X	-	X	X	-	FRIONA	-	-	Well, Pipeline, Transportation
BROWNFIELD	TERRY	8,861	1,383	-	-	X	-	X	X	-	SEAGRAVES	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, BAILEY	BAILEY	1,900	227	-	-	X	-	X	X	-	MULESHOE	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, BRISCOE	BRISCOE	450	141	-	-	X	-	X	X	-	SILVERTON	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, CASTRO	CASTRO	2,456	348	-	-	X	-	X	X	-	DIMMITT	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, COCHRAN	COCHRAN	630	233	-	-	X	-	X	X	-	MORTON	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, CROSBY	CROSBY	928	106	-	-	X	-	X	X	-	RALLS	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, DAWSON	DAWSON	4,527	542	-	-	X	-	X	X	-	LAMESA	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, DEAF SMITH	DEAF SMITH	4,203	478	-	-	X	-	X	X	-	HEREFORD	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, DICKENS	DICKENS	842	110	-	-	X	-	X	X	X	SPUR (RESALE OF WHITE RIVER MWD WATER)	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, FLOYD	FLOYD	1,222	141	-	-	X	-	X	X	-	FLOYDADA	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, GAINES	GAINES	16,148	1,833	-	-	X	-	X	X	-	SEMINOLE	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, GARZA	GARZA	1,117	136	-	-	X	-	X	X	-	POST	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, HALE	HALE	3,973	496	-	-	X	-	X	X	-	PLAINVIEW	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, HOCKLEY	HOCKLEY	7,339	866	-	-	X	-	X	X	-	LEVELLAND	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, LAMB	LAMB	3,006	422	-	-	X	-	X	X	-	LITTLEFIELD	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, LUBBOCK	LUBBOCK	31,664	3,988	-	-	X	-	X	X	-	LUBBOCK	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, LYNN	LYNN	2,661	297	-	-	X	-	X	X	-	TAHOKA	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, MOTLEY	MOTLEY	506	88	-	-	X	-	X	X	-	MATADOR	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, PARMER	PARMER	2,536	484	-	-	X	-	X	X	-	FRIONA	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, SWISHER	SWISHER	2,420	307	-	-	X	-	X	X	-	TULIA	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, TERRY	TERRY	3,047	363	-	-	X	-	X	X	-	BROWNFIELD	-	-	Well, Pipeline, Transportation
COUNTY-OTHER, YOAKUM	YOAKUM	1,531	180	-	-	X	-	X	X	-	PLAINS	-	-	Well, Pipeline, Transportation
CROSBYTON	CROSBY	1,427	218	-	-	X	-	X	X	-	RALLS	-	-	Well, Pipeline, Transportation
DENVER CITY	YOAKUM	5,034	1,390	-	-	X	-	X	X	-	PLAINS, SEAGRAVES, SEMINOLE	-	-	Well, Pipeline, Transportation
DIMMITT	CASTRO	3,737	831	-	-	X	-	X	X	-	HEREFORD, FRIONA, BOVINA, FARWELL	-	-	Well, Pipeline, Transportation
EARTH	LAMB	842	143	-	-	X	-	X	X	-	SPRINGLAKE, OLTON	-	-	Well, Pipeline, Transportation
FARWELL	PARMER	1,546	397	-	-	X	-	X	X	-	CLOVIS, NM	-	-	Well, Pipeline, Transportation
FLOYDADA	FLOYD	2,419	418	-	-	X	-	X	X	-	LUBBOCK	-	-	Well, Pipeline, Transportation
FRIONA	PARMER	4,261	752	-	-	X	-	X	X	-	BOVINA	-	-	Well, Pipeline, Transportation
HALE CENTER	HALE	1,876	226	-	-	X	-	X	X	-	CRMWA, PLAINVIEW	-	-	Well, Pipeline, Transportation
HAPPY	SWISHER	488	72	-	-	X	-	X	X	-	TULIA	-	-	Well, Pipeline, Transportation
HART MUNICIPAL WATER SYSTEM	CASTRO	746	106	-	-	X	-	X	X	-	DIMMITT	-	-	Well, Pipeline, Transportation

Entity				Potential Emergency Water Supply Sources							Implementation Requirements			
Water User Group	County	2030 Population	2030 Demand (Ac-ft/yr)	Release From Upstream Reservoir	Curtailment of Upstream/ Downstream Water Rights	Local Groundwater Well	Brackish Groundwater Desalination	Trucked-in Water	Supply from Nearby Entity	Existing Emergency Interconnect	Potential Entity Providing Supply	Other Local Entities Required to Participate/Coordinate	Emergency Agreements/ Arrangements Already in Place	Type of Infrastructure Required
HEREFORD	DEAF SMITH	15,164	3,352	-	-	X	-	X	X	-	CANYON	-	-	Well, Pipeline, Transportation
IDALOU	LUBBOCK	2,130	373	-	-	X	-	X	X	-	LUBBOCK	-	-	Well, Pipeline, Transportation
LAMESA	DAWSON	7,721	1,739	-	-	X	-	X	X	-	O'DONNELL	-	-	Well, Pipeline, Transportation
LEVELLAND	HOCKLEY	12,404	1,990	-	-	X	-	X	X	-	WHITEFACE	-	-	Well, Pipeline, Transportation
LITTLEFIELD	LAMB	5,558	805	-	-	X	-	X	X	X	LUBBOCK	-	X	Well, Pipeline, Transportation
LOCKNEY	FLOYD	1,402	186	-	-	X	-	X	X	-	FLOYDADA	-	-	Well, Pipeline, Transportation
LORENZO	CROSBY	886	159	-	-	X	-	X	X	-	IDALOU	-	-	Well, Pipeline, Transportation
LUBBOCK	LUBBOCK	300,165	52,502	-	-	X	-	X		-		-	-	Well, Transportation
MATADOR	MOTLEY	471	162	-	-	X	-	X	X	-	DICKENS	-	-	Well, Pipeline, Transportation
MORTON PWS	COCHRAN	1,470	317	-	-	X	-	X	X	-	LUBBOCK	-	-	Pipeline, Transportation
MULESHOE	BAILEY	5,096	1,013	-	-	X	-	X	X	-	LUBBOCK	-	-	Well, Pipeline, Transportation
NAZARETH	CASTRO	259	98	-	-	X	-	X	X	-	HART	-	-	Well, Pipeline, Transportation
NEW DEAL	LUBBOCK	602	76	-	-	X	-	X	X	-	LUBBOCK, PLAINVIEW, FLOYDADA	-	-	Well, Pipeline, Transportation
ODONNELL	DAWSON	665	89	-	-	X	-	X	X	-	LAMESA	-	-	Well, Pipeline, Transportation
OLTON	LAMB	1,904	387	-	-	X	-	X	X	-	PLAINVIEW	-	-	Well, Pipeline, Transportation
PETERSBURG MUNICIPAL WATER SYSTEM	HALE	926	234	-	-	X	-	X	X	-	LUBBOCK	-	-	Well, Pipeline, Transportation
PLAINS	YOAKUM	1,341	340	-	-	X	-	X	X	-	DENVER CITY, SEAGRAVES, SEMINOLE	-	-	Well, Pipeline, Transportation
PLAINVIEW	HALE	22,403	4,075	-	-	X	-	X	X	-	LUBBOCK	-	-	Well, Pipeline, Transportation
POST	GARZA	4,543	576	-	-	X	-	X	X	-	LUBBOCK	-	-	Well, Pipeline, Transportation
QUITAQUE	BRISCOE	302	75	-	-	X	-	X	X	-	SILVERTON, TURKEY, FLOYDADA	-	-	Well, Pipeline, Transportation
RALLS	CROSBY	1,521	222	-	-	X	-	X	X	-	CROSBYTOWN	-	-	Well, Pipeline, Transportation
RANSOM CANYON	LUBBOCK	1,048	296	-	-	X	-	X	X	-	LUBBOCK	-	-	Well, Pipeline, Transportation
RED RIVER AUTHORITY OF TEXAS	DICKENS	13	3	-	-	X	-	X	X	-	SPUR	-	-	Well, Pipeline, Transportation
SEAGRAVES	GAINES	1,849	297	-	-	X	-	X	X	-	PLAINS, DENVER CITY, SEMINOLE	-	-	Well, Pipeline, Transportation
SEMINOLE	GAINES	7,157	2,336	-	-	X	-	X	X	-	PLAINS, DENVER CITY, SEAGRAVES	-	-	Well, Pipeline, Transportation
SHALLOWATER	LUBBOCK	3,294	482	-	-	X	-	X	X	-	LUBBOCK	-	-	Well, Pipeline, Transportation
SILVERTON	BRISCOE	549	91	-	-	X	-	X	X	X	TULIA	-	X	Well, Pipeline, Transportation
SLATON	LUBBOCK	5,665	661	-	-	X	-	X	X	-	SOUTHLAND ISD	-	-	Well, Pipeline, Transportation
SPUR	DICKENS	745	125	-	-	X	-	X	X	-	DICKENS	-	-	Well, Pipeline, Transportation
SUDAN	LAMB	883	208	-	-	X	-	X	X	-	LUBBOCK	-	-	Well, Pipeline, Transportation
SUNDOWN	HOCKLEY	1,195	319	-	-	X	-	X	X	-	WHITEFACE	-	-	Well, Pipeline, Transportation
TAHOKA PUBLIC WATER SYSTEM	LYNN	2,268	371	-	-	X	-	X	X	-	LUBBOCK	-	-	Well, Pipeline, Transportation
TULIA	SWISHER	3,779	653	-	-	X	-	X	X	-	CRMWA	-	-	Well, Pipeline, Transportation
WHITEFACE	COCHRAN	284	66	-	-	X	-	X	X	-	LEVELLAND, MORTON	-	-	Well, Pipeline, Transportation
WOLFFORTH	LUBBOCK	16,487	2,692	-	-	X	-	X	X	-	LUBBOCK	-	-	Well, Pipeline, Transportation

7.6 Region-Specific Drought Response Recommendations and Model Drought Contingency Plans

The LERWPG acknowledges that DCPs are a useful drought management tool for entities with both surface and groundwater sources and recommends that entitles consider having a current DCP in preparation for drought conditions. The region also recommends that, in accordance with TCEQ guidelines, entities update their DCPs every 5 years as triggers can change as wholesale and retail water providers reassess their contracts and supplies. The LERWPG obtained 17 DCP or WCP documents from across the region.

7.6.1 Drought Response Recommendations for Surface Water

Surface water accounts for a minority of projected 2080 municipal supplies in the Llano Estacado Region (see Chapter 3). With a variety of local supply sources, it is difficult to create a set of triggers and responses that fit the needs of each WUG in the regional planning area. The LERWPG recognizes that supplies are understood best by the water system operators and suggests that WUGs without DCPs look to the DCPs of their water providers as examples, if available.

For entities without DCPs, which supply themselves with local surface water, the LERWPG suggests reviewing the drought responses and recommendations used by similar entities in the region. An example of triggers and responses from the DCPs in the region is presented below (Table 7-8). These were selected as common and representative examples. The triggers depend on parameters such as treatment plant use, storage levels, reservoir elevations, and system failures. The responses include categories ranging from home irrigation limits to commercial and industrial use reductions.

7.6.2 Drought Response Recommendations for Groundwater

Groundwater accounts for most projected 2080 municipal supplies (see Chapter 3). With such a variety of supply sources, it is difficult to create a set of triggers and responses that fit the needs of each WUG in the regional planning area. The LERWPG recognizes that supplies are understood best by the operators and suggests that WUGs without DCPs look to the DCPs of their water providers and groundwater conservation districts as examples, if available.

For entities without DCPs supplying themselves with local groundwater, the LERWPG suggests reviewing the drought responses and recommendations used by similar entities in the region. An example of triggers and responses from the DCPs in the region is presented below (Table 7-8). These were selected as common and representative examples. The DCP includes five water stages ranging from “Mild” to “Water Emergency.” The triggers depend on parameters such as season, ground storage levels, contamination, and system failures. The responses include categories ranging from residential irrigation limits to commercial and industrial use reductions.

Table 7-8. Common Llano Estacado Region Drought Contingencies

Drought Stage	Trigger	Actions
Stage I – MILD	Water use exceeds 80% of available capacity	• City reduces water main flushing. • Voluntary limit on irrigation to 2 days a week at designated times. • Customers are requested to minimize or discontinue non-essential water use.
Stage II – MODERATE	Water use exceeds 90% of available capacity	• Mandatory limit on irrigation to 2 days a week at designated times or by handheld hose or 5-gallon bucket. • Vehicle washing allowed only with handheld bucket or hose. • Filling of pools or Jacuzzis limited to watering days/times. • Non-circulating ponds or fountains are prohibited unless supporting aquatic life. • Use of water from fire hydrants shall be limited to firefighting activities or other activities necessary to maintain public health, safety, and welfare. • All restaurants are prohibited from serving water unless requested. • Non-essential uses are prohibited.
Stage III – SEVERE	Water use exceeds 100% of available capacity	• All actions listed in Stage II. • Irrigation limited to handheld hose or less than 5 gallons of faucet water is used during designated watering days and times. • The use of water for construction from designated hydrants under special permit is discontinued.
Stage IV – CRITICAL	Water use exceeds 105% of available capacity	• All actions listed in Stages II and III. • Only washing of mobile equipment in the critical interest of the public health or safety is allowed. Commercial car washes can be used during designated hours. • Filling of swimming pools or fountains is prohibited. • No applications for new, additional or expanded water service infrastructure shall be approved.
Stage V – EMERGENCY	Water shortage due to infrastructure break, contamination, and/or system outage	• All actions described in previous stages. • Irrigation of landscaped areas is absolutely prohibited. • Use of water to wash any vehicle is absolutely prohibited.

7.6.3 Example Drought Contingency Plans

TCEQ has prepared example DCPs for wholesale and retail water suppliers. The examples provide guidance and suggestions regarding preparing DCPs. The TCEQ example DCPs may be available on TCEQ's website or otherwise available by contacting one of their offices. Appendix H contains model DCPs for cities with populations smaller than 15,000 and larger than 15,000.

7.7 Drought Management Water Management Strategies

The regional water plan is developed to meet projected water demands during a drought of severity equivalent to the DOR. The LERWPG sees the purpose of the planning as ensuring that sufficient supplies are available to meet future water demands. Therefore, drought management recommendations have not been made by the LERWPG as a WMS for specific WUG needs. Reducing water demands during a drought as a defined WMS does not mean that sufficient supplies will be available to meet the projected water demands but simply eliminates the demands. While the LERWPG encourages entities in the region to promote demand management during a drought, it should not be identified as a "new source" of supply. Drought management does not make more efficient use of existing supplies, as does conservation, but instead proposes that water will not be available when the water is needed most. Drought management prioritizes which future water demands are not met under drought conditions.

While drought management WMSs are not supported by the LERWPG, DCPs are encouraged for all entities and the region supports the implementation of the drought responses outlined in these DCPs when corresponding triggers occur. While the relief provided from these DCP responses can prolong supply and reduce impacts to communities, they are not considered to be reliable for all entities under all potential droughts.

7.8 Other Drought Recommendations

7.8.1 Texas Drought Preparedness Council and Drought Preparedness Plan

In accordance with TWDB rules, all relevant recommendations from the Drought Preparedness Council were considered in this chapter. The Texas Drought Preparedness Council is composed of representatives from multiple state agencies and plays an important role in monitoring drought conditions, advising the governor and other groups on significant drought conditions, and facilitating coordination among local, state, and federal agencies in drought response planning. The council meets regularly to discuss drought indicators and conditions across the state and releases situation reports summarizing their findings.

Additionally, the council has developed the *State Drought Preparedness Plan*, which sets forth a framework for approaching drought in an integrated manner in order to minimize impacts to people and resources. The Llano Estacado Region supports the ongoing efforts of the Texas Drought Preparedness Council and recommends that water providers and other interested parties regularly review the situation reports as part of their drought monitoring procedures. The council provided two recommendations to all RWPGs, which are addressed in this chapter.

- Follow the outline template for Chapter 7 provided to the regions by the TWDB in April of 2019, making an effort to fully address the assessment of current drought preparations and planned responses, as well as planned responses to local drought conditions or loss of municipal supply.
- Develop region-specific model DCPs for all water use categories in the region that account for more than 10 percent of water demands in any decade over the 50-year planning horizon.

To meet these recommendations, this chapter corresponds with the sections of the outline template. The Llano Estacado Region has also developed a model DCP for water use categories that exceed 10 percent of the demands. For the Llano Estacado Region, these use categories include irrigation only.

The Llano Estacado Region does not recommend any drought management strategies as a long-term supply solution. Instead, it reserves these types of strategies for unanticipated emergency situations only.

7.8.2 Model Updates

It is of upmost importance that RWPGs have the most up-to-date information available to make decisions. For example, the Brazos WAM that covers portions of Llano Estacado Region is used to determine both the DOR and the firm yield of reservoirs but has not been updated in almost 20 years. The LERWPG recommends that the Texas Legislature approve a budget for TCEQ to pursue updated WAMs before the next regional planning cycle.

7.8.3 Monitoring and Assessment

The LERWPG recommends that entities monitor the drought situation around the state and locally to prepare for and facilitate decisions. Several state and local agencies are monitoring and reporting on conditions with up-to-date information. A few informative sources are listed below.

- PSDI: http://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/
- TWDB Drought Information: http://waterdatafortexas.org/drought/
- TCEQ Drought Information: https://www.tceq.texas.gov/response/drought

8

Unique Stream Segments and Reservoir Sites, and Regulatory, Administrative, and Legislative Recommendations

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Chapter 8: Unique Stream Segments, Unique Reservoir Sites, and Other Legislative, Policy, and Regulatory Recommendations

[31 TAC §357.43]

8.1 Recommendations Concerning River and Stream Segments Having Unique Ecological Value

Regional water planning groups (RWPGs) are given the option of designating stream segments having "unique ecological value" within their planning areas, using five criteria to identify such segments.

1. Biological Function
    - Quantity (acreage or areal extent of habitat), and
    - Quality (biodiversity, age, uniqueness).
2. Hydrologic Function
    - Water Quality,
    - Flood Attenuation and Flow Stabilization, and
    - Groundwater Recharge and Discharge.
3. Occurrence of Riparian Conservation Areas
4. Occurrence of High Water Quality, Exceptional Aquatic Life or High Aesthetic Value
5. Occurrence of Threatened or Endangered Species and/or Unique Communities

The Llano Estacado Regional Water Planning Group (LERWPG) has chosen not to designate any stream segments as having unique ecological value.

8.2 Recommendations Concerning Sites Uniquely Suited for Reservoir Construction

Previously, the LERWPG identified Post Reservoir and Jim Bertram Lake 7 as unique sites suited for reservoir construction. Each site was associated with a request by a potential local project sponsor to include the project as a recommended or alternative water management strategy (WMS) in the 2026 Llano Estacado Regional Water Plan (LERWP). During the April 24, 2019, meeting of the LERWPG, Post Reservoir and Jim Bertram Lake 7 were designated as unique reservoir sites in the 2021 LERWP.

8.2.1 Post Reservoir

With the passage of House Bill 3096 (HB 3096) in 2001, the 77th Texas Legislature designated the site of the proposed Post Reservoir as a unique reservoir site. The 80th Texas Legislature placed a "sunset provision" on reservoir sites that were designated by the 2007 state water plan as unique, but because the Post Reservoir designation was made in 2001 by standalone legislation, it is not affected by this provision. The LERWPG has included Post Reservoir as an alternative strategy for the City of Lubbock.

On August 4, 2014, the U.S. Fish and Wildlife Service (USFWS) listed the sharpnose shiner (*Notropis oxyrhynchus*) and smalleye shiner (*Notropis buccula*) as endangered under the Endangered Species Act[254]. The sharpnose shiner's natural historical range included the Brazos, Wichita, and Colorado rivers, and the smalleye shiner was native to the Brazos River. Both species are now confined to the river segments of the Brazos River Basin upstream of Possum Kingdom Reservoir, including portions of Crosby and Garza counties. When listing the shiners, the USFWS also designated approximately 623 miles of the Upper Brazos River Basin as critical habitat. This area includes 11 Texas counties, 2 of which are within the Llano Estacado Region (Crosby and Garza counties). This critical habitat designation will likely impact this project. The shiners listing and potential impacts on the Post Reservoir project are discussed in more detail in Appendix D.

8.2.2 Jim Bertram Lake 7

With the passage of Senate Bill 675 (SB 675) in 2007, the 80th Texas Legislature designated the site of the proposed Jim Bertram Lake 7 as a unique reservoir site. The 80th Texas Legislature placed a sunset provision on reservoir sites that were designated by the 2007 State Water Plan as unique. Water right application 5921, filed in 2005 by the City of Lubbock, is currently pending with the Texas Commission on Environmental Quality (TCEQ). The LERWPG continues to support this legislative designation and has included Jim Bertram Lake 7 as a recommended WMS for the City of Lubbock.

The proposed Jim Bertram Lake 7 is part of the Jim Bertram Lake System (previously known as the Canyon Lake System). The lake system along Yellow House Draw and Yellow House Canyon consists of eight small dams and five small lakes: Lakes 1, 2, 3, 5 and 6. Jim Bertram Lake 7 will be located directly upstream of Buffalo Springs Lake, with a proposed capacity of 20,000 acre-feet (ac-ft).

The City of Lubbock submitted an environmental information document (EID) for the Jim Bertram Lake 7 to the TCEQ in July 2011. With proposed inundation of 774 acres of ranch land, this strategy will have an environmental impact. No federal- or state-protected aquatic species were found at the project site, although a population of Texas horned lizards (a Texas threatened species) and 17 archaeological sites exist on site. The EID acknowledges the need for a mitigation plan to compensate for unavoidable impacts.

The LERWPG does not designate any additional sites as uniquely suited for reservoir construction in the 2026 LERWP.

8.3 Other Legislative Recommendations

The LERWPG established a policy workgroup to discuss issues concerning state water policy and to formulate proposed positions for the LERWPG to consider for recommendation to the Texas Water

[254] U.S. Fish and Wildlife Service (USFWS). 2020. Sharpnose shiner and smalleye shiner. Arlington, Texas Ecological Services Field Office. Available at https://www.fws.gov/media/sharpnose-and-smalleye-shiner-dkeypdf

Development Board (TWDB) and the Texas Legislature. As the population and economic demands grow, water supplies become more stressed. These developments together with recent drought conditions make it increasingly important for water planning groups to consider the policies surrounding the development of proposed water management strategies.

8.3.1 Importance of Agriculture and Stewardship

The LERWPG recognizes the importance of agriculture in the region. Agricultural lands represent the major land use in the region and maintain the greatest area for recharge and capacity for water storage in Texas soil and aquifer systems. The use of water in the region for food and fiber production is the major driver of economic activity in the region and is the justifiable major user of water.

The LERWPG supports agricultural production techniques and technologies that enhance soil water holding capacity, enhance natural recharge of aquifer systems, and regenerate agricultural systems through improved multispecies cropping rotations, including the techniques of cover crops, poly-cultures, and pasture cropping.

The use of ruminants in grazing systems is of particular importance in the Llano Estacado Region because it brings forth improved nutrient cycling, improves plant health, uses the beneficial climate for livestock, and can help achieve a long-term economic benefit of diversification, providing a move from large-scale, intensively irrigated monoculture crop acres to more regenerative models.

Education about techniques that halt region desertification is critical to all inhabitants' future. The entire region must come together to stop bare ground encroachment. The LERWPG supports a focus on methods that promote long-term agricultural community viability and move away from supporting industry segments and business models that can lead to areas of water aquifer deserts or areas of reduced water quality. The LERWPG realizes that the economic and social value of water is ever more important and that the value of high quality safe water in the region and world will forever remain an issue to be protected by means that are just and fair.

The LERWPG supports funding for water education and research as it pertains to developing a continually evolving set of best management practices (BMPs) in each segment of the agricultural industry, and financial incentives to help producers steward in a balance between recharge with usage.

Planning efforts in the past have contended that mining groundwater at unsustainable rates was one method of planning for the futures. The LERWPG no longer supports the concept of justifiable long-term water table decline by any stakeholder or user group. Having aquifer-stored water available during periods of drought will remain its most critical resource time for agriculture. According to select planning group members, without water, farms and civilization will fail in this region and that it is not possible to have civilization without agriculture.

8.3.1.1 Non-Municipal Water Demand Estimation

The LERWPG recommends including RWPG interest group representatives in developing methodologies for non-municipal demand projections. For example, this could include convening a committee of industrial business sector representatives, including steam-electric, mining, and manufacturing interests, to assist the TWDB in developing the methodology for industrial water demands, and an agriculture committee for determining irrigation and livestock water demands. The proposed involvement by non-municipal water user groups in developing water demands could achieve better acceptance of the TWDB-calculated water demands by local interests in future regional water planning cycles.

8.3.2 Planning Issues for the Agricultural Sector

The LERWPG is concerned that the regional water planning process seems to be geared more toward industry and municipalities and does not help solve the problems faced by the agricultural industry. While municipal and industrial water users exhibit a more consistent water use pattern, agricultural water use fluctuates greatly. This fluctuation is a product of commodity prices, growing season rainfall, and other factors. The agricultural projections do not reflect actual conditions, showing large water needs in the agricultural sector that skew the region's water needs, given that producers will change their practices as mandated by economics and groundwater availability. Water supply projects cannot be developed and implemented in the agricultural sector as they can in other sectors, and thus the planning process does not satisfy agricultural water needs. The LERWPG would like there to be a better way to adapt the process to allow greater participation for agricultural interests in order to realistically address the water supply problems.

AGRICULTURAL WATER PLANNING

- The Llano Estacado Regional Water Planning Group (LERWPG) supports agricultural production techniques and technologies that enhance soil water-holding capacity and natural recharge of aquifer systems, and regenerate agricultural systems through improved multispecies cropping rotations.
- The LERWPG would like to adapt the Texas Water Development Board's planning process to allow greater participation for agricultural interests to realistically address the region's future water supply.
- State Water Implementation Fund for Texas (SWIFT) funding is not available to individual agricultural producers, making it difficult for a region dominated by agriculture to take advantage of Texas' current funding opportunities.

8.3.3 Funding for Project Implementation

Since the completion of the 2001 LERWP, it has been clear that some level of state financial assistance will be required, both within the Llano Estacado Region and statewide, in order to implement regional water plans within the necessary time frame. The LERWPG strongly supports the funding that the Texas Legislature has provided for project implementation in past years and would like to thank the Texas Legislature for creating the State Water Implementation Fund for Texas (SWIFT) loan program. The SWIFT program is a step in the right direction, and the LERWPG acknowledges that progress toward funding the necessary projects has been made; however, the LERWPG recommends that additional programs be developed that offer direct grants and/or cost-sharing arrangements in addition to the SWIFT loan program. The LERWPG recommends ongoing dedicated funding for regional and state water plan projects so that future generations of Texans will have reliable, affordable, and sufficient water supplies.

The Llano Estacado Regional Water Planning Group recommends inviting regional water planning interest groups to help in developing methodologies for non-municipal demand projections in order to achieve greater local acceptance of calculated water demands.

The LERWPG supports the implementation of high-priority projects and would like to see additional funding that supports completion of the following.

- Implement water management strategies (WMSs) and water conservation incentives for water user groups (WUGs) in the plan, including loans for public water supply, brush management, water conservation, and research/development of drought tolerant species and more efficient technologies.
- Increase state public education programs regarding water supply issues, including water conservation.
- Continue funding and support for collecting, processing, and analyzing water data needed to continually update and improve understanding of regional surface and groundwater resources.
- Continue funding and support for ongoing development and improvements to the TWDB groundwater availability models (GAMs) for Texas' major and minor aquifers and to the Texas Commission on Environmental Quality (TCEQ) water availability models (WAMs). The LERWPG fully appreciates and recognizes the importance of the systematic review and integration of new data and effects of changed conditions for re-calibration and re-verification of these models, and feels it is imperative that funding for this effort be sustained.

8.3.4 Planning Process Improvements

The LERWPG proposes that the planning process be expanded to allow for more involvement from RWPGs and for the use of higher quality local data, where available. In particular, the LERWPG feels that some of the TWDB per capita water use and population projection data are over-estimates and that the planning process would be improved if the planning group is able to revise these data. Additionally, the LERWPG would like to be able to override the TWDB prescribed approach when justified.

In the previous planning cycle, the LERWPG recommended that the planning process be reviewed by a representative stakeholder group made up of planning group members from across the state, leading to revisions to better capture region-specific characteristics as part of the planning process. The LERWPG appreciates that the TWDB has convened this recommended group in this planning cycle.

8.3.5 Rule of Capture and the Common Law Doctrine of Groundwater Ownership

The LERWPG supports the Rule of Capture, as modified by the rules and regulations of existing underground water conservation districts, and the Common Law Doctrine of Groundwater Ownership. The planning group also supports the state's policy that groundwater conservation districts (GCDs) are the preferred method of managing groundwater and supports the creation and operation of GCDs that are organized and function under Chapter 36 of the Texas Water Code (TWC). Accordingly, the planning group urges the Texas Legislature not to empower the RWPGs with any water management or regulatory authority.

8.3.6 Playa Best Management Practices

The LERWPG supports and encourages the development and voluntary use of BMPs to improve recharge and protect playa basins from siltation, including creating and preserving native grass buffers on land surrounding playas to maintain their water holding capacity.

Of the roughly 80,000 playas in the Great Plains states, about 15,500 are located in the Llano Estacado Region. Within the Panhandle Region, these ephemeral basins could appropriately be called recharge wetlands as they are strongly tied to the Ogallala Aquifer.

One example of a voluntary program directed at rehabilitating altered playas is the Texas Playa Conservation Initiative (TxPCI) that is proving successful in recovering altered playas and augmenting recharge.

Don Kahl, Region 1 Migratory Gamebird Specialist with the Texas Parks and Wildlife Department (TPWD) in the City of Lubbock, is working diligently with TxPCI to restore altered playas to fulfill their role in the water cycle. Healthy playas ensure recharge of clean water into the Ogallala Aquifer. The recharge rate through playas is 10 to 100 times greater than elsewhere. Water that is filtered through playas most benefits wells pumping from the Ogallala Aquifer. Three inches of recharge through a 4-acre playa produces 326,000 gallons of returned water. That is enough to support 2 years of residential use for a family of four, according to Kahl.

> *"Water recharged through playas stays localized where the playa lies. Recharge can range from an inch or less up to 20 inches. The average playa is 17 acres, so that's considerable water recharged from an average-sized playa—far more if the recharge rate is on the high end of up to 20 inches,"* Kahl projected.

The health of the Ogallala Aquifer is a major concern on the Texas High Plains, where massive historic declines in the freshwater aquifer have occurred due to heavy irrigation and residential use. Land use patterns in agriculture and urban sprawl have both had substantial impact on playas' function.

Kahl says Texas has a total of 23,037 playas. Of that number, 4,080 are currently categorized as pristine--functional thanks to a good grass buffer around them, no trenching, and no accumulated silt in the basin. Another 5,631 are currently listed as functional but at risk, and a troubling tally of 13,326 playas are categorized as not functional.

Kahl's work with TxPCI, launched in 2015, seeks to rehabilitate playas listed as not functional. Others partnering with TPWD in the effort include the Playa Lakes Joint Venture, Natural Resources Conservation Service (NRCS), Ducks Unlimited, Texan by Nature, USFWS, and Ogallala Commons.

> *"Our focus is on backfilling tailwater pits in grass-buffered playas. A hole in the clay pan of a playa, such as a tailwater pit, is a hole in the playa's filter mechanism. Water gathered in a pit is not productive like rainwater spread shallowly over a whole playa basin. With pits, you lose the shallow water habitat,"* Kahl says.

Kahl says TxPCI uses satellite imagery to identify potential projects and collect landowner information. Once they have identified a playa they would like to restore, TxPCI directly contacts the landowner. The initiative pays 100 percent of restoration costs and hires and directly pays contractors involved in pushing berms alongside tailwater pits back into the pit. Playa landowners receive a one-time incentive payment of $80 per playa acre and must enter into a 10-year agreement that precludes future pit creation in the playa. Playas that get pit backfilling are remotely monitored.

Primary funding for TxPCI is via migratory gamebird funds through TPWD, federal and North American Waterfowl Conservation Act grants, and regional grants from USFWS.

> *"This effort shows that water conservation goes beyond what you do in your household. It's important to realize where your water comes from, and the important role that playas play in keeping Ogallala Aquifer water available," said Kahl.*

8.3.6.1 Enhanced Recharge

Dr. Chris Grotegut, an agriculture representative on the LERWPG, and a local veterinarian, farmer and stockman in Deaf Smith County, likens playas to "an irrigation farmer's best friend" where recharge of the Ogallala Aquifer is concerned. His stewardship has shown that playas enhance recharge under a limited irrigation scheme.

> *"We've seen that where Ogallala wells recover the best from recharge is around our largest functioning playas. When rains are good and playas are holding water, the water table is steady."*

8.3.7 Control of Invasive Species

The LERWPG supports implementing brush management and controlling invasive aquatic vegetation as water conservation practices and particularly supports and encourages the efforts by the Canadian River Municipal Water Authority (CRMWA) and City of Lubbock to control salt cedar as a means to increase water flow to the reservoirs for water supply and environmental purposes. Further, the LERWPG encourages similar controls be applied to other watersheds regionally, including those of Lake Mackenzie and White River Lake. The LERWPG also supports controlling invasive aquatic species, such as zebra mussels, quagga mussels, golden algae, milfoil and hydrilla, giant salvinia, and water hyacinth that have the potential to negatively impact the state's lakes, reservoirs, and existing infrastructure.

8.3.8 Protection of Springs and Seeps

The LERWPG supports the voluntary protection of springs and seeps as they exist within the region and encourages landowners to use BMPs to protect and maintain these important water resources for not only their practical value for livestock and wildlife, but as aesthetic resources as well. As addressed in past appendices to LERWPs, there are some remnant spring and seep sites across the region that can experience renewed flow in instances of strong rainfall.

A key to the continued life of springs and seeps in the Southern Plains region is maintaining soil health on both farmlands and rangelands across the breadth of the Llano Estacado Region. This is a voluntary measure on the part of landowners, but where soil health is sufficient for the maintenance of improved organic matter in the soil, the ability of the soil to absorb water is greatly enhanced, as further described in *Springs and Seeps of the Llano Estacado Region* prepared by LERWPG member Jim Steiert and included as Appendix I.

8.3.9 Voluntary Water Transfers

The LERWPG supports voluntary water transfers between willing buyers and sellers, but stresses that the governing bodies of each involved party would have to agree before any potential connections and/or transfers could be made.

9

Implementation and Comparison to the Previous Regional Water Plan

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Chapter 9: Implementation and Comparison to the Previous Regional Water Plan

[31 TAC §357.45]

9.1 Introduction

The regional water planning groups (RWPGs) must report the level of implementation and identified, reported implementation impediments to the development of previously recommended water management strategies (WMSs) that have affected progress in meeting water needs. The content of this section is largely supported by data summaries based on information through the previous planning cycle.

9.2 Implementation of the 2021 Llano Estacado Regional Water Plan

As water user groups (WUGs) achieve full implementation of basic municipal and irrigation conservation strategies, implementation becomes more challenging with the remaining WMSs that are more expensive and technically difficult.

In accordance with Texas Water Development Board (TWDB) guidance, TWDB staff disseminated to planning groups a standard template for collecting information on implementation and reported impediments to implementation for WMSs and WMS projects in the 2021 regional water plans/2022 State Water Plan. As directed by the TWDB, this workbook template is to be used for Chapter 9 of the 2026 regional water plans. This workbook is the full extent of the survey instrument for implementation and impediment data that will be provided for the 2026 regional water plan.

In order to meet reporting requirements in statute, the workbook template includes TWDB 2027 database (DB27) data for recommended WMS projects, recommended WUG WMSs not associated with a WMS project, and demand reduction WMSs not associated with a WMS project. The Llano Estacado Regional Water Planning Group (LERWPG) was directed to populate the template. Implementation data gathered as of the Initially Prepared Plan delivery by March 3, 2025, is included in Appendix J. A finalized, populated template must be submitted with the final 2026 regional water plan.

9.3 Progress in Achieving Economies of Scale

This section includes an assessment of the region's efforts to encourage cooperation between WUGs for the purpose of achieving economies of scale and incentivizing WMSs that benefit the entire region. The assessment includes the following.

1. The number of recommended WMSs in the 2021 regional water plan (RWP) and the number of recommended WMSs in the 2026 RWP that serve more than one WUG,

2. The number of recommended WMSs in the 2021 RWP that serve more than one WUG and have been implemented since the 2021 RWP adoption, and

3. A description of the efforts the RWPG has made to encourage WMSs to serve more than one WUG and benefit the entire region.

9.3.1 Efforts to Encourage WMSs to Serve Multiple WUGs and Benefit Region

The LERWPG coordinated with WUGs, wholesale water providers (WWPs), groundwater conservation districts (GCDs), and groundwater management areas (GMAs) in the Llano Estacado Region regarding population and water demand projections developed by the TWDB, groundwater and surface water availability estimates, and proposed WMSs.

At the onset of the planning process in February 2023, municipal WUGs, WWPs, GCDs, councils of governments, and Llano Estacado Region county judges were mailed the Llano Estacado Region population and water demand projections for review.

South Plains Association of Governments (SPAG) staff mailed a survey to municipal WUGs and WWPs on July 19, 2024, regarding their current and future water supply and use, and current and future water conservation strategies (Appendix G).

The City of Lubbock is working to benefit the region with their expanded service to WUGs outside of their city limits. In addition, the Canadian River Municipal Water Authority (CRMWA) began developing its first-ever water supply plan to responsibly develop future water supplies in serving its 11 member cities across the Panhandle Regional Water Planning Area and the Llano Estacado Regional Water Planning Area.

9.4 Comparison to the 2021 Llano Estacado Regional Water Plan

The data compiled and presented within this 2026 LERWP are compared to the data presented in the 2021 LERWP in the following sections.

9.4.1 Changes to WUGs

For the 2021 Regional Water Planning Cycle, the TWDB modified the definition of a municipal WUG and the geographic basis for each WUG's population projections. The previous definition defined a municipal WUG as a city or retail water utility serving a population of 500 people or more or that provided at least 280 acre-feet per year (ac-ft/yr) of water. For cities, this was without regard to a city-owned utility's actual service area. A municipal WUG might be served by more than one actual water utility, if more than one utility had customers within the city limits. Rule revisions to 31 Texas Administrative Code (TAC) §357.10(41) changed the definition of a municipal WUG and clarified the basis of planning to focus on utility service areas rather than geographic census-place names. The definition of a WUG now reflects the utility rather than the city. For the 2021 and 2026 LERWP, municipal WUGs are defined as follows.

1. Any retail public utilities with retail water sales of 100 ac-ft/yr or more;
2. Any privately-owned utilities averaging sales of 100 ac-ft/yr across all owned systems; and
3. WUGs designated as "County-Other" consist of all of the remaining municipal utilities with sales less than 100 ac-ft/yr and other individual users in the counties.

Changes to Llano Estacado Region WUGs included in the 2021 LERWP plan are shown in Table 9-1.

Table 9-1. Changes to WUGs and WWPs in the 2026 Plan

Entity	County	Comments
New WUGs		
Seth Ward WSC	Hale	Met TWDB WUG definition

9.4.2 Water Demand Projections

Water demand projections from the 2026 and 2021 LERWPs are shown in Figure 9-1. Project demands decrease in every decade compared to the previous plan, primarily due to changes in TWDB methodology and LERWPG-requested methodology revisions related to irrigation demands. There were also changes to the projection methodology for all other non-municipal water use categories as well. The small change in municipal demand is due to WUGs requesting small changes to their demand projections. Changes in water demands by WUG category are shown in Table 9-2.

Table 9-2. Change in Water Demand by WUG from 2026 to 2021 LERWPs

Water User Group	Change in Water Demand by Decade (acre-feet per year)				
	2030	2040	2050	2060	2070
Irrigation	1,008,600	859,499	1,079,206	1,426,066	1,432,550
Livestock	(904)	(2,335)	401	4,461	8,589
Manufacturing	4,511	4,222	3,922	3,610	3,288
Mining	8,596	6,981	4,744	2,649	6,516
Municipal	5,376	5,286	5,666	5,217	3,867
Steam-electric	10,762	14,460	14,460	14,956	14,956
TOTAL	1,036,941	888,113	1,108,399	1,456,959	1,469,766

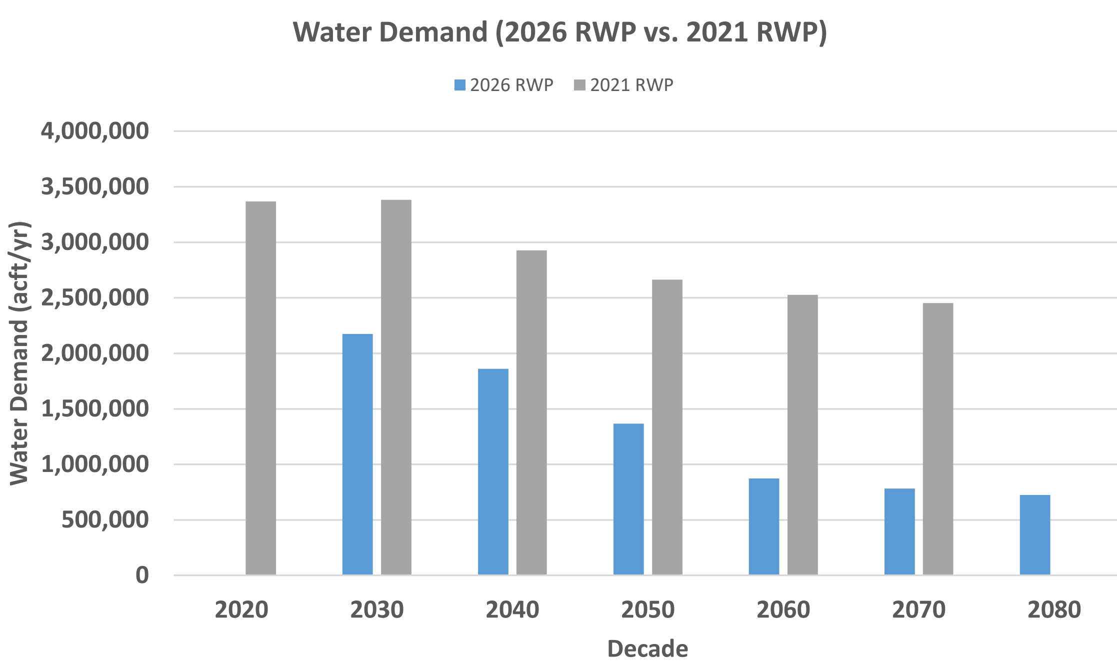

Figure 9-1. Comparison of 2026 and 2021 Water Demand Projections

9.4.3 Drought of Record and Model Assumptions

Droughts of record (DORs) occurred from 1950 to 1957 and from 2010 to 2015, with 2011 being the hottest, driest year on record for the Llano Estacado Region. The DORs are discussed in detail in Chapter 7. The Llano Estacado Region has experienced two recent droughts centered around 1996 and 2011 that were significant enough to be used for planning: the 1990s drought (1992 through 2001) and the 2010s drought, the latter of which is considered the most recent drought. Low moisture levels, periods of extreme temperatures, and high evaporation rates are unique indicators for both of these droughts. Previous regional water plans did not consider or evaluate these two recent droughts.

For surface water availability, the 2026 and 2021 LERWPs used the Texas Commission on Environmental Quality's (TCEQ) Brazos River Basin water availability model (Brazos WAM) as the base model.

In the 2026 and 2021 LERWPs, modeled available groundwater (MAG) was used to estimate groundwater availability. To calculate RWPG-estimated availability, or non-MAG availability, for the "Other Aquifer" designation in the 2026 LERWP, the methodology includes the following assumptions.

- Groundwater capacity is determined based upon historical groundwater pumpage reports available from the TWDB.
- Historical pumpage is reported for river basin portions of each county by aquifer for the time period 2007 through 2020.
- Well capacity is assumed to be the maximum annual pumpage during this time period.

9.4.4 Groundwater and Surface Water Source Availability

Water availability from the 2026 and 2021 LERWPs is shown in Figure 9-2. Overall water availability increased in 2020 and 2030, while the water availability decreased in 2040 through 2070 compared to the previous plan due to changes in the desired future conditions (DFCs) associated with the Ogallala Aquifer. Changes in water demands by WUG category are shown in Table 9-3.

Groundwater availability projected in the 2021 LERWP increased in 2020 and 2030 and decreased in 2040 through 2070. Groundwater supplies available for current uses and for WMSs can change due to revisions in estimated available groundwater resulting from newly adopted MAG determinations arising out of the GMA process.

Reuse availability projected in the 2021 LERWP decreased in 2020 and 2030 and increased in 2040 through 2070 mainly due to a change in the projected reuse amounts from the City of Lubbock to be consistent with their water supply plan.

Surface water availability projected in the 2021 LERWP decreased in all decades as related to minor variations in water right availability. Surface water supplies available for current uses and WMSs will change as the TCEQ updates the Brazos WAM, new projections of future return flows are developed, projections of reservoir sedimentation are revised, and as the TWDB changes requirements for water availability determination.

Table 9-3. Change in Water Availability from 2026 to 2021 LERWPs

Source	Change in Water Availability by Decade (acre-feet per year)				
	2030	2040	2050	2060	2070
Groundwater	(506,531)	(242,589)	(122,282)	(65,040)	(37,358)
Reuse	0	0	0	0	0
Surface Water	(10,950)	(10,950)	(10,930)	(10,910)	(10,550)
TOTAL	(517,481)	(253,539)	(133,212)	(75,950)	(47,908)

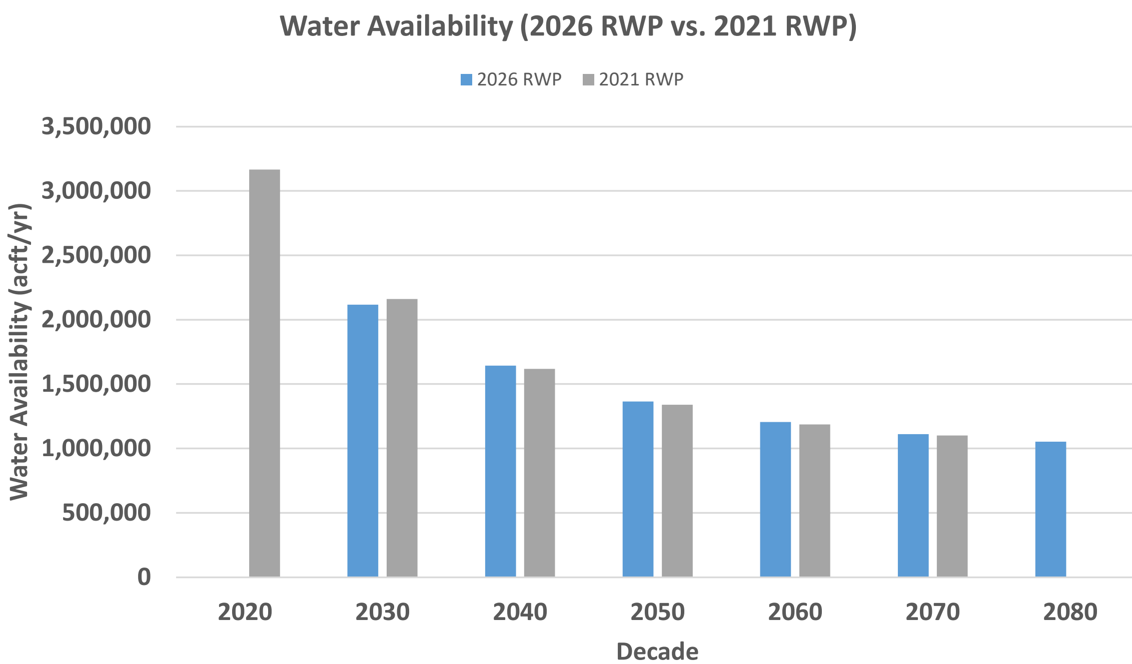

Figure 9-2. Comparison of 2026 and 2021 Water Availability Projections

9.4.5 Existing Water Supplies for Water Users

The changes in the existing water supply by WUG from the 2026 and 2021 LERWPs are shown in Figure 9-3 and Table 9-4. The changes in existing supply are due to the changes in projected demand and the differences in supply allocation methods from the previous plan.

Table 9-4. Change in Water Supply by WUG from 2026 to 2021 LERWPs

Water User Group	Change in Water Supply by Decade (acre-feet)				
	2030	2040	2050	2060	2070
Irrigation	(199,159)	(27,241)	31,715	(17,508)	(19,891)
Livestock	(7,133)	(7,133)	(7,133)	(7,133)	(6,811)
Manufacturing	3,407	3,407	3,407	3,407	3,407
Mining	(5,091)	(5,091)	(5,091)	(5,091)	(5,091)
Municipal	1	(2,101)	(5,554)	(7,114)	(8,774)
Steam-electric	(10,283)	(13,072)	(10,832)	(13,568)	(13,568)
TOTAL	(218,258)	(51,231)	6,512	(47,007)	(50,728)

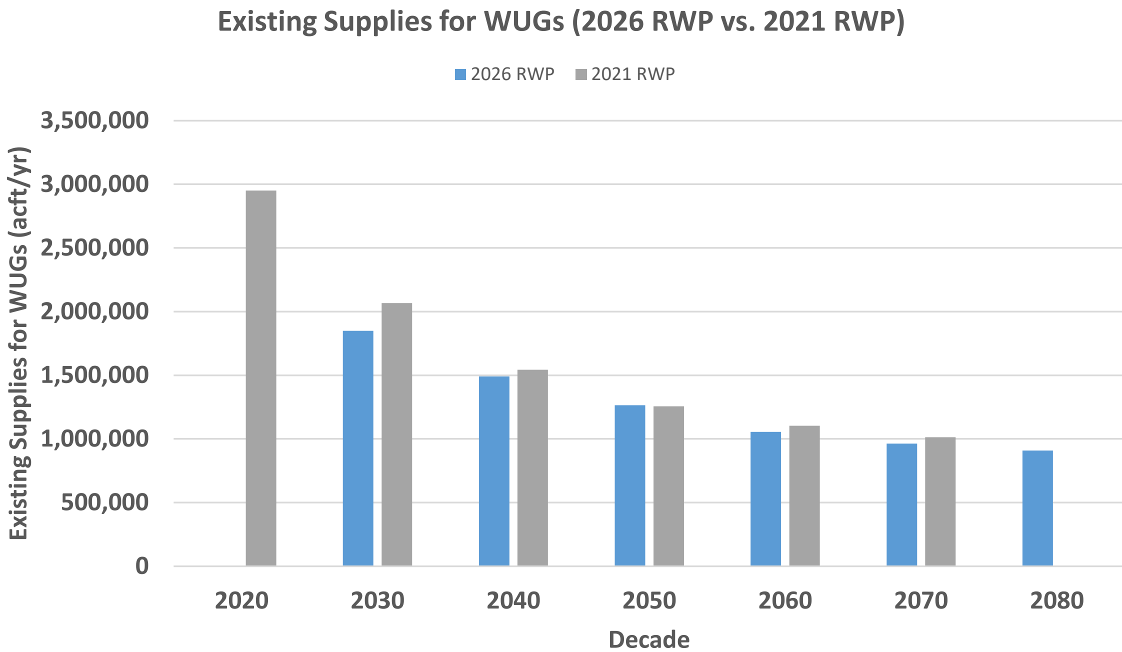

Figure 9-3. Comparison of 2026 and 2021 Existing Supplies for WUGs

9.4.6 Water User Needs

Changes in water user needs by WUG from the 2026 and 2021 LERWPs are shown in Figure 9-4 and Table 9-5. Changes are due to changes in demand projections and changes in the available supply to WUGs.

Table 9-5. Change in Water User Needs by WUG from 2026 to 2021 LERWPs

Water User Group	Change in Water User Needs by Decade (acre-feet)				
	2030	2040	2050	2060	2070
Irrigation	(887,298)	(859,566)	(1,125,984)	(1,418,957)	(1,419,805)
Livestock	(122)	(844)	(2,041)	(3,689)	(5,442)
Manufacturing	(6,482)	(6,482)	(6,482)	(6,482)	(6,482)
Mining	(10,503)	(9,517)	(8,145)	(6,908)	(6,016)
Municipal	(1,170)	1,749	7,062	11,665	16,490
Steam-electric	0	0	0	0	0
TOTAL	(905,575)	(874,660)	(1,135,590)	(1,424,371)	(1,421,255)

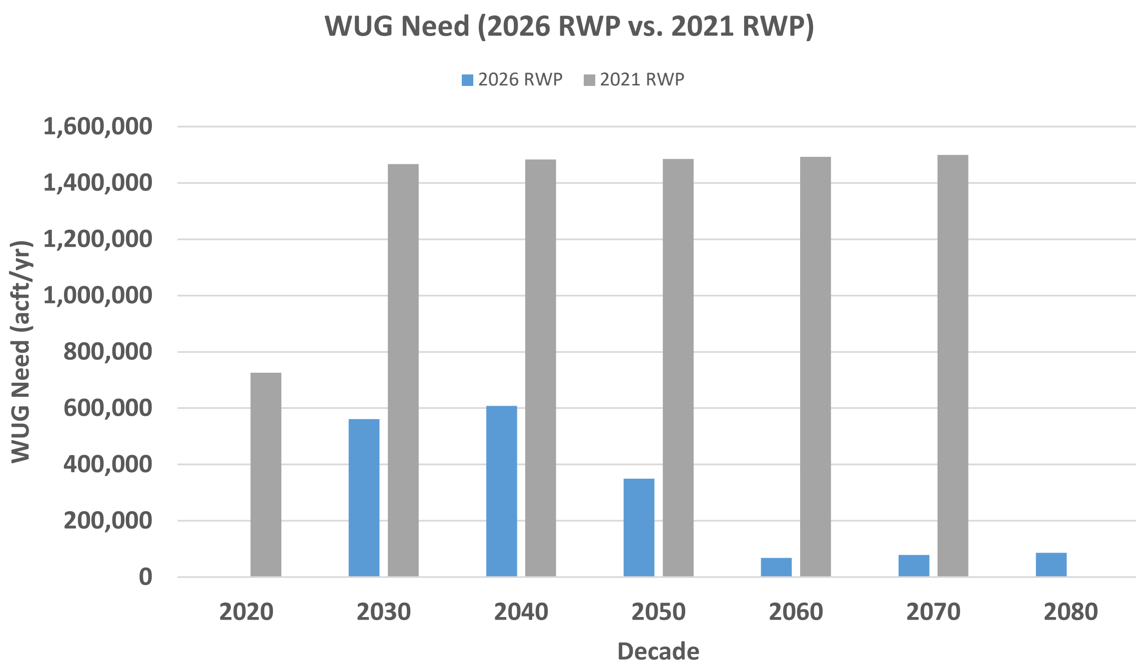

Figure 9-4. Comparison of 2026 and 2021 WUG Need

9.4.7 Recommended and Alternative Water Management Strategies

WMSs and WMS projects from the 2026 and 2021 LERWPs are compared in Table 9-6. Most of the recommended strategies from previous plans are again recommended in this plan.

Table 9-6. Comparison of WMSs and WMS Projects from 2026 to 2021 LERWPs

Water Management Strategies	2026 Regional Water Plan	2021 Regional Water Plan
Municipal conservation	√	√
Agricultural conservation	√	√
Manufacturing conservation	√	√
Local groundwater development	√	√
Water reuse	√	√
Water Loss Reduction	√	
Brackish groundwater desalination	√	√
Bailey County Well Field Capacity Maintenance	√	√
Playa Enhanced Recharge	√	
CRMWA Aquifer Storage and Recovery	√	√
Direct Potable Reuse to North Water Treatment Plant	√	√
Lake 7 Reuse	√	√
Lake Alan Henry Phase 2	√	√
South Lubbock Well Field	√	
Plainview Aquifer Storage and Recovery		√
South Garza Water Supply	√	
Seminole Groundwater Desalination (Alternative)	√	√
Brackish Supplemental Water Supply for Bailey County Well Field (Alternative)	√	√
Direct Potable Resue to South Water Treatment Plant (Alternative)	√	√
North Fork Diversion at CR 7300 (Alternative)	√	√
North Fork Diversion to Lake Alan Henry Pump Station (Alternative)	√	√
Post Reseroir (Alternative)		√
South Fork Discharge (Alternative)		√

WMS = water management strategy; CRMWA = Canadian River Municipal Water Authority

9.4.8 Progress of Regionalization

In accordance with House Bill 807 (HB 807) and codified in Texas Water Code (TWC) §16.053(e)(12), the LERWP shall "assess the progress of the RWPA [regional water planning area] in encouraging cooperation between water user groups for the purpose of achieving economies of scale and otherwise incentivizing strategies that benefit the entire region." The LERWPG has encouraged cooperation between WUGs and across regions. For example, regional water management strategies evaluated in this plan and originating in the Panhandle Region (Region A) regional water plan include the Roberts County Well Field Capacity Maintenance groundwater strategy and CRMWA pipeline expansion WMS to address water needs across both regions.

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Public Participation and Adoption of Plan

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Chapter 10: Public Participation and Adoption of Plan

[31 TAC §357.50]

10.1 Public Participation

The Llano Estacado Regional Water Planning Group (LERWPG) provided opportunity for the public to participate in the regional water planning process. The LERWPG met all requirements under the Texas Open Meetings Act and Public Information Act in accordance with 31 Texas Administrative Code (TAC) Chapters 357.12, 357.21, and 357.50(f) during development of the *Initially Prepared 2026 Llano Estacado Regional Water Plan* (Initially Prepared 2026 LERWP). LERWPG meeting agendas and other meeting materials were posted on the LERWPG website (llanoplan.org) prior to each meeting. The public was invited to speak during public comment periods during each LERWPG meeting.

To comply with the Texas Water Development Board (TWDB) Regional Water Planning Rules [31 TAC Section 357.21(c)(7)(C)], written comments from the public were accepted for a period of 14 days prior to and 14 days after the meeting, where the LERWPG technical memorandum, included in Appendix C, was considered for approval by the LERWPG. Public comments were also accepted at the meeting where the technical memorandum was considered for approval by the LERWPG, held on February 21, 2024. No public comments were received at the meeting or during the official comment period.

The Initially Prepared 2026 LERWP for the Llano Estacado Region was approved at the February 19, 2025, meeting of the LERWPG. The plan was developed in accordance with Texas Water Code (TWC) and 31 TAC Chapters 355, 357, and 358 statutes.

Following its submittal to the TWDB, the Initially Prepared 2026 LERWP was distributed for public inspection in accordance with 31 TAC Chapter 21(d)(4).

10.2 Llano Estacado Regional Water Planning Group Website

The LERWPG has directed the South Plains Association of Governments (SPAG) to maintain a website (llanoplan.org), where LERWPG meeting notices, agendas, and presentation materials may be viewed by the public. In addition to meeting materials, the 2026 LERWP is posted for public viewing and download, as well as documents from the planning process for the development of the 2026 LERWP. The website offers other features, including LERWPG member contact information, planning area maps and planning data.

10.3 Coordination with Water User Groups and Wholesale Water Providers

The LERWPG coordinated with water user groups (WUGs), wholesale water providers (WWPs), groundwater conservation districts (GCDs), and groundwater management areas (GMAs) in the Llano Estacado Region regarding population and water demand projections developed by the TWDB, groundwater and surface water availability estimates, and proposed water management strategies (WMSs).

At the onset of the planning process in February 2023, municipal WUGs, WWPs, GCDs, councils of governments, and Llano Estacado Region county judges were mailed the Llano Estacado Region population and water demand projections for review. A revision request memorandum, included in Appendix C, which includes individual WUG requests for revisions, was submitted to the TWDB on August 11, 2023.

Municipal WUGs and WWPs were mailed a survey by SPAG staff on July 19, 2024, regarding their current and future water supply and use, and current and future water conservation strategies (Appendix G). The survey was used as a method to collect emergency interconnections information, as well. Of the 74 WUGs in the Llano Estacado Region, 29 responded to the survey.

10.4 Coordination with Other Planning Regions

Coordination with other planning regions was accomplished primarily through the technical consultants, who coordinated data and shared information that was later reported to the planning groups. Coordination was accomplished with adjacent Regional Water Planning Groups, including Regions A, B, F, and G. Other coordination was accomplished through the participation of LEWRPG members as liaisons with adjacent planning groups and with two LERWPG members who also serve as members of the Panhandle Regional (Region A) Water Planning Group.

10.5 Llano Estacado Regional Water Planning Group Meetings

The LERWPG regularly met in accordance with the approved bylaws. The LERPWG has met on a more frequent basis as needed in order to facilitate and direct the water planning of the region. Following is a list of the 2026 LERWP development meetings.

- November 17, 2021
- March 3, 2022
- September 20, 2022
- December 7, 2022
- February 22, 2023
- May 10, 2023
- June 28, 2023
- August 3, 2023
- November 30, 2023
- February 21, 2024
- June 19, 2024
- September 24, 2024
- December 3, 2024
- January 21, 2025
- February 19, 2025

The LERWPG also designated several work groups in order to expedite more specific work efforts and further increase the effectiveness and timeliness of the planning process.

10.6 Public Hearing and Responses to Public Comments on Initially Prepared Plan

The LERWPG approved the Initially Prepared 2026 LERWP on February 19, 2025, for submittal to the TWDB. The Initially Prepared 2026 LERWP was submitted to the TWDB on March 3, 2025, and was declared administratively complete on _______2025. The public hearing to receive comments on the Initially Prepared 2026 LERWP was held ______, 2025, providing sufficient time to accept public comments according to statute to meet the October 20, 2025, deadline for submission of the adopted Final 2026 LERWP. The Initially Prepared 2026 LERWP was provided to county libraries and county clerks in the 21 Llano Estacado Region counties and posted on the LERWPG website for public review and comment. The comments received on the Initially Prepared 2026 LERWP with responses will be included in Appendix L of the Final LERWP.

10.7 Plan Adoption

The LERWPG formally adopted the 2026 LERWP on February 19, 2025, and directed SPAG and HDR to submit the 2026 LERWP to the TWDB on or before the October 20, 2025, deadline.

Figure 10-1. LERWPG Meeting on February 19, 2025

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A

DB27 Reports

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TWDB State Water Planning Database (DB27)

The TWDB State Water Planning Database (DB27) includes data compiled and pertaining to the development of the regional water plan. Summary reports available from DB27 include the following.

Report ID	Report Name
71	2026 Regional Water Plan 1 - WUG Population
72	2026 Regional Water Plan 2 - WUG Demand
73	2026 Regional Water Plan 3 - Source Total Availability
74	2026 Regional Water Plan 4 - Water User Group Existing Water Supply
75	2026 Regional Water Plan 5 - Water User Group Needs or Surplus
80	2026 Regional Water Plan 7 - WUG Data Comparison to 2021 RWP
81	2026 Regional Water Plan 8 - Source Data Comparison to 2021 RWP
112	2026 Regional Water Plan 6 - WUG Second-Tier Identified Water Need
113	2026 Regional Water Plan 9 - WUG Unmet Needs
114	2026 Regional Water Plan 10 - Recommended WUG Water Management Strategies
115	2026 Regional Water Plan 11 - Recommended Projects Associated with Water Management Strategies
116	2026 Regional Water Plan 12 - Alternative WUG Water Management Strategies
117	2026 Regional Water Plan 13 - Alternative Projects Associated with Water Management Strategies
118	2026 Regional Water Plan 14 - WUG Management Supply Factor
119	2026 Regional Water Plan 15 - Recommended WMS Supply Associated with New/Amended IBT Permit
120	2026 Regional Water Plan 16 - Recommended WMS with New/Amended IBT Permit & Conservation
121	2026 Regional Water Plan 17 - Sponsored Recommended WMS Supplies Unallocated to WUGs
122	2026 Regional Water Plan 18 - Major Water Provider Existing Sales and Transfers
123	2026 Regional Water Plan 19 - Major Water Provider WMS Summary

Instructions for accessing the TWDB Database Reports:

1. Navigate to the TWDB Database Reports application at https://www3.twdb.texas.gov/apps/SARA/reports/list
2. Enter ‘2026 Regional Water Plan’ into the “Report Name” field to filter to all DB27 reports associated with the 2026 Regional Water Plans.
3. Click on the report name hyperlink to load the desired report.
4. Enter planning region letter parameter, click view report.

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B

Regional Surface Water Rights

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DB27 Draft Source Surface Water Data (Run-of-River, Reservoirs, and Resevoir Systems)

SourceId	Source Region	SourceName	SourceDetail	SourceCounty	SourceBasin	SourceSubtype	Source Comments	Source Availability Comments	Source Methodology Comments
502	O	Alan Henry Lake/Reservoir		Reservoir	Brazos	Reservoir			
2188	O	Brazos Run-of-River	Combined Irrigation WR 12-3696, 12-3698, 12-3699	Dickens	Brazos	Run-of-River	NO FIRM YIELD ASSOCIATED WITH THIS SOURCE.		
2187	O	Brazos Run-of-River	Combined Irrigation WR 12-3708	Crosby	Brazos	Run-of-River	NO FIRM YIELD ASSOCIATED WITH THIS SOURCE.		
2189	O	Brazos Run-of-River	Combined Irrigation WR 12-3713	Lynn	Brazos	Run-of-River	NO FIRM YIELD ASSOCIATED WITH THIS SOURCE.		
2185	O	Brazos Run-of-River	Combined Municipal WR 12-3715 Post ISD	Garza	Brazos	Run-of-River	NO FIRM YIELD ASSOCIATED WITH THIS SOURCE.		
2186	O	Brazos Run-of-River	Municipal WR 12-3707 Town of Lake Ranson Canyon	Lubbock	Brazos	Run-of-River	NO FIRM YIELD ASSOCIATED WITH THIS SOURCE.		
2413	O	Lake 7 (Jim Bertram) Lake/Reservoir		Reservoir	Brazos	Reservoir			
558	O	Mackenzie Lake/Reservoir		Reservoir	Red	Reservoir			
2414	O	Post Lake/Reservoir		Reservoir	Brazos	Reservoir			
2181	O	Red Run-of-River	Irrigation WR 02-5099, 02-5212	Briscoe	Red	Run-of-River			
2182	O	Red Run-of-River	Irrigation WR 02-5101	Floyd	Red	Run-of-River			
2183	O	Red Run-of-River	Irrigation WR 02-5102	Motley	Red	Run-of-River			
2184	O	Red Run-of-River	Irrigation WR 02-5186	Parmer	Red	Run-of-River	NO FIRM YIELD ASSOCIATED WITH THIS SOURCE.		
2180	O	Red Run-of-River	Municipal WR 02-5220 TPWD Caprock Canyons State Park	Briscoe	Red	Run-of-River			
501	O	White River Lake/Reservoir		Reservoir	Brazos	Reservoir	NO FIRM YIELD ASSOCIATED WITH THIS SOURCE.	WAM RUN 3 INDICATES THAT THE FIRM YIELD OF THE WHITE RIVER RESERVOIR IS 0.	

C

Technical Memoranda:

2026 Regional Water Plan Population and Water Demand Revision Requests

2026 Llano Estacado Region O Regional Water Plan

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Memo

Date:	July 14, 2023
Project:	Llano Estacado (Region O) Regional Water Plan
To:	Katie Dahlberg, Texas Water Development Board
From:	Paula Jo Lemonds, PE, PG and Grady Reed, HDR, on behalf of the LERWPG
Subject:	**2026 Regional Water Plan Non-Municipal Water Demand Revision Requests**

Introduction

The Texas Water Development Board (TWDB) 2026 Regional Water Plan draft non-municipal water demand projections for the development of the 2026 Regional Water Plan (RWP) were provided to the Llano Estacado Regional Water Planning Group (LERWPG) for review in 2022. The purpose of this memorandum is to request revisions to the draft non-municipal water demand projections. The water demand projections were presented to the LERWPG at regular meetings of the LERWPG on March 3, 2022, September 20, 2022, December 7, 2022, February 22, 2023, May 10, 2023, and June 28, 2023. Additional detailed information regarding these revision requests is provided in this memorandum.

Steam-Electric Water User Groups

This section summarizes the recommended changes to the water demand projections for steam-electric water user groups.

The following tables show the recommended water demand revisions for steam-electric use in Hale, Lamb, Lubbock, and Yoakum counties.

2026 DRAFT TWDB Regional Water Plan Projections (acft/yr)						
County	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
HALE	29	29	29	29	29	29
LAMB	11,763	11,763	11,763	11,763	11,763	11,763
LUBBOCK	4,151	4,151	4,151	4,151	4,151	4,151
YOAKUM	1,596	1,596	1,596	1,596	1,596	1,596
Total	**17,539**	**17,539**	**17,539**	**17,539**	**17,539**	**17,539**

2026 DRAFT Regional Water Plan Projections (Recommended Revisions) (acft/yr)						
County	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
HALE	42	42	42	42	42	42
LAMB	5,789	3,000	3,000	3,000	3,000	3,000
LUBBOCK	2,909	2,000	2,000	2,000	2,000	2,000

2026 DRAFT Regional Water Plan Projections (Recommended Revisions) (acft/yr)						
County	2030	2040	2050	2060	2070	2080
YOAKUM	1,667	1,667	1,667	1,100	1,100	1,100
Total	**10,407**	**6,709**	**6,709**	**6,142**	**6,142**	**6,142**

Change from 2026 RWP TWDB Projections (Recommended Revisions 2026 RWP Projections) (acft/yr)						
County	2030	2040	2050	2060	2070	2080
HALE	13	13	13	13	13	13
LAMB	(5,974)	(8,763)	(8,763)	(8,763)	(8,763)	(8,763)
LUBBOCK	(1,242)	(2,151)	(2,151)	(2,151)	(2,151)	(2,151)
YOAKUM	71	71	71	(496)	(496)	(496)
Total	**(7,132)**	**(10,830)**	**(10,830)**	**(11,397)**	**(11,397)**	**(11,397)**

SUMMARY OF COMMENTS RECEIVED

- The power plants in each respective county are expected to use the volumes shown in the recommended table above.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- Email documenting projected water usage from Bret Yeary, P.E., Golden Spread Electric Cooperative, Inc. after his personal communications with the region’s power plant operators was received. See Attachment A.

LERWPG RECOMMENDATION

- Methodology – Revise steam-electric demand projections consistent with the recommended changes.

Livestock Water User Groups

This section summarizes the recommended changes to the water demand projections for livestock water uses.

The following tables show the recommended water demand projections and revisions for livestock in the 21 counties of the LERWPG.

2026 DRAFT TWDB Regional Water Plan Projections (acft/yr)						
County	2030	2040	2050	2060	2070	2080
BAILEY	3,792	4,127	4,491	4,892	5,321	5,321
BRISCOE	347	364	382	400	406	406
CASTRO	11,264	12,140	13,091	14,126	15,230	15,230
COCHRAN	280	288	299	310	313	313
CROSBY	180	189	198	208	210	210
DAWSON	84	89	94	99	101	101

2026 DRAFT TWDB Regional Water Plan Projections (acft/yr)						
County	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
DEAF SMITH	12,358	13,147	13,994	14,904	15,863	15,863
DICKENS	428	449	471	495	500	500
FLOYD	1,137	1,159	1,183	1,207	1,213	1,213
GAINES	236	242	250	256	258	258
GARZA	192	201	211	222	224	224
HALE	3,910	4,179	4,476	4,802	5,151	5,151
HOCKLEY	267	279	291	303	305	305
LAMB	5,545	6,011	6,519	7,076	7,677	7,677
LUBBOCK	725	747	772	798	820	820
LYNN	127	133	139	147	149	149
MOTLEY	373	392	411	432	437	437
PARMER	9,470	10,209	11,014	11,891	12,838	12,838
SWISHER	3,768	3,956	4,153	4,360	4,564	4,564
TERRY	435	464	496	530	553	553
YOAKUM	139	146	153	160	163	163
Total	**55,057**	**58,911**	**63,088**	**67,618**	**72,296**	**72,296**

2026 Draft Regional Water Plan Projections (Recommended Revisions) (acft/yr)						
County	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
BAILEY	2,471	2,829	2,854	2,790	2,730	2,673
BRISCOE	299	307	316	325	333	337
CASTRO	9,158	10,223	10,352	10,230	10,124	10,026
COCHRAN	110	113	115	117	119	120
CROSBY	175	180	185	189	194	196
DAWSON	64	65	67	69	71	72
DEAF SMITH	12,678	13,612	13,861	13,929	14,013	14,105
DICKENS	388	398	408	418	428	431
FLOYD	1,222	1,236	1,250	1,265	1,280	1,287
GAINES	143	146	148	151	154	156
GARZA	154	157	161	165	169	170
HALE	2,674	3,040	3,049	2,961	2,878	2,796
HOCKLEY	137	140	143	146	149	150
LAMB	4,467	5,111	5,157	5,041	4,934	4,833
LUBBOCK	823	830	837	844	851	853

2026 Draft Regional Water Plan Projections (Recommended Revisions) (acft/yr)						
County	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
LYNN	69	71	73	74	76	77
MOTLEY	277	284	291	298	306	308
PARMER	7,793	8,762	8,856	8,715	8,588	8,471
SWISHER	2,911	2,986	3,064	3,143	3,225	3,304
TERRY	880	1,011	1,020	996	974	947
YOAKUM	107	110	113	116	119	121
Total	**47,000**	**51,611**	**52,320**	**51,982**	**51,715**	**51,433**

Change from 2026 RWP TWDB Projections (Recommended Revisions 2026 RWP Projections) (acft/yr)						
County	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
BAILEY	(1,321)	(1,298)	(1,637)	(2,102)	(2,591)	(2,648)
BRISCOE	(48)	(57)	(66)	(75)	(73)	(69)
CASTRO	(2,106)	(1,917)	(2,739)	(3,896)	(5,106)	(5,204)
COCHRAN	(170)	(175)	(184)	(193)	(194)	(193)
CROSBY	(5)	(9)	(13)	(19)	(16)	(14)
DAWSON	(20)	(24)	(27)	(30)	(30)	(29)
DEAF SMITH	320	465	(133)	(975)	(1,850)	(1,758)
DICKENS	(40)	(51)	(63)	(77)	(72)	(69)
FLOYD	85	77	67	58	67	74
GAINES	(93)	(96)	(102)	(105)	(104)	(102)
GARZA	(38)	(44)	(50)	(57)	(55)	(54)
HALE	(1,236)	(1,139)	(1,427)	(1,841)	(2,273)	(2,355)
HOCKLEY	(130)	(139)	(148)	(157)	(156)	(155)
LAMB	(1,078)	(900)	(1,362)	(2,035)	(2,743)	(2,844)
LUBBOCK	98	83	65	46	31	33
LYNN	(58)	(62)	(66)	(73)	(73)	(72)
MOTLEY	(96)	(108)	(120)	(134)	(131)	(129)
PARMER	(1,677)	(1,447)	(2,158)	(3,176)	(4,250)	(4,367)
SWISHER	(857)	(970)	(1,089)	(1,217)	(1,339)	(1,260)
TERRY	445	547	524	466	421	394
YOAKUM	(32)	(36)	(40)	(44)	(44)	(42)
Total	**(8,057)**	**(7,300)**	**(10,768)**	**(15,636)**	**(20,581)**	**(20,863)**

SUMMARY OF COMMENTS RECEIVED

- Region O livestock water use is projected to decrease 29% by 2080 from TWDB projections due to differences in baseline inventory, changing conditions, and projected future growth.
- County level livestock water use projections vary considerably (up to 156%) from to TWDB projections.
- Region O livestock water use projections will need to be done at the regional level because of the differences in enterprise composition, changing conditions and an increasing lack of data to delineate confined livestock operations.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- Documentation of analysis provided by Ben Weinheimer, PE, Texas Cattle Feeders Association. See Attachment B.

LERWPG RECOMMENDATION

- Methodology – Revise consistent with the recommended changes for the 21 counties in Region O.

Irrigation Water User Groups

This section summarizes the recommended changes to the water demand projections for irrigation water uses.

The following tables show the recommended water demand revisions for the 21 counties in Region O.

2026 DRAFT TWDB Regional Water Plan Projections (acft/yr)						
County	2030	2040	2050	2060	2070	2080
BAILEY	64,633	64,633	56,440	51,651	48,632	46,583
BRISCOE	19,801	19,801	16,803	15,047	13,946	13,219
CASTRO	280,626	280,626	231,751	205,883	193,243	186,505
COCHRAN	90,152	90,152	82,322	76,618	71,689	68,093
CROSBY	66,991	66,991	66,991	66,991	66,991	66,991
DAWSON	73,566	73,566	73,566	73,566	73,566	73,566
DEAF SMITH	154,355	154,355	128,905	114,321	105,729	100,441
DICKENS	7,547	7,547	7,547	7,547	7,547	7,547
FLOYD	102,902	102,902	90,120	81,970	77,047	73,802
GAINES	302,466	302,466	284,212	271,717	262,846	256,663
GARZA	10,999	10,999	10,999	10,999	10,999	10,999
HALE	233,075	233,075	211,265	199,109	192,275	188,265
HOCKLEY	124,558	124,558	109,179	101,754	97,655	95,173
LAMB	187,495	187,495	169,906	161,881	157,686	155,243
LUBBOCK	148,178	148,178	142,706	138,883	136,105	133,963
LYNN	80,902	80,902	80,902	80,902	80,902	80,902
MOTLEY	8,998	8,998	8,998	8,998	8,998	8,998

2026 DRAFT TWDB Regional Water Plan Projections (acft/yr)						
County	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
PARMER	154,262	154,262	137,529	127,432	121,965	118,426
SWISHER	71,568	71,568	58,701	51,355	46,786	43,749
TERRY	114,037	114,037	102,045	95,832	92,198	89,898
YOAKUM	116,639	116,639	105,175	98,831	95,016	92,516
Total	**2,413,750**	**2,413,750**	**2,176,062**	**2,041,287**	**1,961,821**	**1,911,542**

2026 Draft Regional Water Plan Projections (Recommended Revisions) (acft/yr)						
County	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
BAILEY	58,170	47,535	37,454	27,373	24,677	23,508
BRISCOE	17,821	13,955	10,638	7,320	6,219	5,492
CASTRO	252,563	199,792	111,939	24,087	11,447	4,709
COCHRAN	81,137	69,185	58,077	46,968	42,039	38,443
CROSBY	60,292	60,292	49,031	37,771	30,463	25,891
DAWSON	66,209	66,209	66,209	66,209	62,701	59,384
DEAF SMITH	138,920	107,622	71,017	34,412	25,820	20,532
DICKENS	7,547	7,547	7,547	7,547	7,547	7,547
FLOYD	92,612	73,680	57,123	40,567	35,644	32,399
GAINES	272,219	246,656	192,147	137,639	128,768	122,585
GARZA	9,899	9,899	9,899	9,899	9,899	9,899
HALE	209,768	179,867	102,409	24,951	18,147	14,107
HOCKLEY	112,102	83,099	67,305	51,512	47,413	44,931
LAMB	168,746	142,169	83,500	24,830	20,958	19,645
LUBBOCK	133,360	122,065	99,966	77,867	75,089	72,947
LYNN	72,812	72,812	72,631	72,451	69,834	68,013
MOTLEY	8,998	8,998	8,998	8,998	8,998	8,998
PARMER	138,836	120,358	69,924	19,490	14,037	10,504
SWISHER	64,411	52,349	37,765	23,181	18,612	15,575
TERRY	102,633	86,664	86,664	86,664	84,701	82,401
YOAKUM	104,975	89,685	66,787	43,890	40,075	37,575
Total	**2,174,030**	**1,860,438**	**1,367,030**	**873,626**	**783,088**	**725,086**

Change from 2026 RWP TWDB Projections (Recommended Revisions 2026 RWP Projections) (acft/yr)						
County	2030	2040	2050	2060	2070	2080
BAILEY	(6,463)	(17,098)	(18,986)	(24,278)	(23,955)	(23,075)
BRISCOE	(1,980)	(5,846)	(6,165)	(7,727)	(7,727)	(7,727)
CASTRO	(28,063)	(80,834)	(119,812)	(181,796)	(181,796)	(181,796)
COCHRAN	(9,015)	(20,967)	(24,245)	(29,650)	(29,650)	(29,650)
CROSBY	(6,699)	(6,699)	(17,960)	(29,220)	(36,528)	(41,100)
DAWSON	(7,357)	(7,357)	(7,357)	(7,357)	(10,865)	(14,182)
DEAF SMITH	(15,435)	(46,733)	(57,888)	(79,909)	(79,909)	(79,909)
DICKENS	0	0	0	0	0	0
FLOYD	(10,290)	(29,222)	(32,997)	(41,403)	(41,403)	(41,403)
GAINES	(30,247)	(55,810)	(92,065)	(134,078)	(134,078)	(134,078)
GARZA	(1,100)	(1,100)	(1,100)	(1,100)	(1,100)	(1,100)
HALE	(23,307)	(53,208)	(108,856)	(174,158)	(174,128)	(174,158)
HOCKLEY	(12,456)	(41,459)	(41,874)	(50,242)	(50,242)	(50,242)
LAMB	(18,749)	(45,326)	(86,406)	(137,051)	(136,728)	(135,598)
LUBBOCK	(14,818)	(26,113)	(42,740)	(61,016)	(61,016)	(61,016)
LYNN	(8,090)	(8,090)	(8,271)	(8,451)	(11,068)	(12,889)
MOTLEY	0	0	0	0	0	0
PARMER	(15,426)	(33,904)	(67,605)	(107,942)	(107,928)	(107,922)
SWISHER	(7,157)	(19,219)	(20,936)	(28,174)	(28,174)	(28,174)
TERRY	(11,404)	(27,373)	(15,381)	(9,168)	(7,497)	(7,497)
YOAKUM	(11,664)	(26,954)	(38,388)	(54,941)	(54,941)	(54,941)
Total	(239,720)	(553,312)	(809,032)	(1,167,661)	(1,178,733)	(1,186,457)

SUMMARY OF COMMENTS RECEIVED

- The LERWPG Irrigation Committee met to discuss irrigation demands and potential revisions on March 21, 2023, and June 6, 2023, and the committee also met with TWDB staff to discuss irrigation demands and potential revisions on June 13, 2023.
- Region O irrigation water use is projected to decrease significantly more than TWDB projections reflect due to economic drivers of irrigated versus rainfed (dryland) agricultural production, increases in irrigation efficiency, decrease in irrigated acreage, and projected production changes, including crop-type production shifts and transition of land from farming to rangeland.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- Email documenting the decrease in irrigation received from Jason Coleman, PE, High Plains Water District. See Attachment C.

LERWPG RECOMMENDATION

Revision request methodology applied to most counties (exceptions are Dickens and Motley counties):

- 2030 demand value – 90% of TWDB 2026 projected irrigation demand
- 2040 demand value – Generally reduced at the same rate as from 2030 to 2040 in the 2021 Regional Water Plan irrigation projections. If the annual groundwater availability is lower than the baseline projection at the beginning of the planning period (2030), then beginning in 2040, the subsequent demands will parallel the trend of the groundwater availability, or the modeled available groundwater (MAG). If the annual groundwater availability equals or exceeds the default baseline annual groundwater projection at the beginning of the planning period (2030) but then falls below the baseline projection at a later point, then the irrigation water demand projections will not begin to parallel the groundwater availability until the following decade, after the point at which groundwater availability has fallen below the baseline demand projections.
- 2040-2050-2060 demand values: Straight line decrease to 2060 demand
- 2060 to 2080 demand values: Dependent on available groundwater
    - A. If Draft 2026 RWP irrigation demand for county is less than (Total MAG + Non-MAG -All other projected groundwater demands), then use Draft 2026 RWP irrigation demand

      Examples: Dickens, Motley counties
    - B. If Draft 2026 RWP irrigation demand for county is greater than (Total MAG + Non-MAG - All other projected groundwater demands), then use (Total MAG + Non-MAG - All other projected groundwater demands)

      Examples: Castro, Cochran
- Revise irrigation demand projections consistent with the recommended changes for the 21 counties in Region O.

  Irrigation demand projection revision methodology discussion and justification is provided in Attachment D.

Attachment A

Lemonds, Paula Jo

From: Bret Yeary <byeary@gsec.coop>
Sent: Monday, April 17, 2023 11:06 AM
To: Lemonds, Paula Jo
Subject: Region O Non-Muni Estimates
Attachments: RegionO_Non-Municipal_Apr2023.xlsx

Paula Jo,

I finally caught up with Xcel Energy and we updated electric generation water forecasts in the region. The revised numbers are in red text in columns N – S.

Let me know if you have any questions.

Bret Yeary, P.E.
806-337-1296 (o)
806-282-9081 (c)

		Historical Water Use Estimates					2021 Regional Water Plan Projections						2026 DRAFT Regional Water Plan Projections					
Region	County	2015	2016	2017	2018	2019	2020	2030	2040	2050	2060	2070	2030	2040	2050	2060	2070	2080
O	BAILEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	BRISCOE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	CASTRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	COCHRAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	CROSBY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	DAWSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	DEAF SMITH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	DICKENS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	FLOYD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	GAINES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	GARZA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	HALE	0	5	2	2	29	31	31	31	31	31	31	42	42	42	42	42	42
O	HOCKLEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	LAMB	11,763	10,534	9,050	8,676	6,755	13,450	13,450	13,450	13,450	13,450	13,450	5,789	3,000	3,000	3,000	3,000	3,000
O	LUBBOCK	3,246	2,797	1,779	4,151	4,114	5,694	5,694	5,694	5,694	5,694	5,694	2,909	2,000	2,000	2,000	2,000	2,000
O	LYNN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	MOTLEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	PARMER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	SWISHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	TERRY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	YOAKUM	0	1,302	1,110	1,592	1,596	1,910	1,910	1,910	1,910	1,910	1,910	1,667	1,667	1,667	1,100	1,100	1,100
Region Total		15,009	14,638	11,941	14,421	12,494	21,085	21,085	21,085	21,085	21,085	21,085	10,407	6,709	6,709	6,142	6,142	6,142

Attachment B

Lemonds, Paula Jo

From:	Ben Weinheimer <Ben@tcfa.org>
Sent:	Tuesday, May 23, 2023 4:21 PM
To:	Lemonds, Paula Jo
Subject:	RE: [EXTERNAL]Region O - Livestock Projections Revisions
Attachments:	Livstock Water Demands-A-O 9-27-22.pptx

Paula Jo,

Attached are the revised livestock demand projections for Region A and Region O.

Please refer to slide #23 for Region O livestock projections (see middle part of the table shaded in blue and labeled "2026 RWP O Projections).

Sorry it took me a bit to get this to you. Appreciate all your work on this!

Ben

From: Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
Sent: Wednesday, May 17, 2023 10:12 AM
To: Ben Weinheimer <Ben@tcfa.org>
Subject: [EXTERNAL]Region O - Livestock Projections Revisions

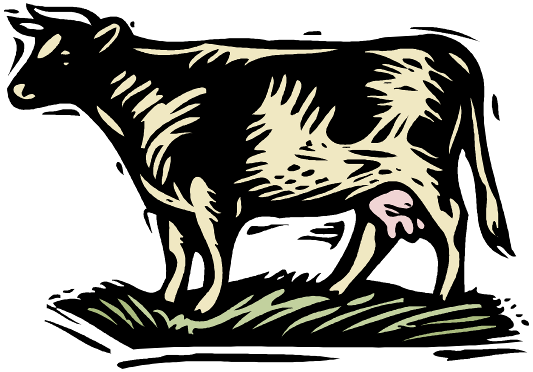
Hi Ben,

This message is a follow up to the voicemail I left for you a moment ago. If you would like to revise the livestock projections for Region O, could you send me the spreadsheet of recommended revisions that was presented at the subcommittee meeting late last year? Thank you!

Paula Jo Lemonds, PG, PE
Associate Vice President | Project Manager

HDR
4401 West Gate Blvd., Suite 400
Austin, TX 78745
D 512.912.5127 | **M** 512.921.7445
paula.lemonds@hdrinc.com

hdrinc.com/follow-us



Estimated SB6 Livestock Water Demands



Issues with TWDB 2021 Livestock Water Use Estimates

- Inability to assign accurately confined livestock operation inventories given information sources to counties due to disclosure problems.
- Failure to recognize differences in the unique livestock enterprise composition within the region.
- Insufficient delineation of water use by species estimates given enterprise composition differences.
- Lack of knowledge concerning ***changing conditions*** within the livestock sector within the region.

2026 RWP and TWDB daily livestock water use estimates per animal

Species	2026 RWP (gal/day)	2026 TWDB (gal/day)
Beef - All	-----	15
Beef Cows	20	-----
Fed Beef	12.5	-----
Summer Stockers	10	-----
Winter Stockers	8	-----
Dairy Cattle	60	55
Equine	12	12
Poultry - All	0.09	-----
Poultry: Hens	-----	0.09
Poultry: Broilers	-----	0.09
Swine - All	-----	5
Swine: Sows	17.5	-----
Swine: Nursery	2.5	-----
Swine: Finishing	5.0	-----

Baseline Livestock Inventories Data Sources

- **Beef Cows**
  - 2017 & previous Census of Agriculture
- **Fed Beef**
  - TCFA
- **Summer Stockers**
  - Estimated via Iterative procedure: (Permanent pasture acres – cow acres)/stocking rate (acres/stocker) * 90% to account for frictional loss
  - Data Sources: Census of Agriculture (pasture acres) & Texas A&M AgriLife Beef Specialist (stocking rates)

Baseline Livestock Inventories Data Sources

- **Winter Stockers**
  - FSA irrigated and dryland wheat acreage (5-year average)
  - Survey of County Agents - % of irrigated and dryland wheat grazed over the past 5 years
  - Irrigated and dryland stocking rates – producer surveys
- **Dairy Cattle**
  - Milk Market Administrator records – 3 or more dairies
  - Direct calls, County Agents, Texas A&M AgriLife Dairy Specialist for counties with less than 3 dairies
- **Equine & Poultry**
  - Census of Agriculture
- **Swine (including herd composition)**
  - Industry contacts and County Agents

Changing Conditions

- **Fed Beef**
  - New packing plant (Beef LLC) in Amarillo breaks ground in 2023 will process 3000 hd./day when it reached capacity
  - Cavaniness Beef Packers replacing ground beef facility in Amarillo. Capacity 2.4 times larger than old facility
- **Dairy**
  - Two new dairies (120,000 hd.) in Moore county and an associated cheese plant are under construction
  - Cacique is expected to open up a new cheese processing plant (200,000 sq. ft.) in Amarillo in late 2022 to make Mexican style cheeses, creams and yogurts.
  - Leprino Foods is opening dairy processing facility (850,000 sq. ft.)in Lubbock to produce mozzarella cheese and dairy ingredients – expected to open in 2026

Region O: Livestock Water Demand Analysis

Region O 2021 RWP and 2026 RWP projected livestock inventory growth by species, 2022 – 2080.

Species	2021 RWP	2026 RWP
(---Projected Growth Rates---)		
Beef Cows:		
2022 – 2080	0.50% annual growth rate	0.25% annual growth rate
Fed Beef:		
2022 – 2030	5.00% growth per decade starting in 2020 in Bailey, Castro, Deaf Smith Lamb, Parmer and Swisher Counties. No growth in other counties.	5.00% growth per decade starting in 2022 in Bailey, Castro, Deaf Smith Lamb, Parmer and Swisher Counties. No growth in other counties.
2030 - 2080	5% growth per decade starting in 2030 in Bailey, Castro, Deaf Smith Lamb, Parmer and Swisher Counties. No growth in other counties.	2.5% growth per decade starting in 2030 in Bailey, Castro, Deaf Smith Lamb, Parmer and Swisher Counties. No growth in other counties.
Summer Stockers:		
2022 - 2080	0.50% annual growth rate	0.25% annual growth rate
Winter Stockers:		
2022 - 2080	0.50% annual growth rate	0.50% annual growth rate

Region O 2021 RWP and 2026 RWP projected livestock inventory growth by species, 2022 – 2080.

Species	2021 RWP	2026 RWP
(---Projected Growth Rates---)		
Dairy Cattle:		
2022 - 2030	2.00% annual growth rate in all dairy counties (Bailey, Castro, Deaf Smith, Hale, Lamb, Parmer and Terry).	1.00% growth rate in all dairy counties.
2030 - 2040	1.00% annual growth rates in all dairy counties.(2030 – 2070)	1.00% annual growth rate in all dairy counties
2040– 2080		0.00% Growth 2040 – 2060 and 2060 – 2080 and a 5.00% decrease per decade in all dairy counties
Equine		
2022 – 2080	0.00%	0.00%
Poultry:		
2022 - 2080	0.00%	0.00%
Swine:		
2022 - 2080	0.00%	0.00%

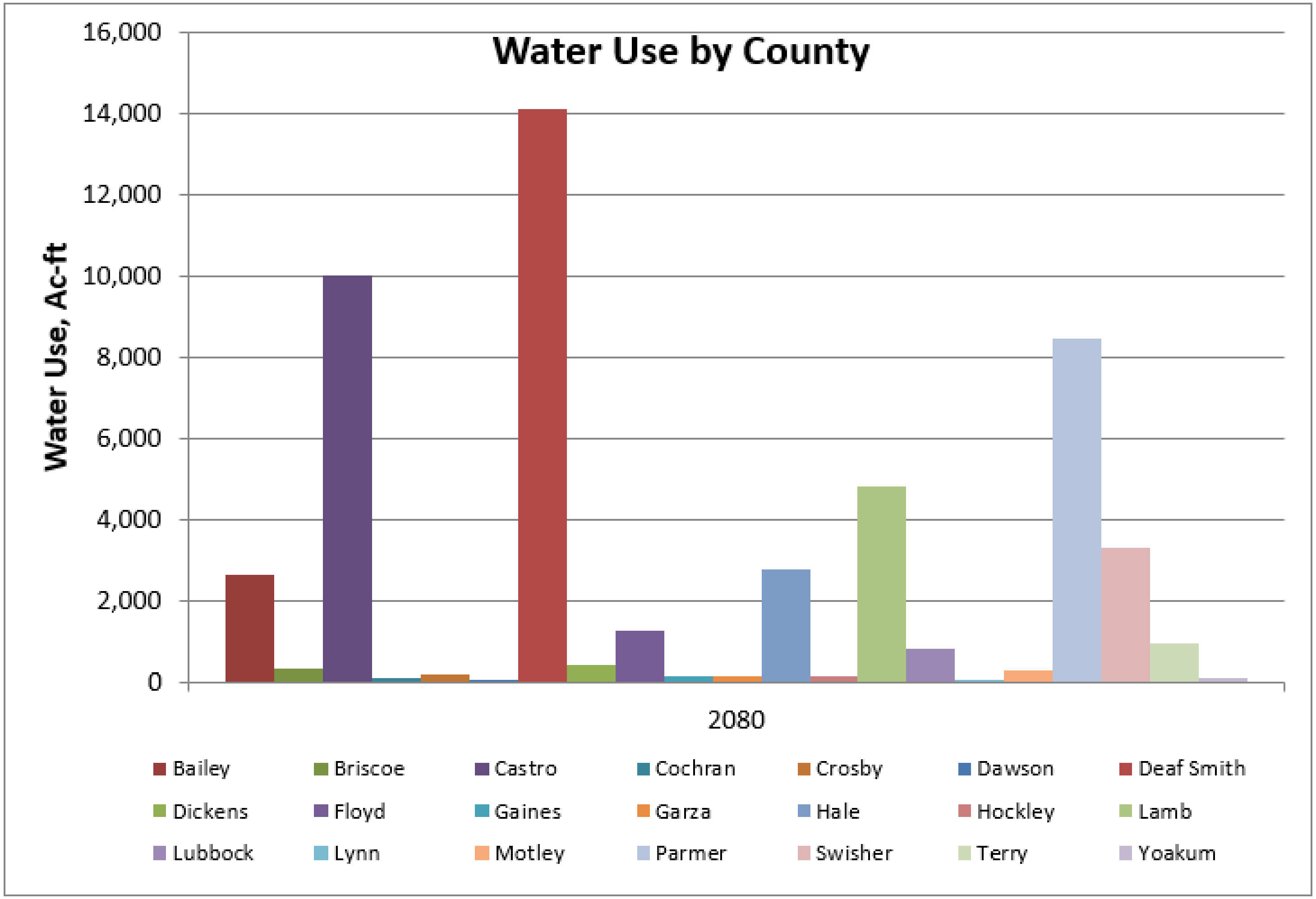
Region O Decadal livestock inventories by species for 2021 and 2026 RWPs.

Species	2021 RWP 2020	2026 RWP 2030	2021 RWP 2070	2026 RWP 2080
	(----------Number of Head----------)			
Beef Cows	140,663	141,371	156,219	160,168
Fed Beef	1,533,825	1,683,999	1,842,759	1,884,960
Summer Stockers	120,568	121,173	133,902	137,288
Winter Stockers	103,283	272,706	332,917	349,943
Dairy Cattle	208,734	266,162	293,503	279,152
Equine	9,641	9,393	9,641	9,393
Poultry	3,264,680	2,746,941	3,264,680	2,746,941
Swine	3,428	7,156	3,428	7,156

2026 RWP Livestock Water Use by County in Region O, 2030 – 2080, Ac-ft.

County	2030	2040	2050	2060	2070	2080
BAILEY	2,471	2,829	2,854	2,790	2,730	2,673
BRISCOE	299	307	316	325	333	337
CASTRO	9,158	10,223	10,352	10,230	10,124	10,026
COCHRAN	110	113	115	117	119	120
CROSBY	175	180	185	189	194	196
DAWSON	64	65	67	69	71	72
DEAF SMITH	12,678	13,612	13,861	13,929	14,013	14,105
DICKENS	388	398	408	418	428	431
FLOYD	1,222	1,236	1,250	1,265	1,280	1,287
GAINES	143	146	148	151	154	156
GARZA	154	157	161	165	169	170
HALE	2,674	3,040	3,049	2,961	2,878	2,796
HOCKLEY	137	140	143	146	149	150
LAMB	4,467	5,111	5,157	5,041	4,934	4,833
LUBBOCK	823	830	837	844	851	853
LYNN	69	71	73	74	76	77
MOTLEY	277	284	291	298	306	308
PARMER	7,793	8,762	8,856	8,715	8,588	8,471
SWISHER	2,911	2,986	3,064	3,143	3,225	3,304
TERRY	880	1,011	1,020	996	974	947
YOAKUM	107	110	113	116	119	121
Total	**47,000**	**51,611**	**52,320**	**51,982**	**51,715**	**51,433**

Region O Livestock Water Use by County, 2080

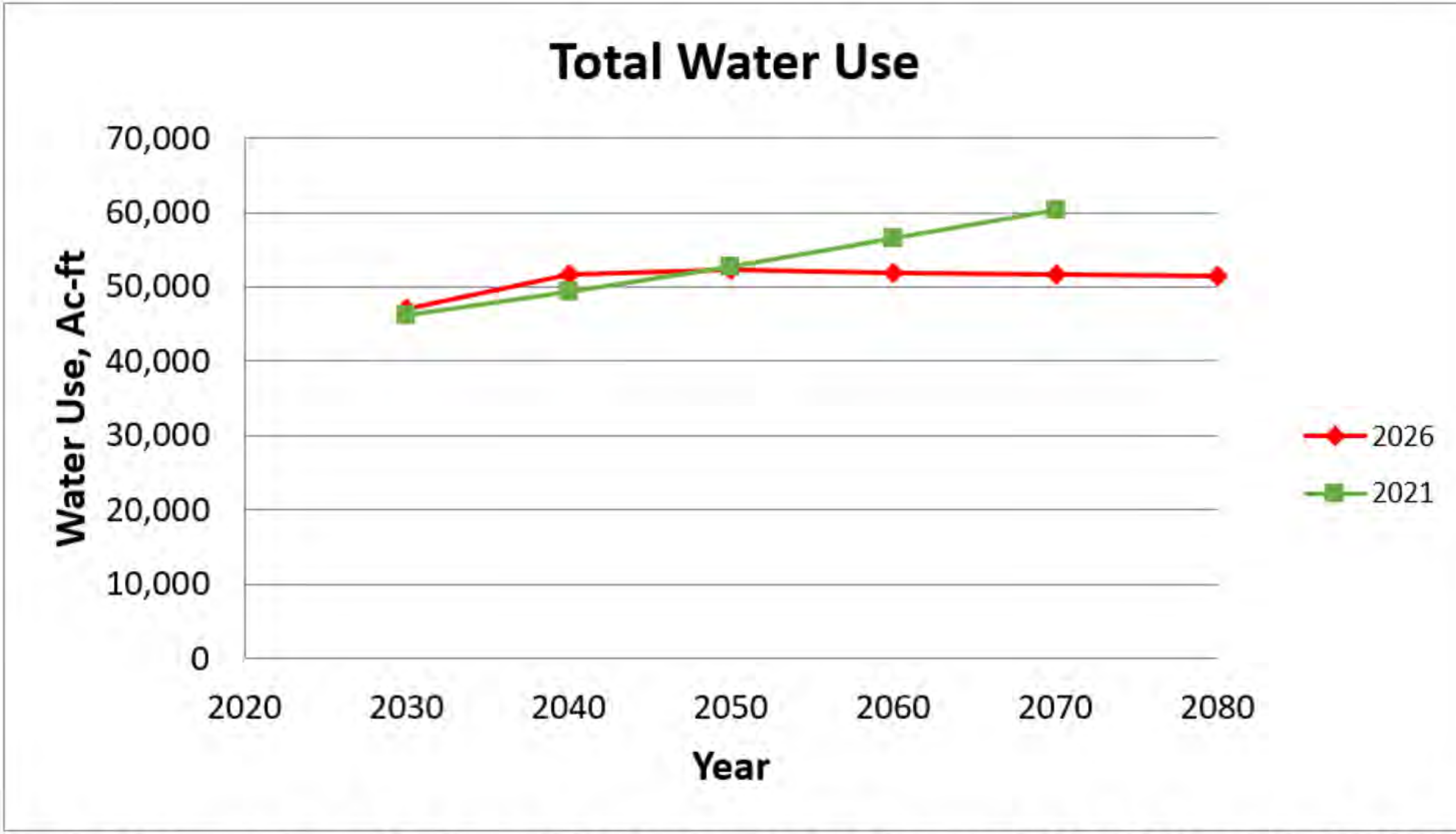


Region O 2026 RWP livestock water use by species for selected years in Ac-ft.

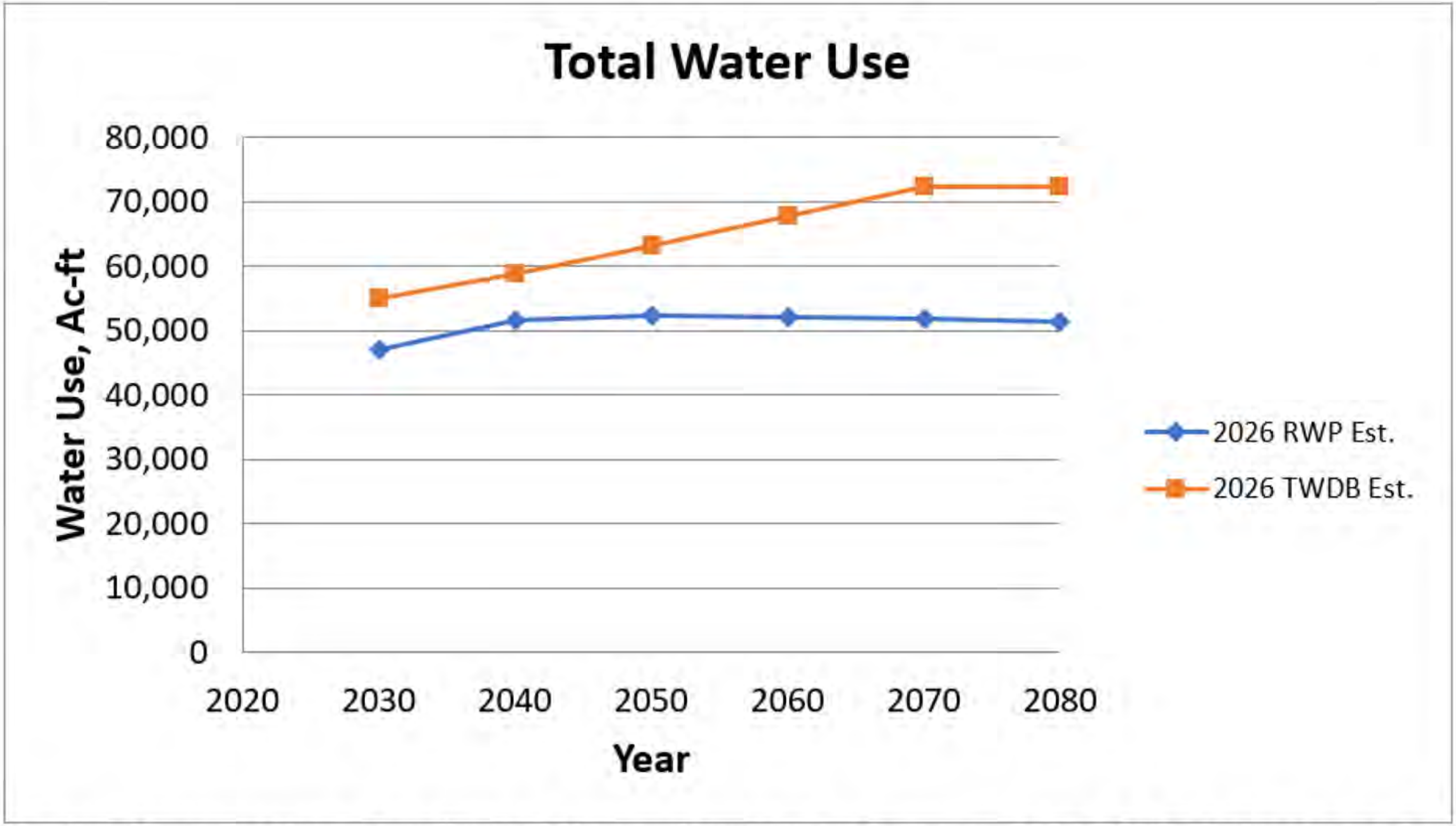
Species	2030	2040	2050	2060	2070	2080
Fed Cattle	23,581	24,117	24,665	25,227	25,805	26,394
Beef Cows	3,166	3,248	3,330	3,413	3,501	3,501
Stockers	1,920	2,002	2,073	2,157	2,245	2,333
Dairy Cows	17,888	21,807	21,807	20,739	19,725	18,761
Swine	39	39	39	39	39	39
Equine	125	125	125	125	125	125
Poultry	276	276	276	276	276	276
Total	46,995	51,614	52,315	51,976	51,716	51,429

Comparison of 2026 TWDB RWP Draft Projections and 2026 RWP O Water Demand Projections - Livestock (in acre-feet)

	2026 TWDB RWP Draft Projections						2026 RWP O Projections						% Change from TWDB 2021 to 2026 RWP (%)					
County	2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
BAILEY	3,792	4,127	4,491	4,892	5,321	5,321	2,471	2,829	2,854	2,790	2,730	2,673	-34.8	-31.5	-36.4	-43.0	-48.7	-49.8
BRISCOE	347	364	382	400	406	406	299	307	316	325	333	337	-13.7	-15.5	-17.3	-18.9	-17.9	-17.0
CASTRO	11,264	12,140	13,091	14,126	15,230	15,230	9,158	10,223	10,352	10,230	10,124	10,026	-18.7	-15.8	-20.9	-27.6	-33.5	-34.2
COCHRAN	280	288	299	310	313	313	110	113	115	117	119	120	-60.5	-60.9	-61.7	-62.3	-62.0	-61.7
CROSBY	180	189	198	208	210	210	175	180	185	189	194	196	-2.6	-4.8	-6.8	-9.0	-7.5	-6.7
DAWSON	84	89	94	99	101	101	64	65	67	69	71	72	-24.1	-26.4	-28.4	-30.1	-29.6	-28.6
DEAF SMITH	12,358	13,147	13,994	14,904	15,863	15,863	12,678	13,612	13,861	13,929	14,013	14,105	2.6	3.5	-1.0	-6.5	-11.7	-11.1
DICKENS	428	449	471	495	500	500	388	398	408	418	428	431	-9.3	-11.4	-13.5	-15.6	-14.4	-13.9
FLOYD	1,137	1,159	1,183	1,207	1,213	1,213	1,222	1,236	1,250	1,265	1,280	1,287	7.5	6.7	5.7	4.8	5.5	6.1
GAINES	236	242	250	256	258	258	143	146	148	151	154	156	-39.3	-39.8	-40.6	-41.0	-40.4	-39.7
GARZA	192	201	211	222	224	224	154	157	161	165	169	170	-20.0	-21.8	-23.7	-25.8	-24.7	-24.3
HALE	3,910	4,179	4,476	4,802	5,151	5,151	2,674	3,040	3,049	2,961	2,878	2,796	-31.6	-27.2	-31.9	-38.3	-44.1	-45.7
HOCKLEY	267	279	291	303	305	305	137	140	143	146	149	150	-48.7	-49.9	-50.9	-51.9	-51.2	-50.8
LAMB	5,545	6,011	6,519	7,076	7,677	7,677	4,467	5,111	5,157	5,041	4,934	4,833	-19.4	-15.0	-20.9	-28.8	-35.7	-37.0
LUBBOCK	725	747	772	798	820	820	823	830	837	844	851	853	13.5	11.1	8.4	5.7	3.7	4.0
LYNN	127	133	139	147	149	149	69	71	73	74	76	77	-45.8	-46.9	-47.8	-49.3	-48.7	-48.1
MOTLEY	373	392	411	432	437	437	277	284	291	298	306	308	-25.9	-27.7	-29.3	-31.0	-30.1	-29.6
PARMER	9,470	10,209	11,014	11,891	12,838	12,838	7,793	8,762	8,856	8,715	8,588	8,471	-17.7	-14.2	-19.6	-26.7	-33.1	-34.0
SWISHER	3,768	3,956	4,153	4,360	4,564	4,564	2,911	2,986	3,064	3,143	3,225	3,304	-22.7	-24.5	-26.2	-27.9	-29.3	-27.6
TERRY	435	464	496	530	553	553	880	1,011	1,020	996	974	947	102.3	117.9	105.7	87.9	76.1	71.2
YOAKUM	139	146	153	160	163	163	107	110	113	116	119	121	-23.1	-24.8	-26.3	-27.5	-26.9	-26.0
Region Total	55,057	58,911	63,088	67,618	72,296	72,296	47,000	51,611	52,320	51,982	51,715	51,433	-14.6	-12.4	-17.1	-23.1	-28.5	-28.9



Region O comparison of estimated livestock water use between 2021 RWP and 2026 RWP for selected years.



Region O comparison of estimated livestock water use between 2026 RWP Estimates and 2026 TWDB Estimates for selected years.

Summary & Conclusion

- Region A livestock water use is projected to be up 3% and Region O down 29% by 2080 from the TWDB projections due to differences in baseline inventory, changing conditions and projected future growth
- County level livestock water use projections vary considerably (up to 156%) from the TWDB projections
- **Conclusion:** Livestock water use projections will need to be done at the regional level because of the differences in enterprise composition, changing conditions and an increasing lack of data to delineate confined livestock operations.

Questions ???

Comments???

Attachment C

Lemonds, Paula Jo

From: Jason Coleman <jason.coleman@hpwd.org>
Sent: Tuesday, May 23, 2023 10:27 AM
To: Lemonds, Paula Jo
Subject: RE: Region O - Irrigation Demand Revision justification
Attachments: HPWD irrigation usage.xlsx

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

I have attached the total irrigation water usage for HPWD since 1985. I added a simple linear trendline in the chart for reference.

As for explanatory text, we might also consider the following as examples:

1. Prior Region O water plans contemplated methods of meeting large irrigation demands. These include **precipitation enhancement**, as well as **water importation from Arkansas**.
2. Precip enhancement was tried and subsequently discontinued many years ago. Local opposition to weather modification resulted in its termination in 2001.
3. Water importation is too costly for agricultural irrigation, and poses numerous environmental challenges. It is no longer a feasible strategy.
4. Reduction in irrigated acreage, use of conservation tools, and adding more wells has been the primary method of managing irrigation needs.

We can talk more by phone if you would like. Let me know what you think.

Regards

Jason Coleman, P.E.
Manager
High Plains Water District
www.hpwd.org

From: Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
Sent: Monday, May 22, 2023 1:30 PM
To: Jason Coleman <jason.coleman@hpwd.org>
Subject: [EXTERNAL]Region O - Irrigation Demand Revision justification

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Jason,

This message is a follow up to the voicemail I left for you a moment ago. Do you know of any documentation, HPWD-authored or another author, that we should include in the justification for revision of the irrigation demands?
This could be water use data showing decreases, economic reasons, annual reports, etc.

Thank you for your help. If a call would be more useful, let me know and we can visit. Thank you!

Paula Jo Lemonds, PG, PE
Associate Vice President | Project Manager

HDR
4401 West Gate Blvd., Suite 400
Austin, TX 78745
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Attachment D

Attachment D. Irrigation Demand Revision Justification

Introduction

The Llano Estacado (Region O) Regional Water Planning Group (LERWPG) is requesting a revision to the draft irrigation demand projections for most of the counties within the region. According to data collected by the High Plains Water District, the long-term (1985 to 2021) trend for irrigation water usage has been declining as shown in Figure 1.

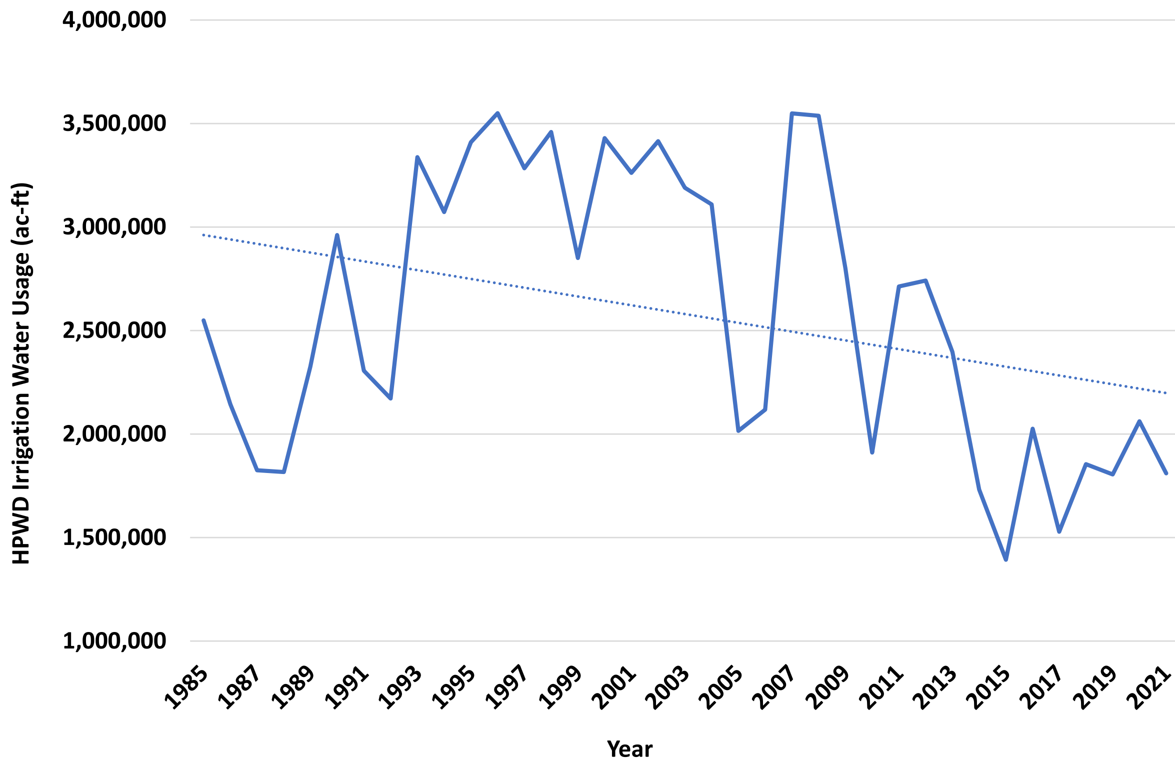


Figure 1. Estimated irrigation water usage from 1985 to 2021 within the HPWD area

As water levels in the High Plains (Ogallala) Aquifer continue to decline, irrigation costs increase as the cost to pump groundwater from greater depths below the ground surface and from less transmissible formations for irrigation operations increase. As this occurs, irrigated farmland is being converted to rainfed (dryland) farming or is being used for cattle or other livestock grazing.

According to Modeled Available Groundwater (MAG) data supplied by the Texas Water Development Board (TWDB), enough groundwater is not available to meet all demands, including irrigation, in many Region O counties. Feasible water management strategies to meet irrigation shortages (i.e. any project to meet needs results in water that is not economical to use for irrigation purposes) do not exist. As water availability in the region declines, irrigation pumpage will also see a decline due to less available water, with available water generally being used for municipal and other purposes before being used for irrigation.

Summary of Analysis

This revision request meets the following criteria for adjustment.

“Evidence that recent (10-years or less) are more indicative of future trends than the draft water demand projections”

Figures for each Region O county showing historical irrigation use estimates as provided by the TWDB, TWDB draft irrigation demand projections and the requested revised demands are included at the conclusion of the attachment. In most cases, a downward trend in the volume of water pumped for irrigation purposes exists. In contrast, the draft TWDB demand projections include average irrigation demand calculated from historical use estimates from 2015 to 2019 held constant for the projection decade from 2030 to 2040.

Irrigation Demand Methodology

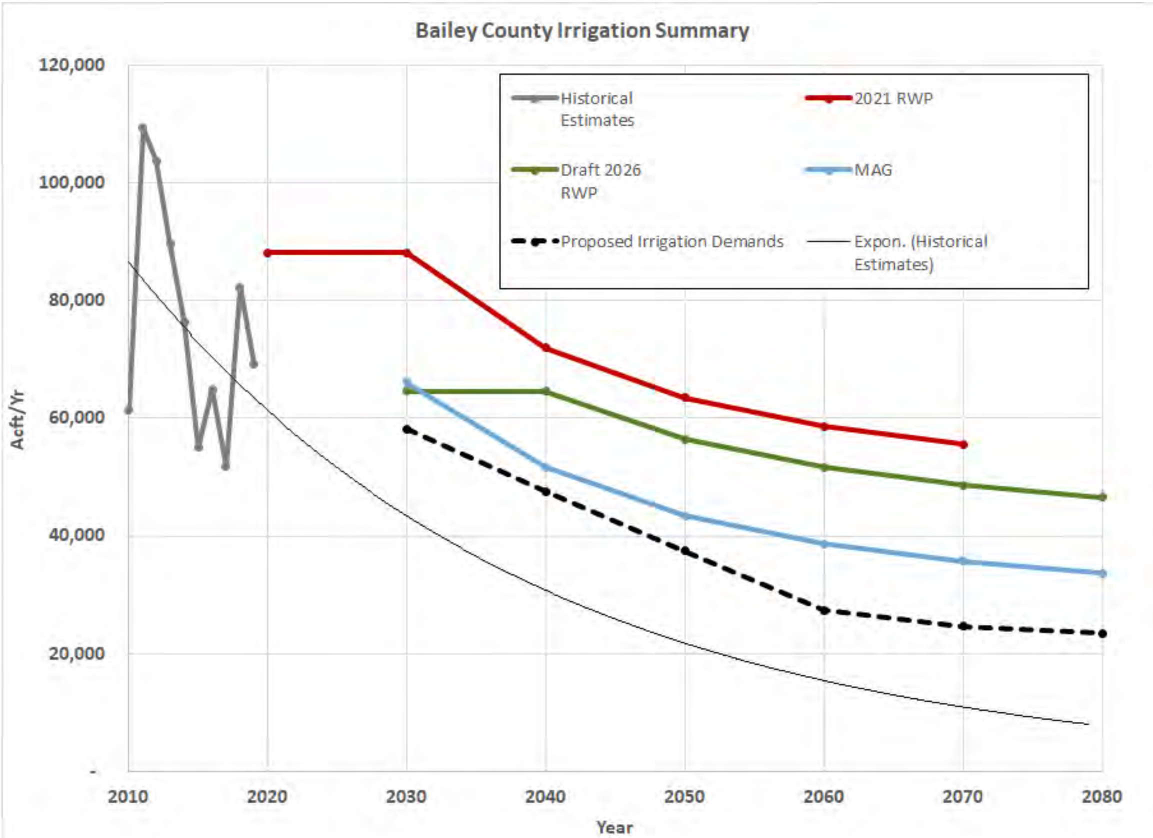
To determine the revised irrigation demand values for each Region O County, the following steps were used.

- 2030 demand value – 90% of TWDB 2026 projected irrigation demand
- 2040 demand value – Generally reduced at the same rate as from 2030 to 2040 in the 2021 Regional Water Plan irrigation projections. If the annual groundwater availability is lower than the baseline projection at the beginning of the planning period (2030), then beginning in 2040, the subsequent demands will parallel the trend of the groundwater availability, or the modeled available groundwater (MAG). If the annual groundwater availability equals or exceeds the default baseline annual groundwater projection at the beginning of the planning period (2030) but then falls below the baseline projection at a later point, then the irrigation water demand projections will not begin to parallel the groundwater availability until the following decade, after the point at which groundwater availability has fallen below the baseline demand projections.
- 2040-2050-2060 demand values: Straight line decrease to 2060 demand
- 2060 to 2080 demand values: Dependent on available groundwater
    - The latest MAG values for each county were used to determine total groundwater availability.
    - Municipal pumpage for non-County-Other entities was assumed to remain the same as in the previous regional water plan.
    - Supplies from the Ogallala Aquifer for County-Other entities were generally set to the maximum demand during the planning period (in some cases, other sources were considered and included as a supply).
    - Supplies for other use types (Manufacturing, Mining, Steam-Electric and Livestock) were generally set to the maximum demand during the planning period (in some cases, other available supplies were considered).
    - Supplies for irrigation were set to zero.
    - The remaining groundwater availability was then used as the revised irrigation demands. If this value was higher than the TWDB draft demand, then the lower of the two values was used.

Using the methodology outlined above does not preclude irrigation shortages, or unmet irrigation needs, within Region O. The analysis described does not consider supplies to other regions, supplies needed for water management strategies, or any changes in demand for other use categories.

Demand Summary

The draft irrigation demand projections for Region O are 2.4 million acft in 2030, declining to 1.9 million acft in 2080. The proposed irrigation demand projection revisions are 2.2 million acft in 2030, declining to approximately 725,000 acft in 2080. The LEWRPG believes the revised irrigation demands are commensurate with actual irrigation water use in the future.



Bailey County Irrigation Summary
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100,000
80,000
60,000
40,000
20,000
-
Acft/Yr
2010
2020
2030
2040
2050
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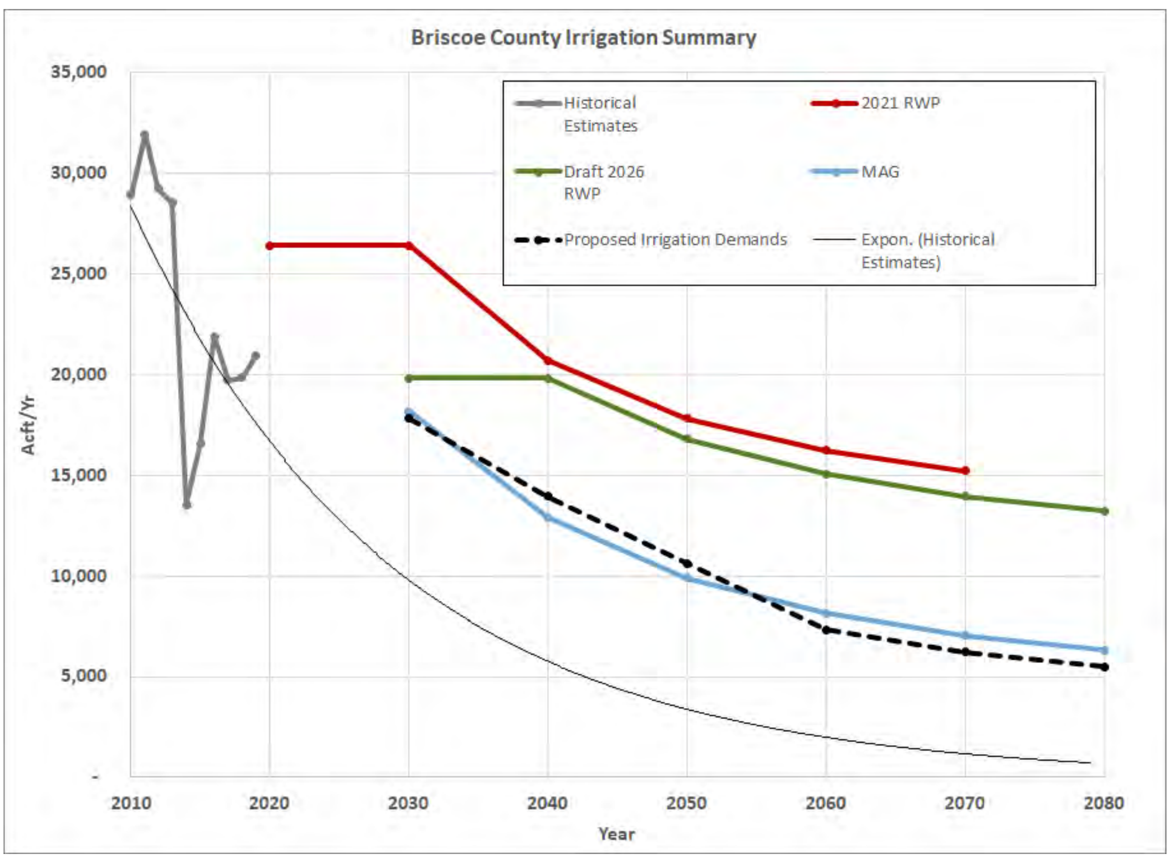
2080
Year
Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)



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30,000
25,000
20,000
15,000
10,000
5,000
-
Acft/Yr
2010
2020
2030
2040
2050
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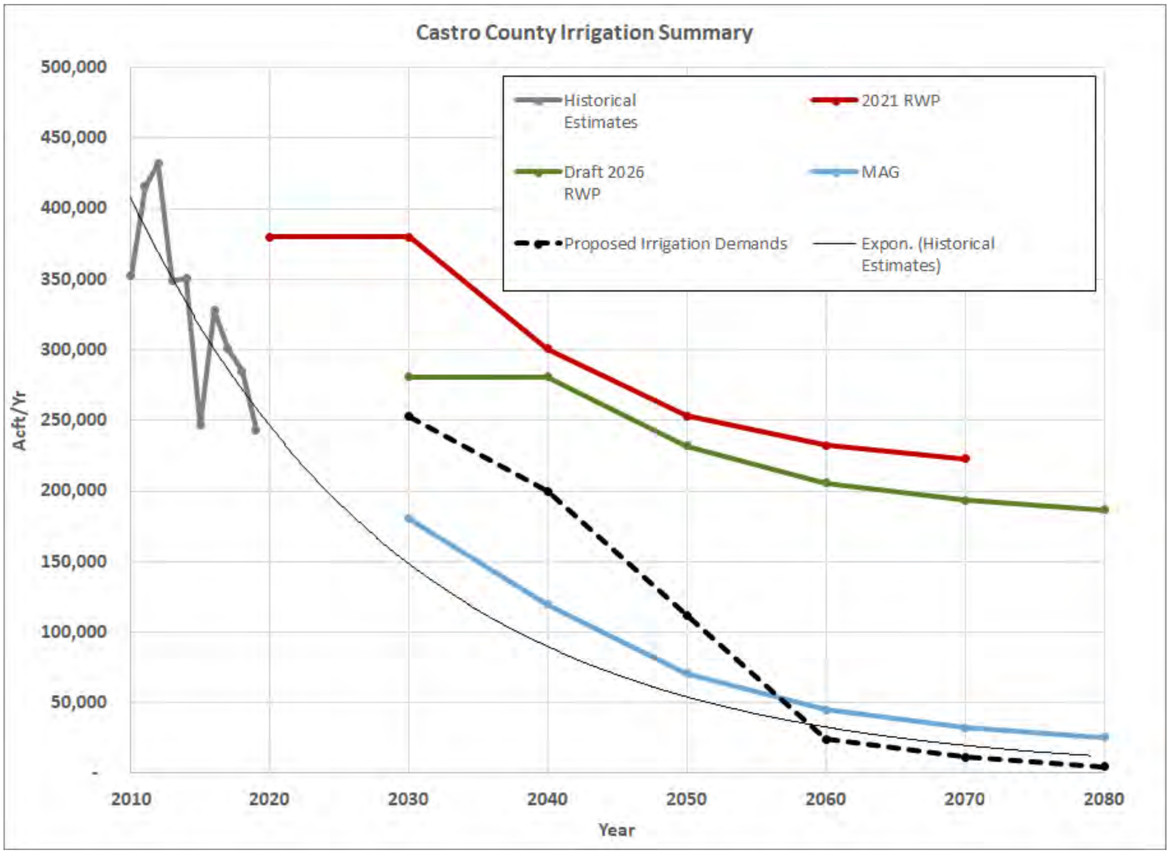
2080
Year
Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)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200,000
150,000
100,000
50,000
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Acft/Yr
2010
2020
2030
2040
2050
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2070
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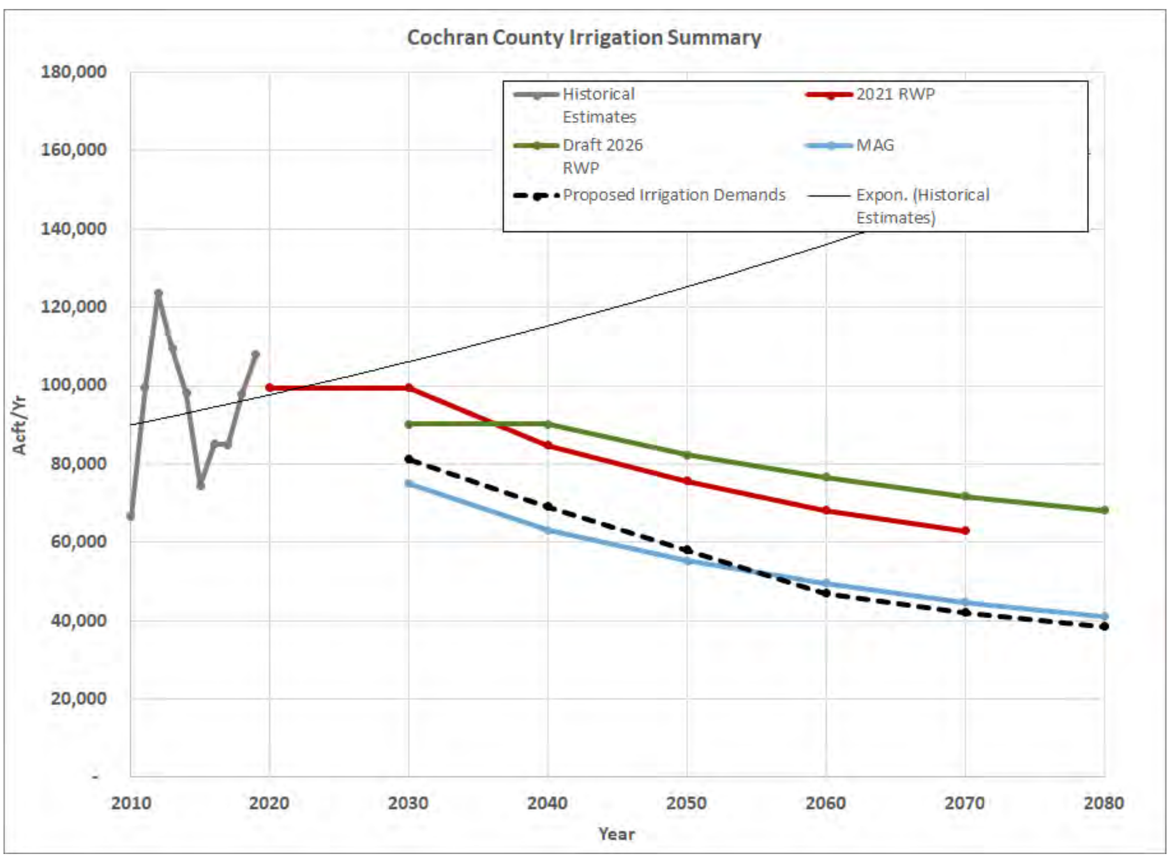
Year
Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)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80,000
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40,000
20,000
-
Acft/Yr
2010
2020
2030
2040
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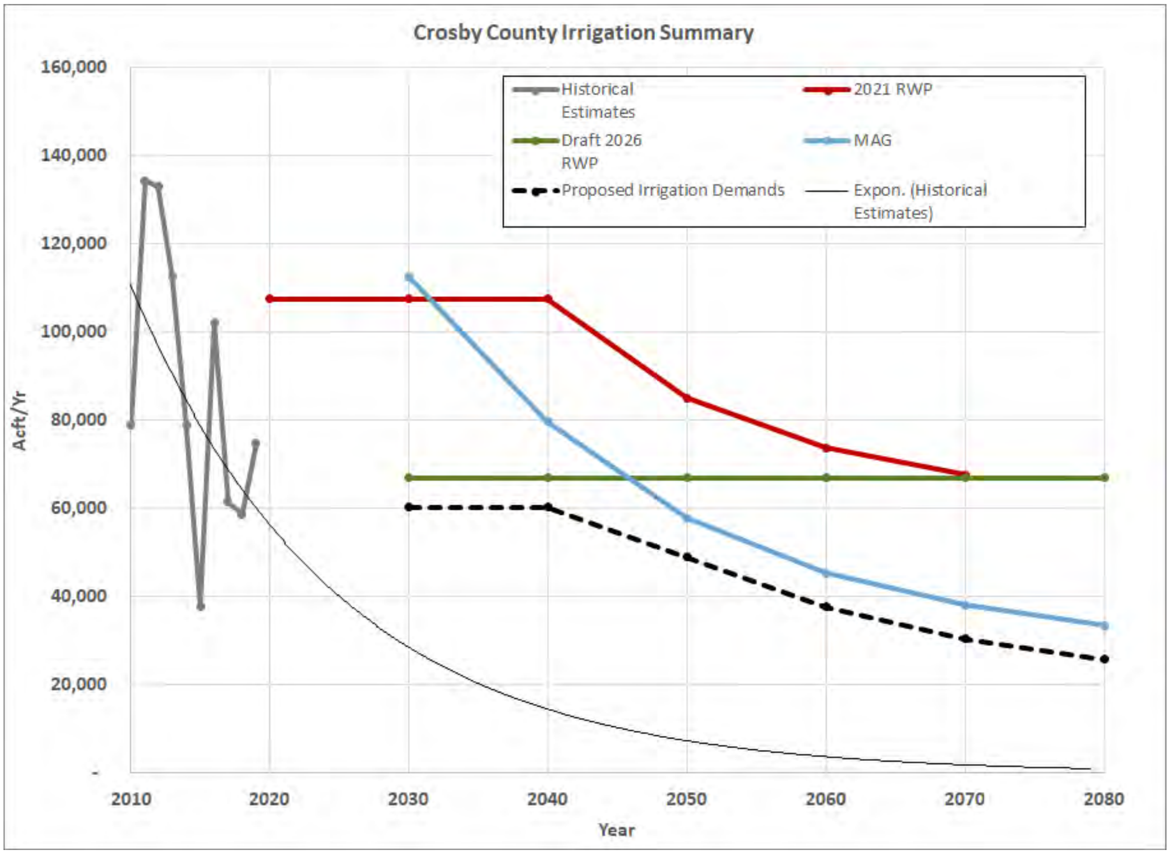
Year
Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)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Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)
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140,000
120,000
100,000
80,000
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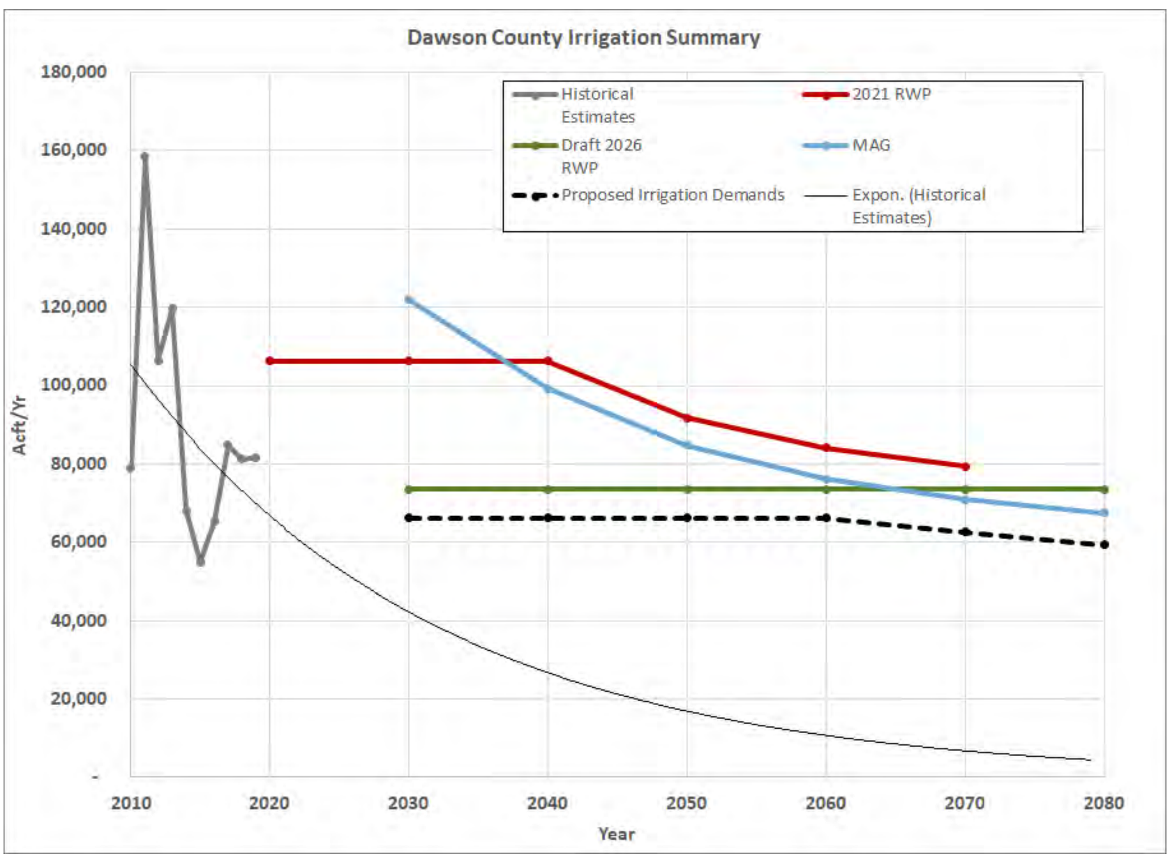
40,000
20,000
-
Acft/Yr
2010
2020
2030
2040
2050
2060
2070
2080
Year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Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)
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140,000
120,000
100,000
80,000
60,000
40,000
20,000
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Acft/Yr
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2020
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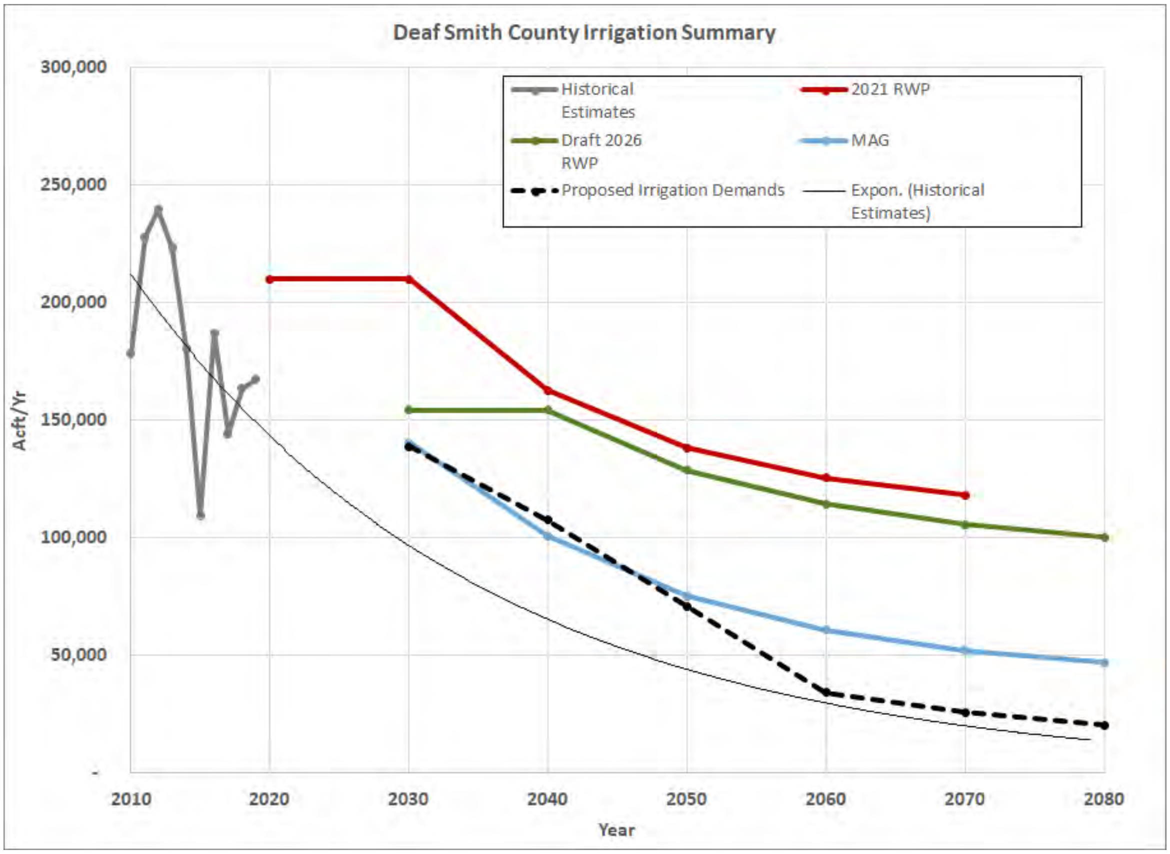
Year



Deaf Smith County Irrigation Summary
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200,000
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50,000
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Acft/Yr
2010
2020
2030
2040
2050
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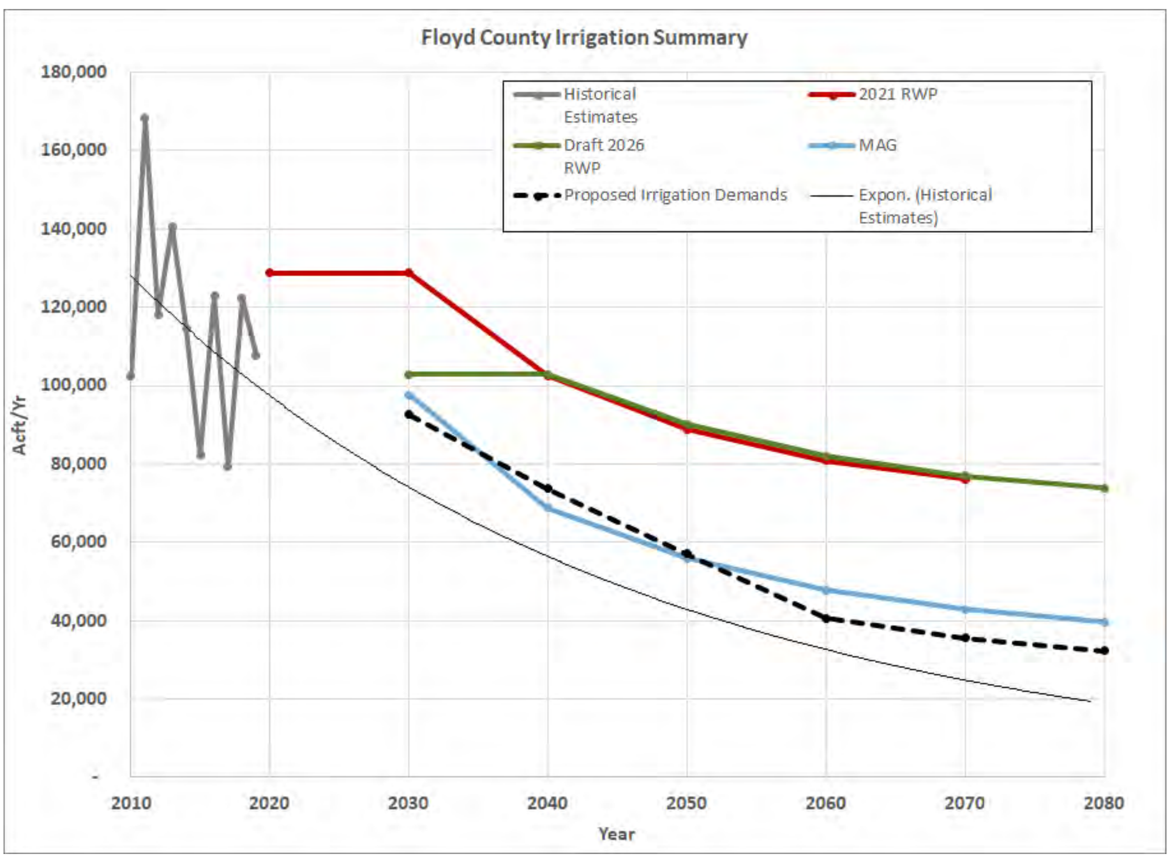
Year
Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)



Floyd County Irrigation Summary
180,000
160,000
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120,000
100,000
80,000
60,000
40,000
20,000
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Acft/Yr
2010
2020
2030
2040
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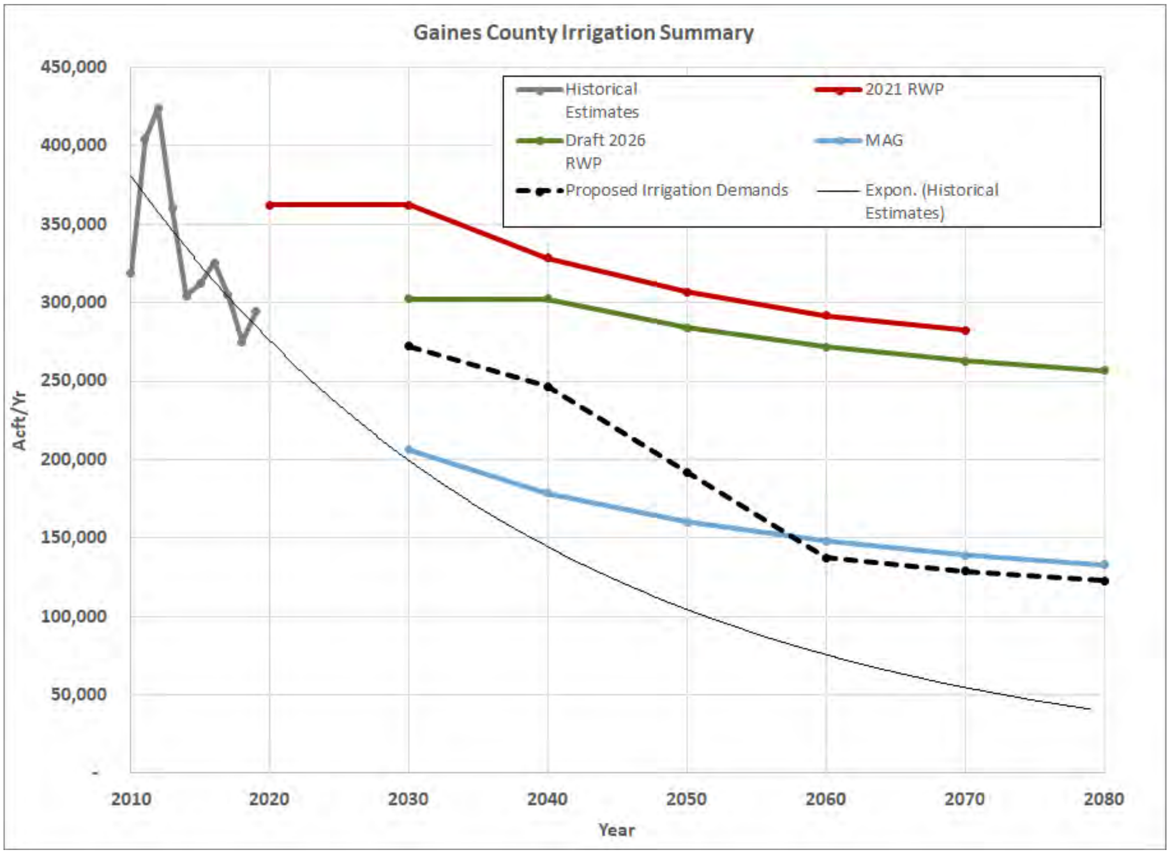
Year
Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)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Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)
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400,000
350,000
300,000
250,000
200,000
150,000
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Acft/Yr
2010
2020
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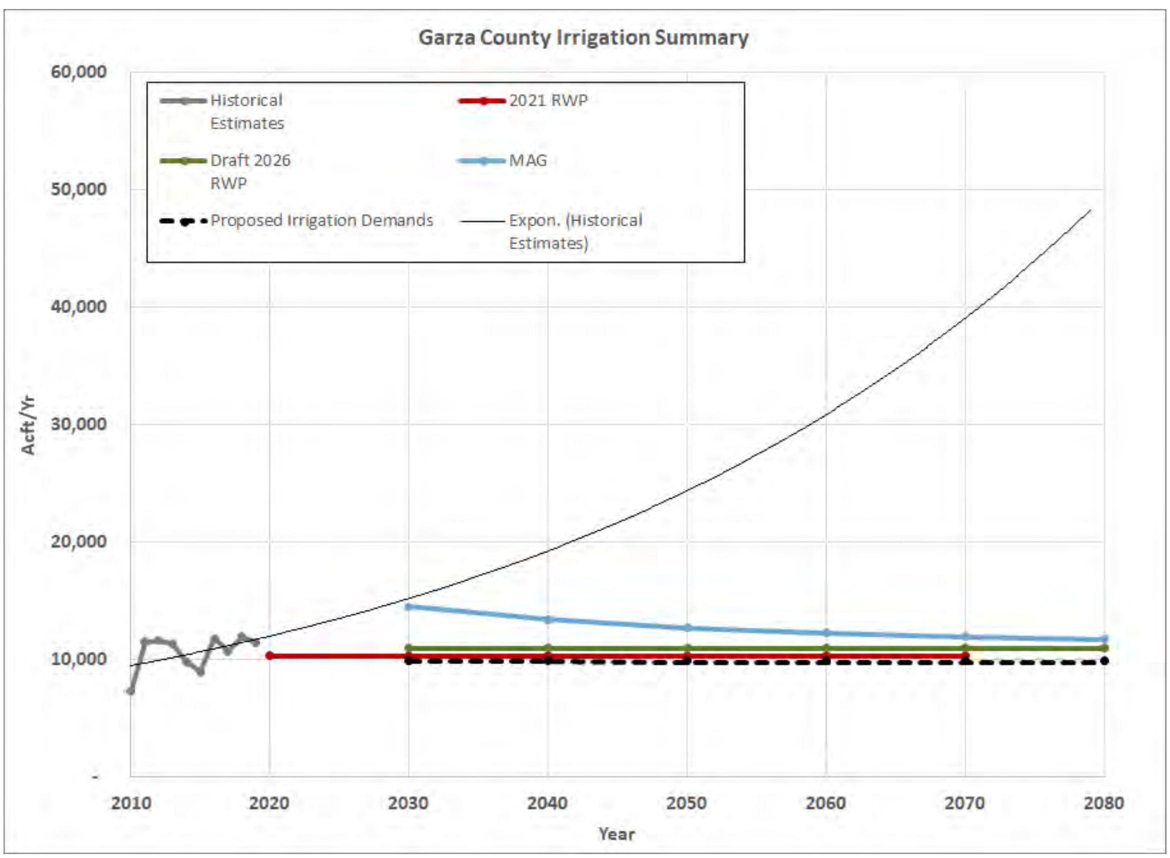
Year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Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)
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50,000
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Acft/Yr
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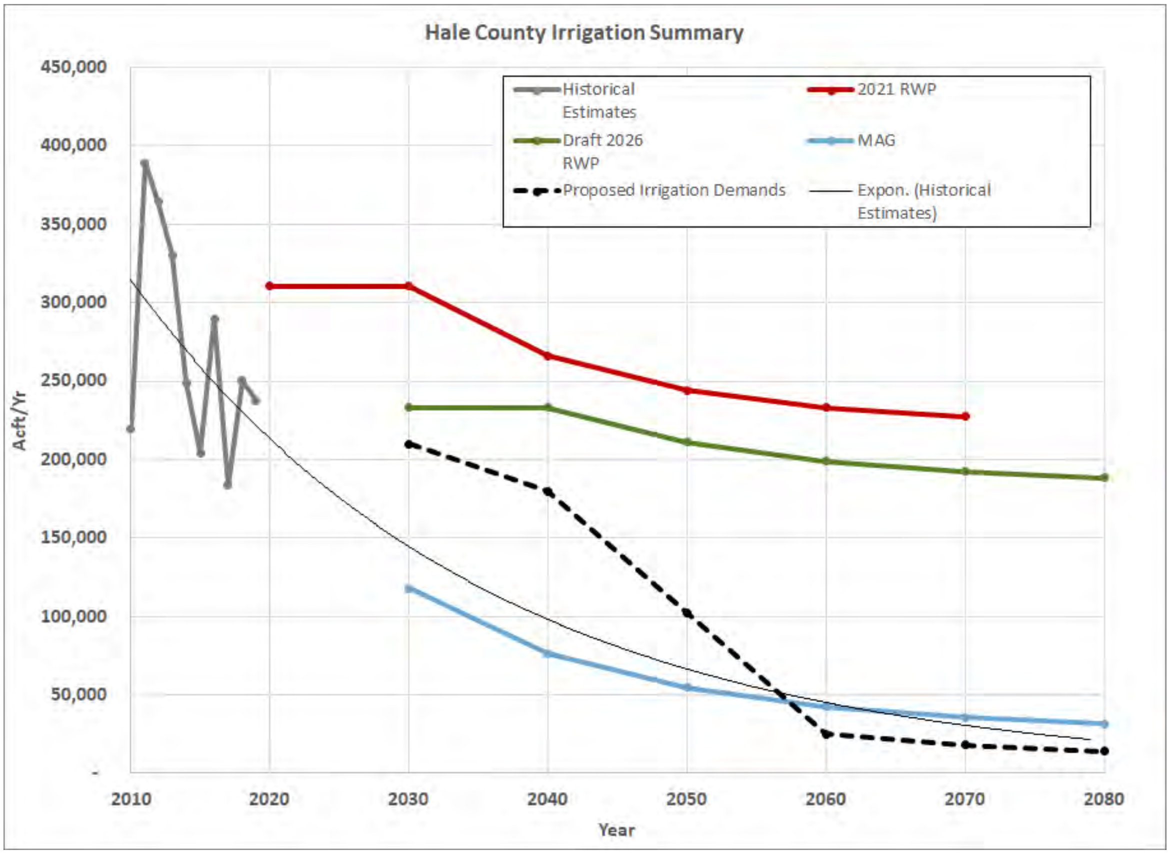
Year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250,000
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150,000
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Acft/Yr
2010
2020
2030
2040
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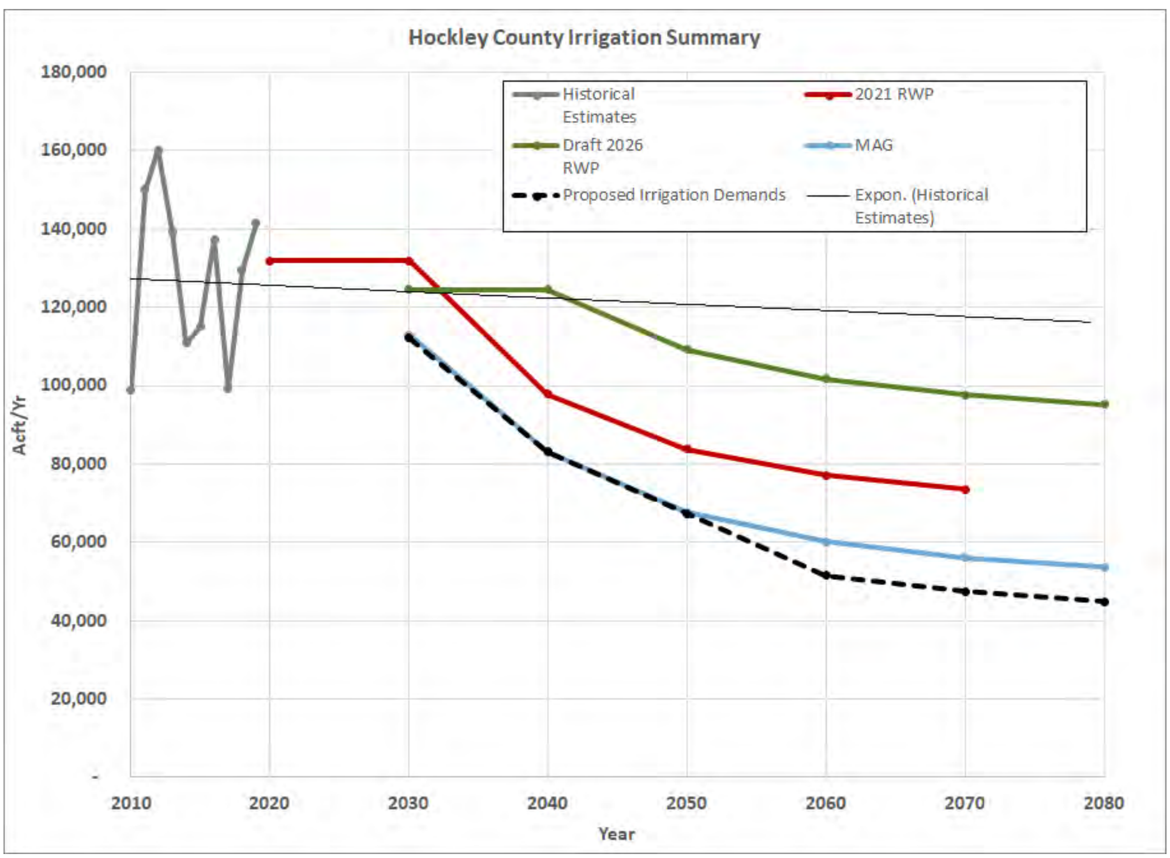
Year
Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)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Acft/Yr
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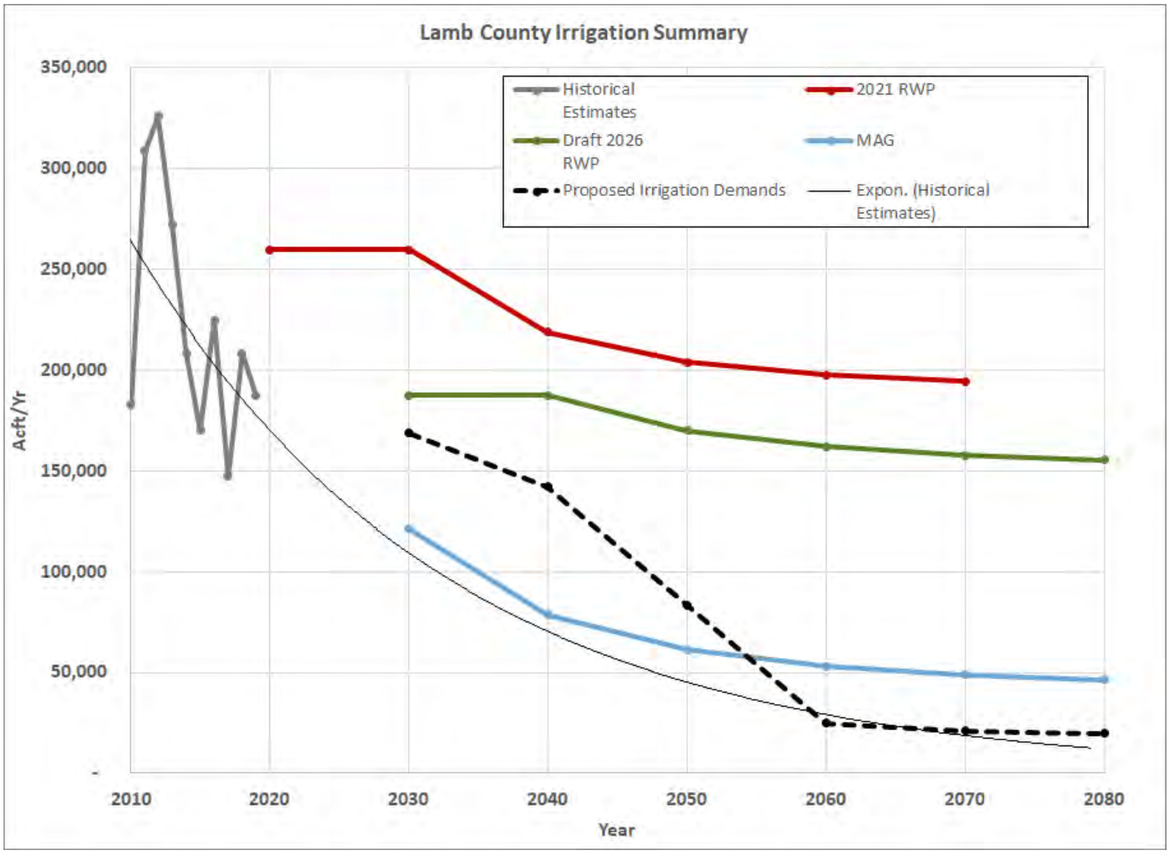
Year
Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)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250,000
200,000
150,000
100,000
50,000
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Acft/Yr
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2020
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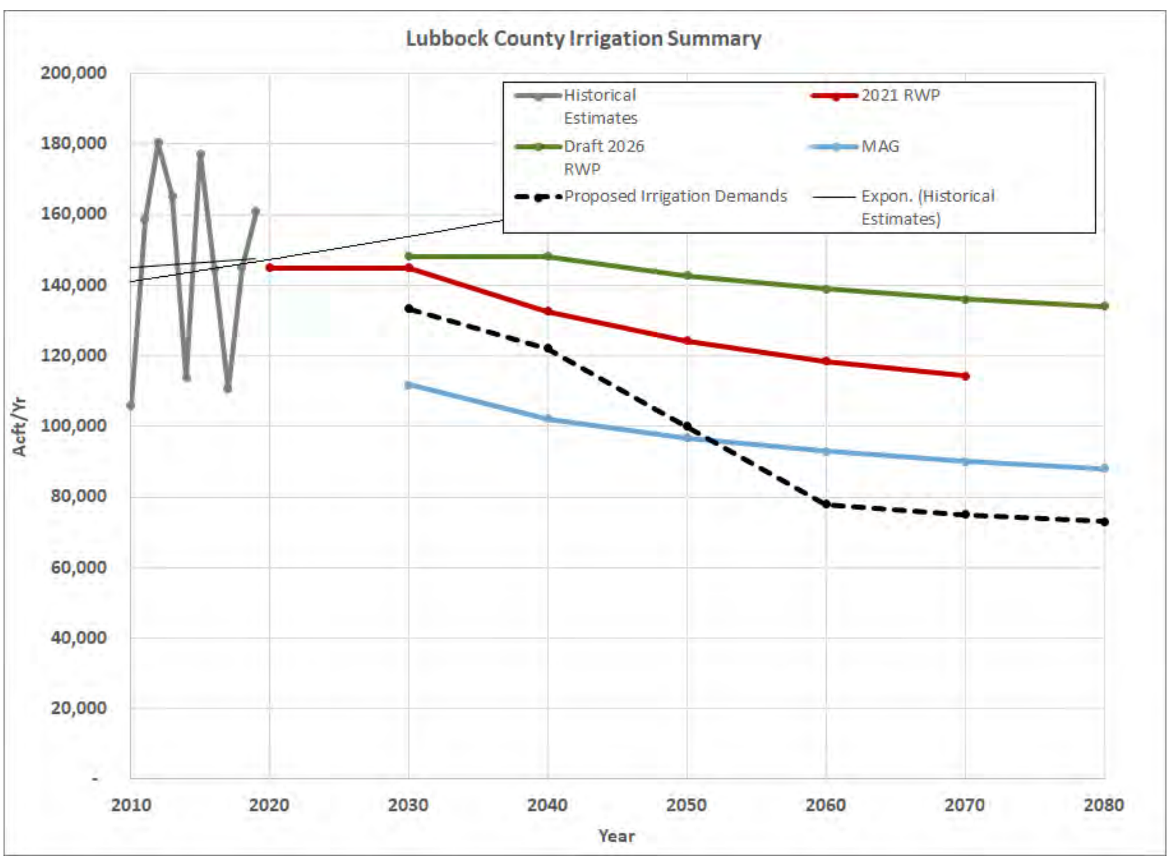
Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)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140,000
120,000
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Acft/Yr
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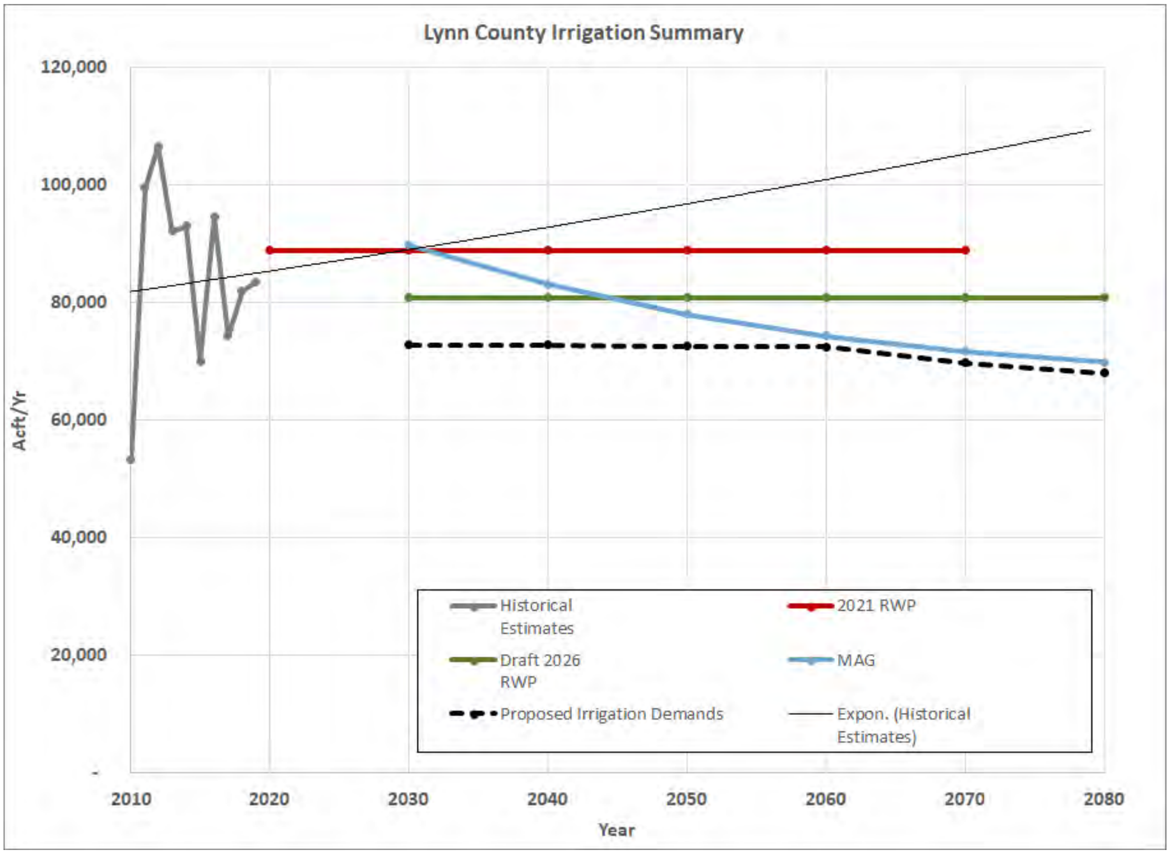
Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)



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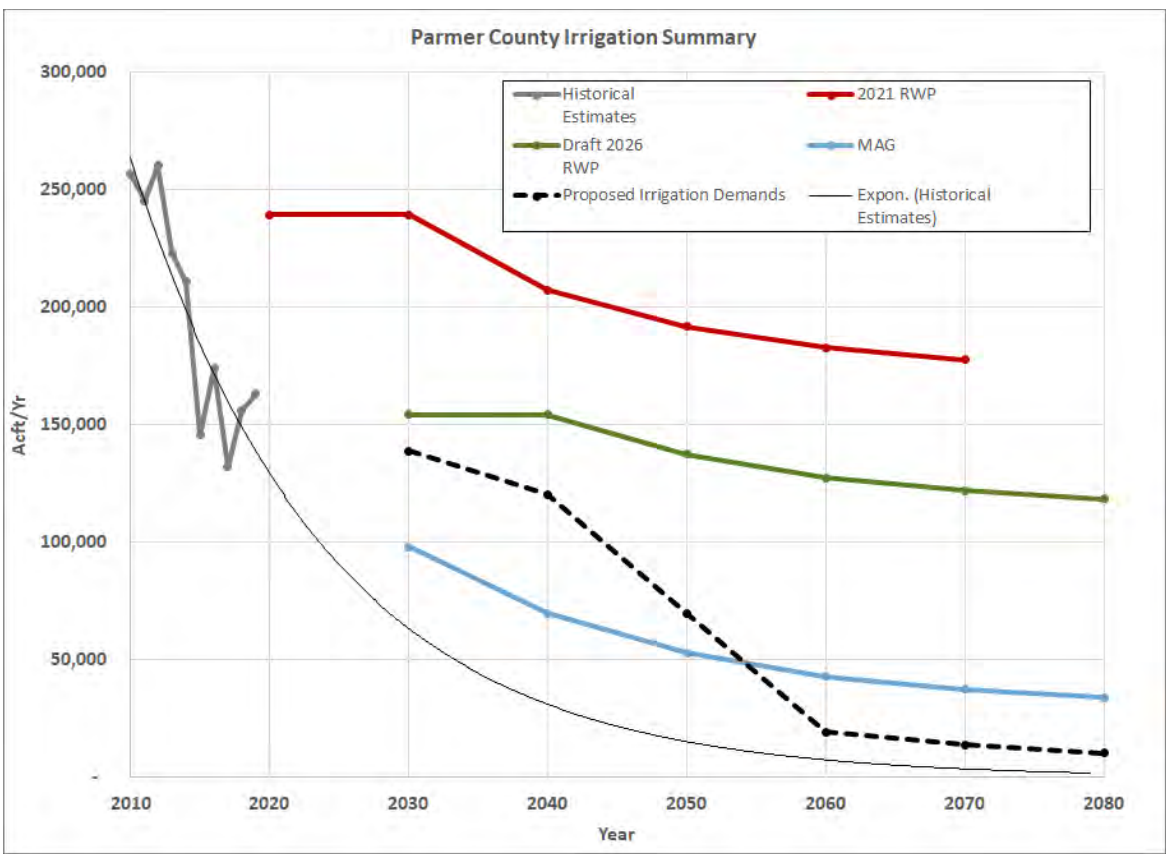
Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)



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Acft/Yr
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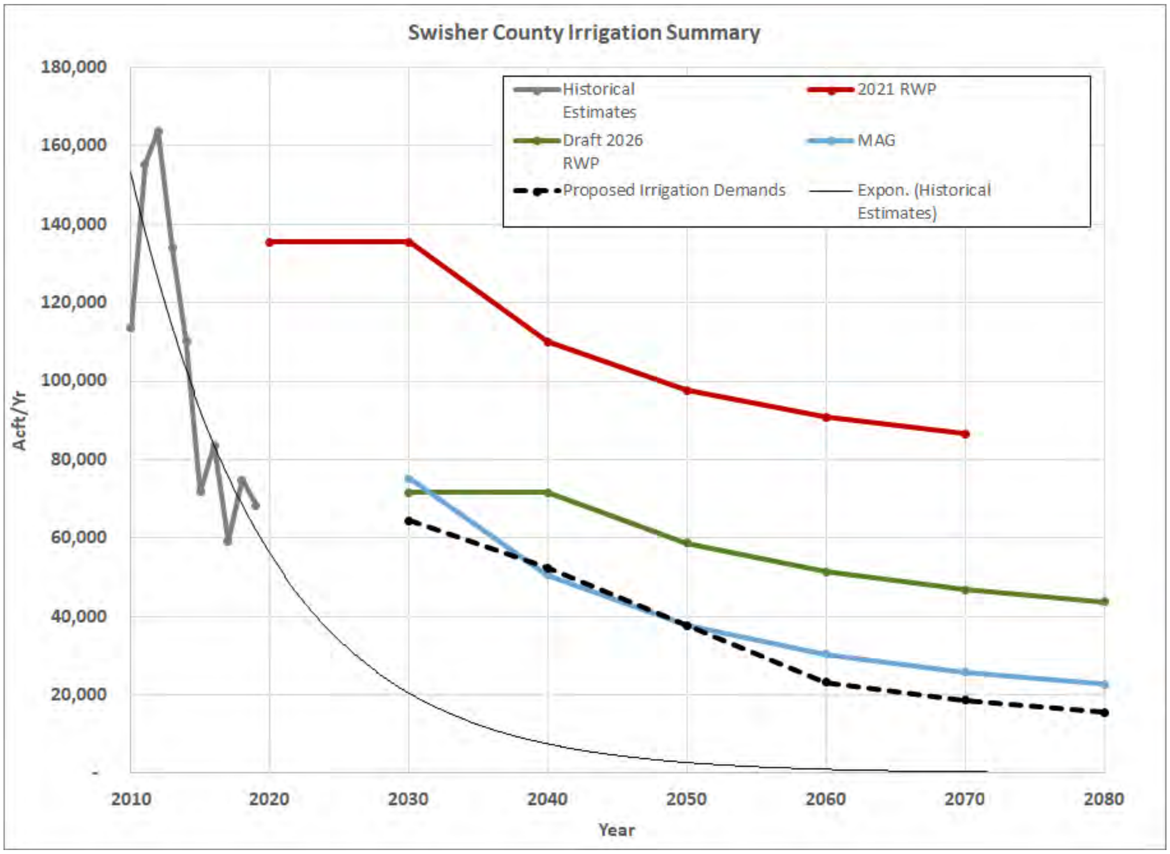
Year
Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)



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Acft/Yr
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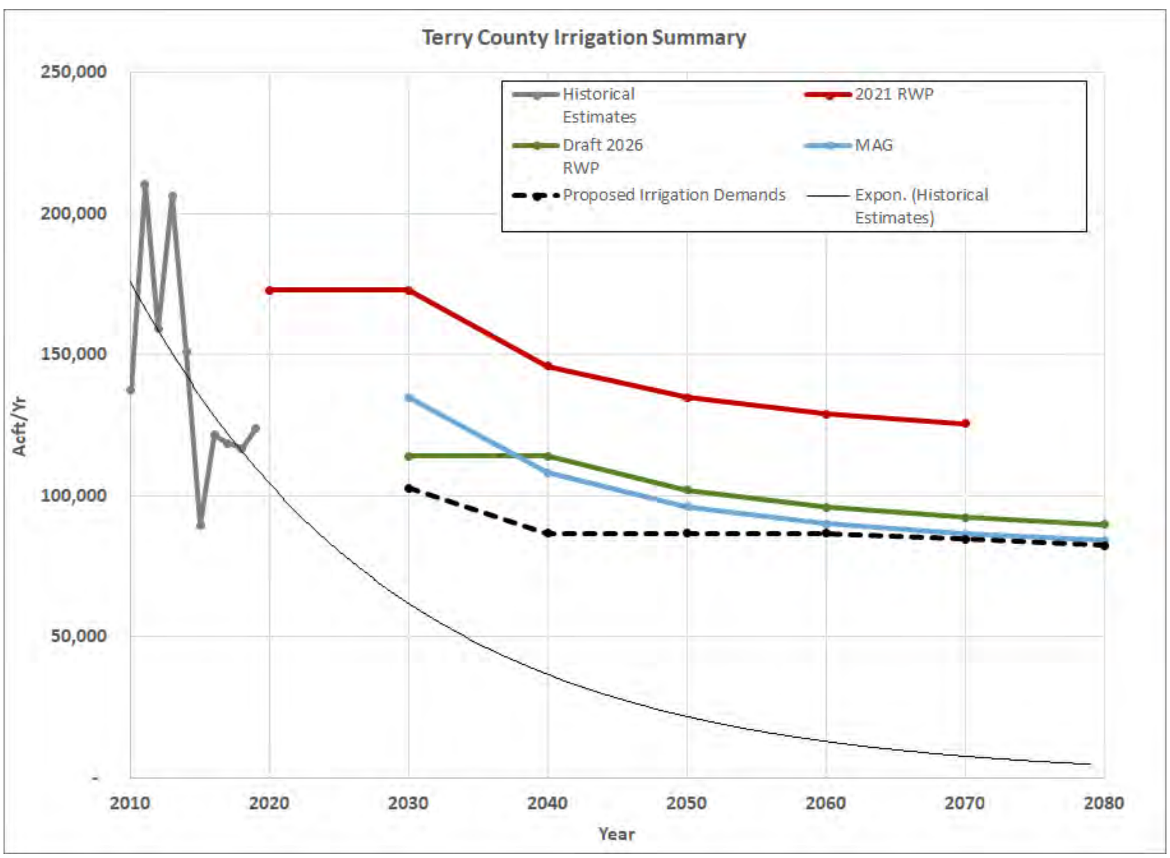
Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)



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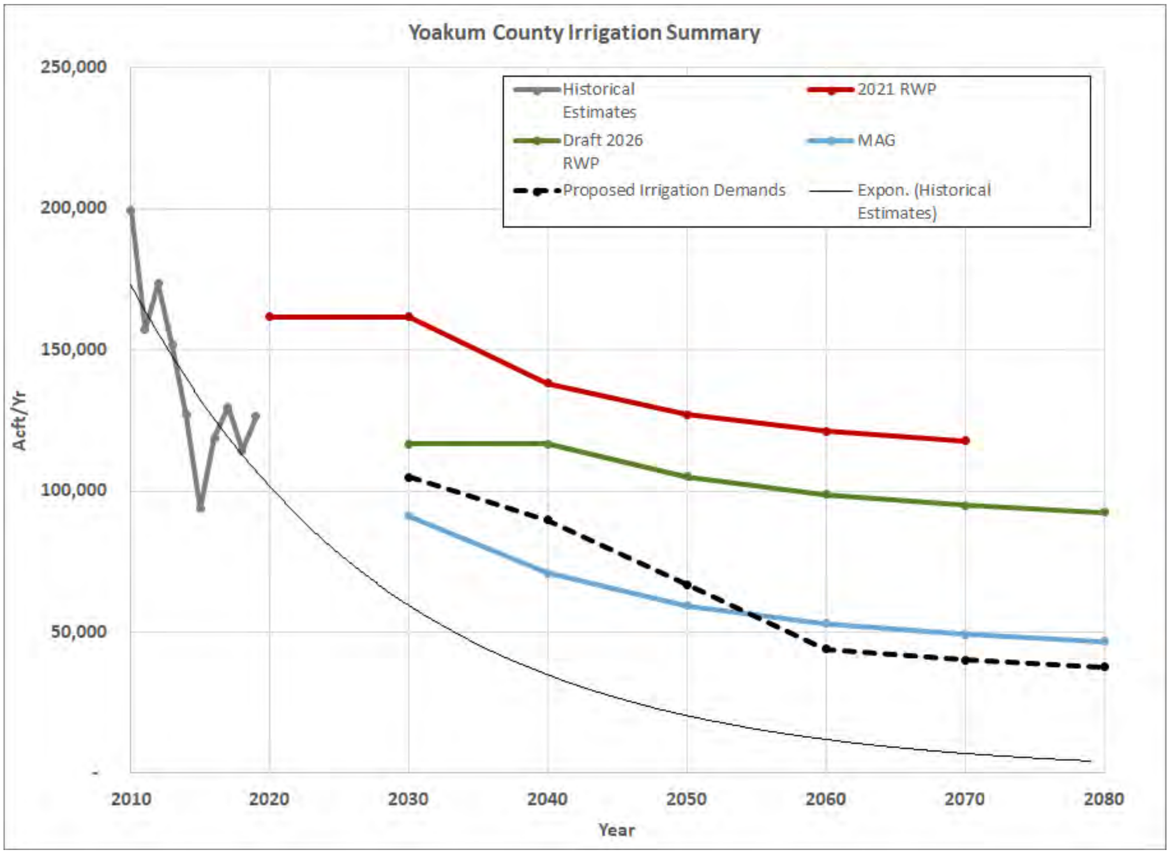
Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)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Historical Estimates
2021 RWP
Draft 2026 RWP
MAG
Proposed Irrigation Demands
Expon. (Historical Estimates)
250,000
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150,000
100,000
50,000
-
Acft/Yr
2010
2020
2030
2040
2050
2060
2070
2080
Year

Memo

Date:	March 3, 2024
Project:	2026 Llano Estacado (Region O) Regional Water Plan
To:	Texas Water Development Board
From:	Paula Jo Lemonds, PE, PG, Grady Reed, and Zach Stein, PE - HDR, on behalf of the Llano Estacado (Region O) Regional Water Planning Group
Subject:	**2026 Regional Water Plan Technical Memorandum**

Introduction

The Llano Estacado Regional Water Planning Group (LERWPG) submits this technical memorandum to fulfill the Texas Water Development Board (TWDB) requirements for the 2026 Regional Water Plan (RWP) development.[1] This memorandum documents the LERWPG's preliminary analysis of water demand projections, water availability, existing water supplies, and water needs, and presents potentially feasible water management strategies.

At a regular meeting of the LERWPG on February 21, 2024, and during a 14-day public comment period prior to the meeting, the LERWPG received no public comments.

1.0 TWDB DB27 Reports

The TWDB's regional water plan development guidance,[2] describes the State Water Planning Database (DB27) as the tool that "will synthesize regions' data and provide summary reports that shall be incorporated into the Technical Memorandum, initially prepared plan (IPP), and final adopted regional water plan (RWP)." The TWDB guidance document further states that regional water planning groups (RWPGs) will complete and submit to the TWDB, via the DB27 interface, all data generated or updated during the current cycle of planning, in accordance with TWDB specifications, prior to submitting the technical memorandum and IPP.

The following required TWDB DB27 reports are submitted with this technical memorandum:

- 2026 Region O Water User Group (WUG) Population,
- 2026 Region O Water User Group (WUG) Demand,
- 2026 Region O Source Total Availability,
- 2026 Region O Water User Group (WUG) Existing Water Supply,
- 2026 Region O Water User Group (WUG) Needs or Surplus,
- 2026 Region O Regional Water Plan (RWP) Water User Group (WUG) Data Comparison to 2021 RWP, and
- 2026 Region O Regional Water Plan (RWP) Source Availability Comparison to 2021 RWP.

[1] TWDB, 2023. Second Amended General Guidelines for Development of the 2026 Regional Water Plans.
[2] Ibid.

Data entered into DB27 is rounded to the nearest whole number to avoid cumulative data errors.

1.1 Water User Group Population

The TWDB DB27 WUG population projection report presenting population projections by WUG, county, and river basin is included in Appendix A.

1.2 Water User Group Water Demand Reports

The TWDB DB27 water demand report presenting water demand projections by WUG, county, and river basin is included in Appendix B.

1.3 Source Water Availability Report

The TWDB DB27 source water availability report presenting water availability by source is included in Appendix C.

1.4 Water User Group Existing Water Supplies Report

The TWDB DB27 existing water supplies report presenting existing water supplies by WUG, county, and river basin is included in Appendix D.

1.5 Water User Group Identified Water Needs/Surpluses Report

The TWDB DB27 identified water needs/surpluses report presenting identified water needs by WUG, county, and river basin is included in Appendix E.

1.6 Water User Group Data Comparison to 2021 RWP Report

The TWDB DB27 WUG data comparison report, presenting availability, supply, demands, and needs compared to the 2021 RWP report, is included in Appendix F.

1.7 Source Availability Comparison to 2021 RWP Report

The TWDB DB27 comparison of availability, supply, demands, and needs to 2021 RWP report, presenting sources at an aggregated level and WUG supplies, demands, and needs at a county level, is included in Appendix G.

2.0 Surface Water Availability

The LERWPG met on November 30, 2023, and discussed the process to determine the amount of surface water available from existing water rights and future water management strategies. During this meeting, the LERWPG discussed specific variations from the standard TWDB guidance that will be employed to develop the 2026 Llano Estacado Regional Water Plan (LERWP).

The guidance provided by the TWDB in the base scope of work for the Sixth Cycle of Regional Water Planning requires the use of the Run 3 (full authorization) version of Water Availability Models (WAMs) maintained by the Texas Commission on Environmental Quality (TCEQ). The TCEQ uses these river-basin-scale models to evaluate legal water available to applications for new or amended water rights, and as such, the models include some aspects that are not appropriate for water planning. This section includes model modification assumptions and yields used in developing the 2026 LERWP.

2.1 Summary of Water Availability Models

This section describes information regarding the WAM simulations used in determining surface water availability. The model input and output files used to date are submitted with this memorandum as an electronic appendix, Appendix H.

The LERWPG used the following WAMs to determine the water availability of existing surface water sources in the Llano Estacado planning area:

1. TCEQ Brazos River Basin and San Jacinto Coastal Basin WAM (Brazos WAM) – Period of record of 1940-2018
2. TCEQ Red River Basin WAM (Red River WAM) – Period of record of 1948-2018

Hydrologic Variances

In a letter dated December 12, 2023, the LERWPG requested that the TWDB allow specific variations from the base TCEQ WAMs for analyses that determine surface water available to existing rights. In a letter dated February 16, 2024, the TWDB approved the variances as described in this section. Appendix I includes both the hydrologic variance request from the LERWPG and the subsequent approval letter from the TWDB.

For Lake Alan Henry analyses, the LERWPG received approval from the TWDB to conduct analyses using a 2-year safe yield in the evaluation of existing and strategy supply.

For determining the firm yield of water supplies in the Canadian River Basin that support LERWPG WUGs, specifically Lake Meredith, the LERWPG received approval from the TWDB to use yield values developed by the Panhandle Regional Water Planning Group, using the TCEQ Canadian River Basin WAM.

2.2 Sedimentation Rates and Area-Capacity Rating Curves

This section provides the assumed reservoir sediment accumulation rates and describes the methodology used for calculating 2030 and 2080 area-capacity rating curves. The LERWPG used the 2030 and 2080 reservoir rating curves developed by TWDB[3] in the region's surface water availability modeling, unless otherwise noted in Table 1. Also, the LERWPG included Possum Kingdom Reservoir 2030 and 2080 area-capacity rating curves in the Brazos WAM simulations, even though the reservoir is not a Llano Estacado region supply source, since the senior priority of the reservoir's water right influences water availability of upstream sources in the planning area. Table 1 summarizes assumed sedimentation rates.

[3] https://www.twdb.texas.gov/surfacewater/data/WAMRatingCurve/index.asp, accessed February 5, 2024.

Table 1. Summary of Sedimentation Rates for Region O Existing Supply Reservoirs

Reservoir	Sedimentation Rate (acre-feet/year)	Notes
Lake Alan Henry	231	Rate published in TWDB 2017 Lake Alan Henry Volumetric and Sediment Survey Report and used in 2021 RWP. Several surface areas in TWDB rating curves were adjusted to correct apparent errors.
White River Reservoir	270	Rate based on differences in TWDB 2030 and 2080 rating curves. Several surface areas in TWDB rating curves were adjusted to correct apparent errors.
Possum Kingdom Reservoir	472	Rate based on differences in TWDB 2030 and 2080 rating curves.
Mackenzie Reservoir	---	No TWDB rating curves or completed reservoir surveys are available. Therefore, the area-capacity rating curve in the TCEQ WAM was assumed for 2030 and 2080. This methodology is consistent with the 2021 RWP.

2.3 Versions and Dates of WAM Simulations

This section lists the versions and dates of WAM simulations completed to calculate available surface water supply for the region. Table 2 summarizes WAM details and Table 3 summarizes the yield simulations completed.

Brazos River Basin

For Brazos River Basin supply calculations, the LEWRPG used the unmodified Brazos WAM version, dated October 1, 2023 (TCEQ Run 3, including updated sediment conditions), to determine 2030 and 2080 surface water supplies. No return flows were included in the WAM simulations.

Red River Basin

For Red River Basin WAM simulations, the LEWRPG used the unmodified Red River WAM version, dated October 1, 2023, to determine 2030 and 2080 surface water supplies.

Dates of WAM Simulations

HDR staff ran the yield simulations on February 5, 2024, and February 7, 2024.

Table 2. Summary of WAM Details

River Basin	Model	Model Period of Record	Version Date	Date of Model Run	Modifications	Input/Output Files
Brazos	Modified TCEQ WAM	1940-2018	October 1, 2023	February 5, 2024	2030 and 2080 area-volume rating curves for Region O supply reservoirs and Possum Kingdome Reservoir	TCEQ WAM input files were used and were not modified unless noted. WAM output of monthly timeseries of storage, diversions, and available flow were used to determine availability.
Red	Unmodified TCEQ WAM	1948-2018	October 1, 2023	February 7, 2024	None	TCEQ WAM input files were used and were not modified unless noted. WAM output of monthly timeseries of storage, diversions, and available flow were used to determine availability.

Table 3. Summary of WAM simulations completed to date

River Basin	Model	Reservoir / Water Body	Firm that Performed Model Run	Date of Model Run	Decade and Type of Yield	Yield (acre feet/year)
Brazos	Modified Brazos WAM	Lake Alan Henry	HDR	February 5, 2024	2030 Firm	18,800
					2080 Firm	16,500
		Lake Alan Henry	HDR	February 5, 2024	2030 2-Yr Safe	11,300
					2080 2-Yr Safe	9,800
		White River	HDR	February 5, 2024	2030 and 2080 Firm	0
		Brazos Run of River	HDR	February 5, 2024	2030 and 2080 Firm	0
Red	Unmodified Red WAM	Mackenzie	HDR	February 7, 2024	2030 and 2080 Firm	2,900
	Unmodified Red WAM	Red Run of River	HDR	February 7, 2024	2030 and 2080 Firm	118

3.0 Groundwater Availability

The LERWPG uses the established modeled available groundwater (MAG) values for the Regional Water Planning Area (RWPA) in development of the 2026 LERWP.

3.1 Non-Modeled Available Groundwater Availability

MAG reports for the Llano Estacado RWPA do not include availabilities for “Other Aquifer.” Therefore, to calculate estimated availability, or non-MAG availability, for the “Other Aquifer” designation in the 2026 LERWP, the LERWPG used a methodology that includes the following assumptions.

- Groundwater availability is determined based upon historical groundwater pumpage reports available from the TWDB.
- Historical pumpage is reported for river basin portions of each county by aquifer for the time period 2012 through 2021.
- Groundwater availability for “Other Aquifer” and other non-MAG portions of aquifers is generally set to be equal to historical pumpage from each aquifer over the time period from 2012 through 2021.

Table 4 summarizes groundwater availability methodology by county and aquifer.

Table 4. Summary of groundwater availability methodology by county and aquifer

County	Aquifer	Groundwater Availability Methodology
Bailey	Edwards-Trinity High Plains (ETHP)	MAG
	Dockum	MAG
Briscoe	ETHP	MAG
	Dockum	MAG
	Seymour	MAG
	Other	Non-MAG
Castro	ETHP	MAG
	Dockum	MAG
Cochran	ETHP	MAG
	Dockum	MAG
Crosby	ETHP	MAG
	Dockum	MAG
	Other	Non-MAG
Dawson	ETHP	MAG
	Dockum	MAG
Deaf Smith	ETHP	MAG
	Dockum	MAG

County	Aquifer	Groundwater Availability Methodology
Dickens	Ogallala	Non-MAG
	Dockum	Non-MAG
	Other	Non-MAG
Floyd	ETHP	MAG
	Dockum	MAG
	Other	Non-MAG
Gaines	ETHP	MAG
	Dockum	MAG
Garza	ETHP	MAG
	Dockum	MAG
	Other	Non-MAG
Hale	ETHP	MAG
	Dockum	MAG
Hockley	ETHP	MAG
	Dockum	MAG
Lamb	ETHP	MAG
	Dockum	MAG
Lubbock	ETHP	MAG
	Dockum	MAG
Lynn	ETHP	MAG
	Dockum	MAG
Motley	Ogallala	MAG
	Dockum	MAG
	Seymour	MAG
	Other	Non-MAG
Parmer	ETHP	MAG
	Dockum	MAG
Swisher	ETHP	MAG
	Dockum	MAG
Terry	ETHP	MAG
Yoakum	ETHP	MAG

4.0 Identification of Potentially Feasible Water Management Strategies

TWDB rules require that the process for identifying potentially feasible water management strategies (WMSs) be documented at a public meeting.[4] On November 30, 2023, the LERWPG formally considered the following process for identifying, evaluating, and selecting WMSs.

1. Potentially include strategies identified in previous plans.
   a. Potentially include recommended and alternative strategies from 2021.
   b. Potentially include strategies evaluated, but not recommended in 2021.
   c. Potentially include strategies evaluated in previous Plans that were not moved forward.
2. Identify draft needs and develop additional ideas to meet those needs.
3. Maintain ongoing communication from local interests through the regional water planning process.

Then, determine an initial list of potentially feasible strategies. Include additional WMSs if local interests request them and the planning schedule and budget allow for the addition.

5.0 Potentially Feasible Water Management Strategies

Table 5 lists all potentially feasible WMSs identified by the LERWPG to date.

Table 5. Potentially feasible WMSs identified by the LERWPG to date

#	Potentially Feasible Water Management Strategies
1	Municipal water conservation
2	Non-municipal water conservation
3	Reclaimed wastewater supplies and reuse
4	Local groundwater development
5	Water loss reduction
6	Groundwater desalination
7	Lake Alan Henry Water District Water Supply
8	Bailey County Well Field capacity maintenance
9	Jim Bertram Lake 7
10	Lake Alan Henry Phase 2
11	North Fork scalping operation
12	South Lubbock well field

[4] 31 Texas Administrative Code (TAC) §357.21(g)(2))

#	Potentially Feasible Water Management Strategies
13	Potable reuse
14	Wolfforth Canadian River Municipal Water Authority (CRMWA) lease from Slaton
15	Direct potable reuse to North Water Treatment Plant
16	Direct potable reuse to South Water Treatment Plant
17	North Fork diversion at Country Road (CR) 7300
18	North Fork diversion to Lake Alan Henry pump station
19	Post Reservoir
20	Reclaimed water to aquifer storage and recovery
21	South Fork discharge
22	Transportation of water between counties of surplus and need
23	Brackish well field in Lubbock area
24	CRMWA aquifer storage and recovery
25	CRMWA II (Roberts County Wellfield)
26	Chloride control project
27	City of Plainview CRMWA Aquifer Storage and Recovery (ASR)
28	City of Plainview Reuse
29	Enhanced recharge project
30	Playa enhanced recharge project

6.0 Analysis of Infeasible Water Management Strategies and/or Projects

In accordance with the Texas Water Code (§16.053(h)(10)), a strategy or project is considered infeasible if:

> *"…the proposed sponsor of the water management strategy or project has not taken an affirmative vote or other action to make expenditures necessary to construct or file applications for permits required in connection with the implementation of the water management strategy or project under federal or state law on a schedule that is consistent with the completion of the implementation of the water management strategy or project by the time the water management strategy or project is projected by the regional water plan or the state water plan to be needed."*

At minimum, RWPGs must review the status of recommended strategies and projects that were listed with an online decade of 2020 in the 2021 RWP. In accordance with contract guidance for the 2021 RWPs, recommended strategies and projects with an online decade of 2020 were required to be online and delivering water by January 5, 2023.

For example, if any such WMSs and water management strategy projects (WMSPs) were not implemented by this date, and the project sponsor has not taken any affirmative steps toward implementation, the 2021 RWP must be amended to remove or revise the WMSs or WMSPs to make them feasible.

Affirmative steps by sponsor may include, but are not limited to:

1. spending money on the strategy or project,
2. voting to spend money on the strategy or project, or
3. applying for a federal or state permit for the strategy or project.

LEWRPG's review of infeasible WMSs and/or WMSPs included the following.

- December 2022 LERWPG meeting:
    - Request by City of Lubbock to acknowledge that Lake 8 is no longer considered a feasible WMS. Lake 8 was not a recommended WMS in the 2021 RWP but was designated a unique reservoir site in 2007 by Senate Bill 3.
        - Approved by LERWPG
- February 2023 LERWPG meeting:
    - Reviewed recommended WMSPs associated with an online decade of 2020.
- August 2023 LERWPG meeting:
    - Presentation by Kevin Smith, TWDB
    - Reviewed recommended WMSPs associated with an online decade of 2020.

WMSs and WMSPs within Llano Estacado RWPA that were analyzed include the following.

- Mining: Crosby, Dawson, Hale, Lamb, Lubbock, Lynn, Terry, Yoakum
- Manufacturing: Deaf Smith, Gaines, Hale, Lubbock
- Aggregated conservation – municipal, agricultural, industrial

The TWDB recognizes information may be difficult to obtain or may not be available for some WUG categories. Other WMSs and WMSPs were determined to be making affirmative steps toward implementation. No infeasible WMSs or WMSPs were identified.

7.0 Interregional Coordination to Date

To date, the LERWPG has primarily coordinated with other planning regions through technical consultants, who coordinated data and shared information that is reported to the planning groups. The LERWPG has coordinated with adjacent RWPGs, including Regions A, B, F, and G. Additional coordination has been accomplished through the participation of LEWRPG members as liaisons with adjacent planning groups. Also, two LERWPG members serve as members of the Panhandle Regional (Region A) Water Planning Group, and one LERWPG member actively serves on the Interregional Planning Council.

8.0 Summary of Public Comments

To comply with the TWDB Regional Water Planning Rules[5], the LERWPG accepted written comments from the public for a period of 14 days prior to, and at the February 21, 2024, meeting where the LERWPG considered this technical memorandum for approval. No public comments were received at the meeting or during the official 14-day comment period.

[5] 31 TAC Section 357.21(g)(2).

Appendix A. TWDB DB27 Report – 2026 RWP WUG Population

DRAFT Region O Water User Group (WUG) Population

	WUG Population					
	2030	2040	2050	2060	2070	2080
Bailey County Total	**6,996**	**7,153**	**7,155**	**7,179**	**7,204**	**7,230**
Bailey County / Brazos Basin Total	**6,996**	**7,153**	**7,155**	**7,179**	**7,204**	**7,230**
Muleshoe	5,096	5,230	5,351	5,525	5,764	6,094
County-Other	1,900	1,923	1,804	1,654	1,440	1,136
Briscoe County Total	**1,301**	**1,203**	**1,134**	**1,054**	**971**	**885**
Briscoe County / Red Basin Total	**1,301**	**1,203**	**1,134**	**1,054**	**971**	**885**
Quitaque	302	278	258	238	217	197
Silverton	549	508	478	442	407	371
County-Other	450	417	398	374	347	317
Castro County Total	**7,198**	**7,024**	**6,799**	**6,625**	**6,444**	**6,255**
Castro County / Brazos Basin Total	**5,968**	**5,828**	**5,653**	**5,518**	**5,385**	**5,257**
Dimmitt	3,737	3,692	3,628	3,591	3,559	3,535
Hart Municipal Water System	746	712	683	655	642	648
County-Other	1,485	1,424	1,342	1,272	1,184	1,074
Castro County / Red Basin Total	**1,230**	**1,196**	**1,146**	**1,107**	**1,059**	**998**
Nazareth	259	265	269	276	285	297
County-Other	971	931	877	831	774	701
Cochran County Total	**2,384**	**2,233**	**2,082**	**1,942**	**1,796**	**1,644**
Cochran County / Brazos Basin Total	**2,181**	**2,043**	**1,907**	**1,782**	**1,651**	**1,514**
Morton PWS	1,470	1,377	1,285	1,198	1,110	1,017
Whiteface	284	266	254	246	235	224
County-Other	427	400	368	338	306	273
Cochran County / Colorado Basin Total	**203**	**190**	**175**	**160**	**145**	**130**
County-Other	203	190	175	160	145	130
Crosby County Total	**4,762**	**4,433**	**4,037**	**3,663**	**3,273**	**2,867**
Crosby County / Brazos Basin Total	**4,753**	**4,424**	**4,029**	**3,656**	**3,267**	**2,862**
Crosbyton	1,427	1,332	1,219	1,113	1,002	890
Lorenzo	886	825	752	683	612	537
Ralls	1,521	1,417	1,291	1,171	1,047	918
County-Other	919	850	767	689	606	517

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

DRAFT Region O Water User Group (WUG) Population

	WUG Population					
	2030	2040	2050	2060	2070	2080
Crosby County / Red Basin Total	**9**	**9**	**8**	**7**	**6**	**5**
County-Other	9	9	8	7	6	5
Dawson County Total	**12,342**	**12,302**	**12,210**	**12,024**	**11,830**	**11,628**
Dawson County / Brazos Basin Total	**111**	**110**	**109**	**109**	**106**	**103**
ODonnell	94	93	92	92	89	86
County-Other	17	17	17	17	17	17
Dawson County / Colorado Basin Total	**12,231**	**12,192**	**12,101**	**11,915**	**11,724**	**11,525**
Lamesa	7,721	7,666	7,569	7,400	7,220	7,024
County-Other	4,510	4,526	4,532	4,515	4,504	4,501
Deaf Smith County Total	**19,367**	**19,492**	**19,289**	**18,823**	**18,337**	**17,831**
Deaf Smith County / Canadian Basin Total	**7**	**7**	**6**	**5**	**3**	**1**
County-Other	7	7	6	5	3	1
Deaf Smith County / Red Basin Total	**19,360**	**19,485**	**19,283**	**18,818**	**18,334**	**17,830**
Hereford	15,164	15,591	15,903	16,145	16,523	17,113
County-Other	4,196	3,894	3,380	2,673	1,811	717
Dickens County Total	**1,592**	**1,483**	**1,328**	**1,181**	**1,028**	**869**
Dickens County / Brazos Basin Total	**1,404**	**1,308**	**1,171**	**1,042**	**907**	**767**
Spur	745	695	622	554	482	407
County-Other	659	613	549	488	425	360
Dickens County / Red Basin Total	**188**	**175**	**157**	**139**	**121**	**102**
Red River Authority of Texas*	5	5	5	4	3	2
County-Other	183	170	152	135	118	100
Floyd County Total	**5,043**	**4,758**	**4,470**	**4,212**	**3,943**	**3,663**
Floyd County / Brazos Basin Total	**4,644**	**4,390**	**4,136**	**3,909**	**3,675**	**3,435**
Floydada	2,419	2,331	2,258	2,200	2,154	2,122
Lockney	1,402	1,299	1,188	1,084	969	841
County-Other	823	760	690	625	552	472
Floyd County / Red Basin Total	**399**	**368**	**334**	**303**	**268**	**228**
County-Other	399	368	334	303	268	228

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DRAFT Region O Water User Group (WUG) Population

	WUG Population					
	2030	2040	2050	2060	2070	2080
Gaines County Total	**25,154**	**30,014**	**34,831**	**39,552**	**44,611**	**50,032**
Gaines County / Colorado Basin Total	**25,154**	**30,014**	**34,831**	**39,552**	**44,611**	**50,032**
Seagraves	1,849	1,654	1,468	1,263	1,090	944
Seminole	7,157	7,647	8,093	8,378	8,716	9,101
County-Other	16,148	20,713	25,270	29,911	34,805	39,987
Garza County Total	**5,660**	**5,501**	**5,250**	**4,905**	**4,546**	**4,172**
Garza County / Brazos Basin Total	**5,660**	**5,501**	**5,250**	**4,905**	**4,546**	**4,172**
Post	4,543	4,409	4,217	3,961	3,695	3,419
County-Other	1,117	1,092	1,033	944	851	753
Hale County Total	**33,015**	**32,465**	**31,253**	**29,960**	**29,000**	**28,102**
Hale County / Brazos Basin Total	**33,012**	**32,463**	**31,252**	**29,959**	**28,999**	**28,102**
Abernathy	2,355	2,549	2,750	2,971	3,267	3,688
Hale Center	1,876	1,834	1,752	1,666	1,572	1,471
Petersburg Municipal Water System	926	905	866	823	777	726
Plainview	22,403	22,403	22,403	22,403	21,395	20,347
Seth Ward WSC	1,482	1,451	1,386	1,317	1,244	1,162
County-Other	3,970	3,321	2,095	779	744	708
Hale County / Red Basin Total	**3**	**2**	**1**	**1**	**1**	**0**
County-Other	3	2	1	1	1	0
Hockley County Total	**21,758**	**21,831**	**21,558**	**21,281**	**20,992**	**20,691**
Hockley County / Brazos Basin Total	**20,303**	**20,409**	**20,211**	**20,006**	**19,799**	**19,591**
Anton	820	808	796	785	778	779
Levelland	12,404	12,510	12,452	12,386	12,327	12,278
County-Other	7,079	7,091	6,963	6,835	6,694	6,534
Hockley County / Colorado Basin Total	**1,455**	**1,422**	**1,347**	**1,275**	**1,193**	**1,100**
Sundown	1,195	1,162	1,091	1,024	947	860
County-Other	260	260	256	251	246	240
Lamb County Total	**12,846**	**12,761**	**12,522**	**12,265**	**11,997**	**11,718**
Lamb County / Brazos Basin Total	**12,846**	**12,761**	**12,522**	**12,265**	**11,997**	**11,718**
Amherst	653	654	650	647	644	645
Earth	842	813	788	769	761	768
Littlefield	5,558	5,447	5,368	5,328	5,359	5,489
Olton	1,904	1,837	1,782	1,740	1,723	1,737

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DRAFT Region O Water User Group (WUG) Population

	WUG Population					
	2030	2040	2050	2060	2070	2080
Sudan	883	903	927	957	997	1,051
County-Other	3,006	3,107	3,007	2,824	2,513	2,028
Lubbock County Total	**361,834**	**401,911**	**442,502**	**494,185**	**549,570**	**608,921**
Lubbock County / Brazos Basin Total	**361,834**	**401,911**	**442,502**	**494,185**	**549,570**	**608,921**
Abernathy	779	805	832	860	891	926
Idalou	2,130	2,047	1,971	1,874	1,784	1,698
Lubbock	300,165	333,391	367,043	409,890	455,805	505,009
New Deal	602	565	531	493	459	426
Ransom Canyon	1,048	1,121	1,196	1,288	1,386	1,493
Shallowater	3,294	3,688	4,086	4,596	5,142	5,727
Slaton	5,665	5,396	5,146	4,849	4,571	4,311
Wolfforth	16,487	25,847	31,863	34,157	35,898	36,975
County-Other	31,664	29,051	29,834	36,178	43,634	52,356
Lynn County Total	**5,500**	**5,387**	**5,278**	**5,114**	**4,943**	**4,765**
Lynn County / Brazos Basin Total	**5,466**	**5,354**	**5,246**	**5,083**	**4,913**	**4,736**
ODonnell	571	559	547	531	512	493
Tahoka Public Water System	2,268	2,223	2,180	2,114	2,046	1,975
County-Other	2,627	2,572	2,519	2,438	2,355	2,268
Lynn County / Colorado Basin Total	**34**	**33**	**32**	**31**	**30**	**29**
County-Other	34	33	32	31	30	29
Motley County Total	**985**	**911**	**856**	**850**	**844**	**838**
Motley County / Red Basin Total	**985**	**911**	**856**	**850**	**844**	**838**
Matador	471	436	410	407	404	401
Red River Authority of Texas*	8	6	6	6	6	6
County-Other	506	469	440	437	434	431
Parmer County Total	**9,809**	**9,721**	**9,471**	**9,210**	**8,938**	**8,655**
Parmer County / Brazos Basin Total	**4,828**	**4,596**	**4,232**	**3,855**	**3,426**	**2,929**
Bovina	1,466	1,331	1,134	931	693	409
Farwell	1,546	1,698	1,858	2,035	2,247	2,511
County-Other	1,816	1,567	1,240	889	486	9
Parmer County / Red Basin Total	**4,981**	**5,125**	**5,239**	**5,355**	**5,512**	**5,726**
Friona	4,261	4,504	4,747	5,003	5,319	5,722

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

DRAFT Region O Water User Group (WUG) Population

	WUG Population					
	2030	2040	2050	2060	2070	2080
County-Other	720	621	492	352	193	4
Swisher County Total	**6,687**	**6,458**	**6,172**	**5,924**	**5,666**	**5,397**
Swisher County / Brazos Basin Total	**315**	**309**	**303**	**297**	**291**	**285**
County-Other	315	309	303	297	291	285
Swisher County / Red Basin Total	**6,372**	**6,149**	**5,869**	**5,627**	**5,375**	**5,112**
Happy*	488	473	454	437	419	401
Tulia	3,779	3,610	3,392	3,205	3,011	2,805
County-Other	2,105	2,066	2,023	1,985	1,945	1,906
Terry County Total	**11,908**	**12,074**	**12,061**	**12,013**	**11,963**	**11,911**
Terry County / Brazos Basin Total	**43**	**43**	**41**	**38**	**34**	**30**
County-Other	43	43	41	38	34	30
Terry County / Colorado Basin Total	**11,865**	**12,031**	**12,020**	**11,975**	**11,929**	**11,881**
Brownfield	8,861	9,026	9,158	9,336	9,548	9,802
County-Other	3,004	3,005	2,862	2,639	2,381	2,079
Yoakum County Total	**7,906**	**8,271**	**8,596**	**8,861**	**9,137**	**9,424**
Yoakum County / Colorado Basin Total	**7,906**	**8,271**	**8,596**	**8,861**	**9,137**	**9,424**
Denver City	5,034	5,265	5,470	5,646	5,828	6,020
Plains	1,341	1,424	1,488	1,482	1,468	1,445
County-Other	1,531	1,582	1,638	1,733	1,841	1,959
Region O Population Total	**564,047**	**607,386**	**648,854**	**700,823**	**757,033**	**817,498**

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Appendix B. TWDB DB27 Report – 2026 RWP WUG Demand

DRAFT Region O Water User Group (WUG) Demand

	WUG Demand (acre-feet per year)					
	2030	2040	2050	2060	2070	2080
Bailey County Total	**61,881**	**51,628**	**41,582**	**31,453**	**28,719**	**27,523**
Bailey County / Brazos Basin Total	**61,881**	**51,628**	**41,582**	**31,453**	**28,719**	**27,523**
Muleshoe	1,013	1,036	1,060	1,094	1,141	1,207
County-Other	227	228	214	196	171	135
Livestock	2,471	2,829	2,854	2,790	2,730	2,673
Irrigation	58,170	47,535	37,454	27,373	24,677	23,508
Briscoe County Total	**18,427**	**14,545**	**11,221**	**7,894**	**6,781**	**6,037**
Briscoe County / Red Basin Total	**18,427**	**14,545**	**11,221**	**7,894**	**6,781**	**6,037**
Quitaque	75	68	63	59	53	48
Silverton	91	84	79	73	67	61
County-Other	141	131	125	117	109	99
Livestock	299	307	316	325	333	337
Irrigation	17,821	13,955	10,638	7,320	6,219	5,492
Castro County Total	**263,171**	**211,436**	**123,677**	**35,681**	**22,912**	**16,054**
Castro County / Brazos Basin Total	**170,901**	**137,223**	**80,167**	**22,967**	**14,665**	**10,205**
Dimmitt	831	819	804	796	789	784
Hart Municipal Water System	106	101	97	93	91	92
County-Other	210	201	189	179	167	151
Livestock	5,587	6,237	6,316	6,242	6,177	6,117
Irrigation	164,167	129,865	72,761	15,657	7,441	3,061
Castro County / Red Basin Total	**92,270**	**74,213**	**43,510**	**12,714**	**8,247**	**5,849**
Nazareth	98	100	101	104	107	112
County-Other	138	131	123	117	109	99
Manufacturing	67	69	72	75	78	81
Livestock	3,571	3,986	4,036	3,988	3,947	3,909
Irrigation	88,396	69,927	39,178	8,430	4,006	1,648
Cochran County Total	**82,029**	**70,038**	**58,893**	**47,749**	**42,782**	**39,148**
Cochran County / Brazos Basin Total	**55,752**	**47,589**	**40,003**	**32,418**	**29,033**	**26,554**
Morton PWS	317	296	276	257	238	218
Whiteface	66	61	59	57	54	52
County-Other	158	147	136	125	113	101
Livestock	38	39	40	41	41	42
Irrigation	55,173	47,046	39,492	31,938	28,587	26,141

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DRAFT Region O Water User Group (WUG) Demand

	WUG Demand (acre-feet per year)					
	2030	2040	2050	2060	2070	2080
Cochran County / Colorado Basin Total	**26,277**	**22,449**	**18,890**	**15,331**	**13,749**	**12,594**
County-Other	75	70	64	59	53	48
Mining	166	166	166	166	166	166
Livestock	72	74	75	76	78	78
Irrigation	25,964	22,139	18,585	15,030	13,452	12,302
Crosby County Total	**61,656**	**61,637**	**50,348**	**39,064**	**31,731**	**27,124**
Crosby County / Brazos Basin Total	**59,268**	**59,249**	**48,406**	**37,567**	**30,523**	**26,097**
Crosbyton	218	203	185	169	152	135
Lorenzo	159	148	135	122	110	96
Ralls	222	206	188	170	152	133
County-Other	105	97	87	78	69	58
Manufacturing	1	1	1	1	1	1
Mining	483	509	535	563	589	613
Livestock	174	179	184	188	193	195
Irrigation	57,906	57,906	47,091	36,276	29,257	24,866
Crosby County / Red Basin Total	**2,388**	**2,388**	**1,942**	**1,497**	**1,208**	**1,027**
County-Other	1	1	1	1	1	1
Livestock	1	1	1	1	1	1
Irrigation	2,386	2,386	1,940	1,495	1,206	1,025
Dawson County Total	**74,494**	**74,562**	**74,580**	**74,637**	**67,560**	**64,240**
Dawson County / Brazos Basin Total	**916**	**915**	**915**	**915**	**867**	**821**
ODonnell	13	12	12	12	12	11
County-Other	2	2	2	2	2	2
Livestock	1	1	1	1	1	1
Irrigation	900	900	900	900	852	807
Dawson County / Colorado Basin Total	**73,578**	**73,647**	**73,665**	**73,722**	**66,693**	**63,419**
Lamesa	1,739	1,722	1,700	1,662	1,622	1,578
County-Other	540	539	539	537	536	536
Mining	5,927	6,013	6,051	6,146	2,616	2,657
Livestock	63	64	66	68	70	71
Irrigation	65,309	65,309	65,309	65,309	61,849	58,577

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DRAFT Region O Water User Group (WUG) Demand

	WUG Demand (acre-feet per year)					
	2030	2040	2050	2060	2070	2080
Deaf Smith County Total	**156,926**	**126,664**	**90,374**	**53,871**	**45,411**	**40,285**
Deaf Smith County / Canadian Basin Total	**1,391**	**1,077**	**711**	**345**	**258**	**205**
County-Other	1	1	1	1	0	0
Irrigation	1,390	1,076	710	344	258	205
Deaf Smith County / Red Basin Total	**155,535**	**125,587**	**89,663**	**53,526**	**45,153**	**40,080**
Hereford	3,352	3,436	3,504	3,558	3,641	3,771
County-Other	477	440	381	301	205	81
Manufacturing	1,498	1,553	1,610	1,670	1,732	1,796
Livestock	12,678	13,612	13,861	13,929	14,013	14,105
Irrigation	137,530	106,546	70,307	34,068	25,562	20,327
Dickens County Total	**8,171**	**8,163**	**8,151**	**8,140**	**8,127**	**8,106**
Dickens County / Brazos Basin Total	**4,752**	**4,742**	**4,728**	**4,715**	**4,701**	**4,682**
Spur	125	116	104	93	81	68
County-Other	86	79	71	63	55	47
Livestock	240	246	252	258	264	266
Irrigation	4,301	4,301	4,301	4,301	4,301	4,301
Dickens County / Red Basin Total	**3,419**	**3,421**	**3,423**	**3,425**	**3,426**	**3,424**
Red River Authority of Texas*	1	1	1	1	1	0
County-Other	24	22	20	18	15	13
Livestock	148	152	156	160	164	165
Irrigation	3,246	3,246	3,246	3,246	3,246	3,246
Floyd County Total	**94,588**	**75,627**	**59,046**	**42,471**	**37,527**	**34,252**
Floyd County / Brazos Basin Total	**35,203**	**28,362**	**22,379**	**16,403**	**14,614**	**13,420**
Floydada	418	401	389	379	371	365
Lockney	186	171	157	143	128	111
County-Other	95	88	79	72	63	54
Mining	9	9	9	10	10	10
Livestock	1,155	1,168	1,181	1,195	1,210	1,216
Irrigation	33,340	26,525	20,564	14,604	12,832	11,664
Floyd County / Red Basin Total	**59,385**	**47,265**	**36,667**	**26,068**	**22,913**	**20,832**
County-Other	46	42	39	35	31	26
Livestock	67	68	69	70	70	71

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DRAFT Region O Water User Group (WUG) Demand

	WUG Demand (acre-feet per year)					
	2030	2040	2050	2060	2070	2080
Irrigation	59,272	47,155	36,559	25,963	22,812	20,735
Gaines County Total	**279,263**	**254,364**	**200,522**	**146,635**	**136,590**	**131,134**
Gaines County / Colorado Basin Total	**279,263**	**254,364**	**200,522**	**146,635**	**136,590**	**131,134**
Seagraves	297	264	235	202	174	151
Seminole	2,336	2,491	2,637	2,730	2,840	2,965
County-Other	1,883	2,403	2,931	3,469	4,037	4,638
Manufacturing	515	534	554	574	595	617
Mining	1,870	1,870	1,870	1,870	22	22
Livestock	143	146	148	151	154	156
Irrigation	272,219	246,656	192,147	137,639	128,768	122,585
Garza County Total	**10,784**	**10,763**	**10,736**	**10,697**	**10,656**	**10,610**
Garza County / Brazos Basin Total	**10,784**	**10,763**	**10,736**	**10,697**	**10,656**	**10,610**
Post	576	556	532	500	466	431
County-Other	136	132	125	114	103	91
Mining	19	19	19	19	19	19
Livestock	154	157	161	165	169	170
Irrigation	9,899	9,899	9,899	9,899	9,899	9,899
Hale County Total	**218,881**	**189,302**	**111,753**	**34,097**	**27,094**	**22,876**
Hale County / Brazos Basin Total	**216,785**	**187,504**	**110,730**	**33,848**	**26,913**	**22,735**
Abernathy	547	590	637	688	757	854
Hale Center	226	219	210	199	188	176
Petersburg Municipal Water System	234	228	218	207	196	183
Plainview	4,075	4,060	4,060	4,060	3,877	3,687
Seth Ward WSC	100	98	94	89	84	79
County-Other	496	412	260	97	92	88
Manufacturing	731	758	786	815	845	876
Mining	1	1	1	1	1	1
Steam Electric Power	29	29	29	29	29	29
Livestock	2,674	3,040	3,049	2,961	2,878	2,796
Irrigation	207,672	178,069	101,386	24,702	17,966	13,966
Hale County / Red Basin Total	**2,096**	**1,798**	**1,023**	**249**	**181**	**141**
County-Other	0	0	0	0	0	0
Irrigation	2,096	1,798	1,023	249	181	141

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DRAFT Region O Water User Group (WUG) Demand

	WUG Demand (acre-feet per year)					
	2030	2040	2050	2060	2070	2080
Hockley County Total	**116,818**	**87,856**	**72,067**	**56,281**	**52,187**	**49,710**
Hockley County / Brazos Basin Total	**108,619**	**81,697**	**67,033**	**52,370**	**48,584**	**46,305**
Anton	103	101	100	98	97	97
Levelland	1,990	1,998	1,988	1,978	1,968	1,961
County-Other	835	831	817	802	785	767
Manufacturing	1,232	1,278	1,325	1,374	1,425	1,478
Mining	69	69	69	69	69	69
Livestock	135	138	140	143	146	147
Irrigation	104,255	77,282	62,594	47,906	44,094	41,786
Hockley County / Colorado Basin Total	**8,199**	**6,159**	**5,034**	**3,911**	**3,603**	**3,405**
Sundown	319	309	290	273	252	229
County-Other	31	31	30	29	29	28
Livestock	2	2	3	3	3	3
Irrigation	7,847	5,817	4,711	3,606	3,319	3,145
Lamb County Total	**181,446**	**152,713**	**94,071**	**35,265**	**31,267**	**29,837**
Lamb County / Brazos Basin Total	**181,446**	**152,713**	**94,071**	**35,265**	**31,267**	**29,837**
Amherst	81	80	80	80	79	79
Earth	143	137	133	130	129	130
Littlefield	805	785	774	768	773	791
Olton	387	372	361	353	349	352
Sudan	208	212	218	225	234	247
County-Other	422	434	420	394	351	283
Manufacturing	398	413	428	444	460	477
Steam Electric Power	5,789	3,000	3,000	3,000	3,000	3,000
Livestock	4,467	5,111	5,157	5,041	4,934	4,833
Irrigation	168,746	142,169	83,500	24,830	20,958	19,645
Lubbock County Total	**199,536**	**194,158**	**179,090**	**165,730**	**172,288**	**180,111**
Lubbock County / Brazos Basin Total	**199,536**	**194,158**	**179,090**	**165,730**	**172,288**	**180,111**
Abernathy	181	186	193	199	206	214
Idalou	373	357	344	327	311	296
Lubbock	52,502	58,086	63,949	71,414	79,414	87,986
New Deal	76	71	66	62	57	53
Ransom Canyon	296	316	337	363	391	421
Shallowater	482	537	595	669	749	834
Slaton	661	626	597	563	531	500

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DRAFT Region O Water User Group (WUG) Demand

	WUG Demand (acre-feet per year)					
	2030	2040	2050	2060	2070	2080
Wolfforth	2,692	4,207	5,186	5,559	5,843	6,018
County-Other	3,988	3,641	3,739	4,534	5,469	6,562
Manufacturing	1,174	1,217	1,262	1,309	1,357	1,407
Mining	19	19	19	20	20	20
Steam Electric Power	2,909	2,000	2,000	2,000	2,000	2,000
Livestock	823	830	837	844	851	853
Irrigation	133,360	122,065	99,966	77,867	75,089	72,947
Lynn County Total	**73,640**	**73,624**	**73,431**	**73,230**	**70,591**	**68,747**
Lynn County / Brazos Basin Total	**68,532**	**68,516**	**68,335**	**68,147**	**65,692**	**63,975**
ODonnell	76	74	73	71	68	65
Tahoka Public Water System	371	363	356	345	334	322
County-Other	293	285	279	271	261	252
Mining	15	15	15	15	15	15
Livestock	62	64	65	66	68	69
Irrigation	67,715	67,715	67,547	67,379	64,946	63,252
Lynn County / Colorado Basin Total	**5,108**	**5,108**	**5,096**	**5,083**	**4,899**	**4,772**
County-Other	4	4	4	3	3	3
Livestock	7	7	8	8	8	8
Irrigation	5,097	5,097	5,084	5,072	4,888	4,761
Motley County Total	**9,527**	**9,515**	**9,508**	**9,513**	**9,520**	**9,520**
Motley County / Red Basin Total	**9,527**	**9,515**	**9,508**	**9,513**	**9,520**	**9,520**
Matador	162	150	141	140	139	138
Red River Authority of Texas*	2	1	1	1	1	1
County-Other	88	82	77	76	76	75
Livestock	277	284	291	298	306	308
Irrigation	8,998	8,998	8,998	8,998	8,998	8,998
Parmer County Total	**150,703**	**133,258**	**82,966**	**32,438**	**26,911**	**23,315**
Parmer County / Brazos Basin Total	**117,510**	**103,367**	**63,030**	**22,526**	**18,012**	**15,031**
Bovina	257	232	198	162	121	71
Farwell	397	435	476	521	575	643
County-Other	347	297	236	168	92	1
Livestock	5,440	6,116	6,181	6,083	5,994	5,913
Irrigation	111,069	96,287	55,939	15,592	11,230	8,403

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DRAFT Region O Water User Group (WUG) Demand

	WUG Demand (acre-feet per year)					
	2030	2040	2050	2060	2070	2080
Parmer County / Red Basin Total	**33,193**	**29,891**	**19,936**	**9,912**	**8,899**	**8,284**
Friona	752	791	834	879	935	1,005
County-Other	137	118	93	67	37	1
Manufacturing	2,184	2,265	2,349	2,436	2,526	2,619
Livestock	2,353	2,646	2,675	2,632	2,594	2,558
Irrigation	27,767	24,071	13,985	3,898	2,807	2,101
Swisher County Total	**68,354**	**56,327**	**41,773**	**27,228**	**22,700**	**19,697**
Swisher County / Brazos Basin Total	**11,663**	**9,492**	**6,867**	**4,241**	**3,419**	**2,872**
County-Other	40	39	38	37	37	36
Livestock	29	30	31	31	32	33
Irrigation	11,594	9,423	6,798	4,173	3,350	2,803
Swisher County / Red Basin Total	**56,691**	**46,835**	**34,906**	**22,987**	**19,281**	**16,825**
Happy*	72	70	67	64	62	59
Tulia	653	622	584	552	519	483
County-Other	267	261	255	251	245	240
Livestock	2,882	2,956	3,033	3,112	3,193	3,271
Irrigation	52,817	42,926	30,967	19,008	15,262	12,772
Terry County Total	**105,390**	**89,571**	**89,584**	**89,562**	**87,580**	**85,257**
Terry County / Brazos Basin Total	**5,191**	**4,408**	**4,409**	**4,408**	**4,307**	**4,192**
County-Other	5	5	5	5	4	4
Manufacturing	14	15	15	16	16	17
Livestock	68	78	79	77	75	73
Irrigation	5,104	4,310	4,310	4,310	4,212	4,098
Terry County / Colorado Basin Total	**100,199**	**85,163**	**85,175**	**85,154**	**83,273**	**81,065**
Brownfield	1,383	1,403	1,423	1,451	1,484	1,523
County-Other	358	356	339	312	282	246
Manufacturing	16	16	17	17	18	18
Mining	101	101	101	101	101	101
Livestock	812	933	941	919	899	874
Irrigation	97,529	82,354	82,354	82,354	80,489	78,303
Yoakum County Total	**109,334**	**94,132**	**71,315**	**47,985**	**44,231**	**41,795**
Yoakum County / Colorado Basin Total	**109,334**	**94,132**	**71,315**	**47,985**	**44,231**	**41,795**
Denver City	1,390	1,450	1,506	1,555	1,605	1,658

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DRAFT Region O Water User Group (WUG) Demand

	WUG Demand (acre-feet per year)					
	2030	2040	2050	2060	2070	2080
Plains	340	360	376	375	371	366
County-Other	180	185	191	203	215	229
Mining	746	746	746	746	746	746
Steam Electric Power	1,596	1,596	1,596	1,100	1,100	1,100
Livestock	107	110	113	116	119	121
Irrigation	104,975	89,685	66,787	43,890	40,075	37,575
Region O Demand Total	**2,345,019**	**2,039,883**	**1,554,688**	**1,069,621**	**983,165**	**935,378**

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Appendix C. TWDB DB27 Report – 2026 RWP Source Availability

DRAFT Region O Source Total Availability

				Source Availability (acre-feet per year)					
Source Name	**County**	**Basin**	**Salinity***	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Groundwater Source Availability Total				**2,054,463**	**1,577,282**	**1,297,703**	**1,136,666**	**1,041,774**	**982,358**
Blaine Aquifer	Dickens	Red	Fresh	0	0	0	0	0	0
Blaine Aquifer	Motley	Red	Fresh	0	0	0	0	0	0
Dockum Aquifer	Bailey	Brazos	Fresh	949	949	949	949	949	949
Dockum Aquifer	Briscoe	Red	Fresh	0	0	0	0	0	0
Dockum Aquifer	Castro	Brazos	Fresh	0	0	0	0	0	0
Dockum Aquifer	Castro	Red	Fresh	484	484	484	484	484	484
Dockum Aquifer	Cochran	Brazos	Fresh	118	118	118	118	118	118
Dockum Aquifer	Cochran	Colorado	Fresh	988	988	988	988	988	988
Dockum Aquifer	Crosby	Brazos	Fresh	4,393	4,393	4,393	4,393	4,393	4,393
Dockum Aquifer	Crosby	Red	Fresh	0	0	0	0	0	0
Dockum Aquifer	Dawson	Brazos	Fresh	0	0	0	0	0	0
Dockum Aquifer	Dawson	Colorado	Fresh	640	640	640	640	640	640
Dockum Aquifer	Deaf Smith	Canadian	Fresh	0	0	0	0	0	0
Dockum Aquifer	Deaf Smith	Red	Fresh	5,013	5,013	5,013	5,013	5,013	5,013
Dockum Aquifer	Dickens	Brazos	Fresh	104	104	104	104	104	104
Dockum Aquifer	Dickens	Red	Fresh	36	36	36	36	36	36
Dockum Aquifer	Floyd	Brazos	Fresh	3,389	3,389	3,389	3,389	3,389	3,389
Dockum Aquifer	Floyd	Red	Fresh	285	285	285	285	285	285
Dockum Aquifer	Gaines	Colorado	Fresh	880	880	880	880	880	880
Dockum Aquifer	Garza	Brazos	Brackish	1,038	1,038	1,038	1,038	1,038	1,038
Dockum Aquifer	Garza	Colorado	Fresh	0	0	0	0	0	0

* Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.
** Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

DRAFT Region O Source Total Availability

				Source Availability (acre-feet per year)					
Source Name	**County**	**Basin**	**Salinity***	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Dockum Aquifer	Hale	Brazos	Fresh	1,244	1,244	1,244	1,244	1,244	1,244
Dockum Aquifer	Hale	Red	Fresh	33	33	33	33	33	33
Dockum Aquifer	Hockley	Brazos	Fresh	1,013	1,013	1,013	1,013	1,013	1,013
Dockum Aquifer	Hockley	Colorado	Fresh	191	191	191	191	191	191
Dockum Aquifer	Lamb	Brazos	Fresh	1,051	1,051	1,051	1,051	1,051	1,051
Dockum Aquifer	Lubbock	Brazos	Fresh	1,236	1,236	1,236	1,236	1,236	1,236
Dockum Aquifer	Lynn	Brazos	Fresh	901	901	901	901	901	901
Dockum Aquifer	Lynn	Colorado	Fresh	138	138	138	138	138	138
Dockum Aquifer	Motley	Red	Fresh	93	92	92	92	92	92
Dockum Aquifer	Parmer	Brazos	Fresh	3,590	3,590	3,590	2,585	2,571	2,565
Dockum Aquifer	Parmer	Red	Fresh	2,617	2,617	2,617	2,617	2,617	2,617
Dockum Aquifer	Swisher	Brazos	Fresh	29	29	29	29	29	29
Dockum Aquifer	Swisher	Red	Fresh	1,767	1,767	1,767	1,767	1,767	1,767
Dockum Aquifer	Terry	Brazos	Fresh	0	0	0	0	0	0
Dockum Aquifer	Terry	Colorado	Fresh	0	0	0	0	0	0
Dockum Aquifer	Yoakum	Colorado	Fresh	0	0	0	0	0	0
Ogallala and Edwards-Trinity-High Plains Aquifers	Bailey	Brazos	Fresh	65,138	50,725	42,532	37,743	34,724	32,675
Ogallala and Edwards-Trinity-High Plains Aquifers	Briscoe	Red	Fresh	17,859	12,598	9,600	7,844	6,743	6,016
Ogallala and Edwards-Trinity-High Plains Aquifers	Castro	Brazos	Fresh	106,971	71,565	40,493	24,591	17,282	13,530
Ogallala and Edwards-Trinity-High Plains Aquifers	Castro	Red	Fresh	72,957	47,509	29,706	19,740	14,409	11,423

* Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.
** Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

DRAFT Region O Source Total Availability

				Source Availability (acre-feet per year)					
Source Name	**County**	**Basin**	**Salinity***	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Ogallala and Edwards-Trinity-High Plains Aquifers	Cochran	Brazos	Fresh	20,220	18,297	17,034	16,204	15,655	15,283
Ogallala and Edwards-Trinity-High Plains Aquifers	Cochran	Colorado	Fresh	53,771	43,798	37,231	32,357	27,977	24,753
Ogallala and Edwards-Trinity-High Plains Aquifers	Crosby	Brazos	Fresh	105,148	72,526	50,976	38,890	31,952	27,655
Ogallala and Edwards-Trinity-High Plains Aquifers	Crosby	Red	Fresh	2,917	2,776	2,549	2,149	1,779	1,504
Ogallala and Edwards-Trinity-High Plains Aquifers	Dawson	Brazos	Fresh	1,390	1,294	1,230	1,187	1,156	1,134
Ogallala and Edwards-Trinity-High Plains Aquifers	Dawson	Colorado	Fresh	119,946	97,296	82,962	74,261	69,106	65,811
Ogallala and Edwards-Trinity-High Plains Aquifers	Deaf Smith	Canadian	Fresh	0	0	0	0	0	0
Ogallala and Edwards-Trinity-High Plains Aquifers	Deaf Smith	Red	Fresh	135,383	95,875	70,425	55,841	47,249	41,961
Ogallala and Edwards-Trinity-High Plains Aquifers	Floyd	Brazos	Fresh	73,465	45,024	32,571	24,708	20,244	17,492
Ogallala and Edwards-Trinity-High Plains Aquifers	Floyd	Red	Fresh	20,488	20,063	19,734	19,447	18,988	18,495
Ogallala and Edwards-Trinity-High Plains Aquifers	Gaines	Colorado	Fresh	205,486	177,777	159,523	147,028	138,157	131,974
Ogallala and Edwards-Trinity-High Plains Aquifers	Garza	Brazos	Fresh	13,508	12,402	11,717	11,263	10,948	10,721
Ogallala and Edwards-Trinity-High Plains Aquifers	Garza	Colorado	Fresh	0	0	0	0	0	0
Ogallala and Edwards-Trinity-High Plains Aquifers	Hale	Brazos	Fresh	116,240	74,782	53,039	40,940	34,150	30,172

* Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.
** Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

DRAFT Region O Source Total Availability

				Source Availability (acre-feet per year)					
Source Name	**County**	**Basin**	**Salinity***	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Ogallala and Edwards-Trinity-High Plains Aquifers	Hale	Red	Fresh	375	326	259	202	158	126
Ogallala and Edwards-Trinity-High Plains Aquifers	Hockley	Brazos	Fresh	84,987	67,316	58,259	53,255	50,258	48,358
Ogallala and Edwards-Trinity-High Plains Aquifers	Hockley	Colorado	Fresh	26,800	14,469	8,147	5,726	4,624	4,042
Ogallala and Edwards-Trinity-High Plains Aquifers	Lamb	Brazos	Fresh	120,172	77,677	60,088	52,063	47,868	45,425
Ogallala and Edwards-Trinity-High Plains Aquifers	Lubbock	Brazos	Fresh	110,472	100,950	95,478	91,655	88,877	86,735
Ogallala and Edwards-Trinity-High Plains Aquifers	Lynn	Brazos	Fresh	82,425	76,194	71,817	68,689	66,499	64,962
Ogallala and Edwards-Trinity-High Plains Aquifers	Lynn	Colorado	Fresh	6,343	5,870	5,216	4,635	4,208	3,924
Ogallala and Edwards-Trinity-High Plains Aquifers	Parmer	Brazos	Fresh	51,129	37,132	28,030	22,549	19,129	16,878
Ogallala and Edwards-Trinity-High Plains Aquifers	Parmer	Red	Fresh	40,896	26,436	18,805	15,194	13,161	11,879
Ogallala and Edwards-Trinity-High Plains Aquifers	Swisher	Brazos	Fresh	11,508	6,845	4,598	3,421	2,759	2,360
Ogallala and Edwards-Trinity-High Plains Aquifers	Swisher	Red	Fresh	61,899	41,909	31,289	25,120	21,213	18,575
Ogallala and Edwards-Trinity-High Plains Aquifers	Terry	Brazos	Fresh	6,825	6,322	5,998	5,776	5,612	5,487
Ogallala and Edwards-Trinity-High Plains Aquifers	Terry	Colorado	Fresh	128,053	101,860	90,192	84,201	80,731	78,556
Ogallala and Edwards-Trinity-High Plains Aquifers	Yoakum	Colorado	Fresh	90,983	70,810	59,346	53,002	49,187	46,687

* Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.
** Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

DRAFT Region O Source Total Availability

				Source Availability (acre-feet per year)					
Source Name	**County**	**Basin**	**Salinity***	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Ogallala Aquifer	Dickens	Brazos	Fresh	5,089	5,089	5,089	5,089	5,089	5,020
Ogallala Aquifer	Dickens	Red	Fresh	0	0	0	0	0	0
Ogallala Aquifer	Motley	Red	Fresh	409	409	409	409	409	409
Other Aquifer	Briscoe	Red	Fresh	6,000	6,000	6,000	6,000	6,000	6,000
Other Aquifer	Crosby	Brazos	Brackish	9,000	9,000	9,000	9,000	9,000	9,000
Other Aquifer	Dickens	Brazos	Brackish	6,000	6,000	6,000	6,000	6,000	6,000
Other Aquifer	Dickens	Red	Brackish	4,000	4,000	4,000	4,000	4,000	4,000
Other Aquifer	Floyd	Red	Fresh	16,000	16,000	16,000	16,000	16,000	16,000
Other Aquifer	Garza	Brazos	Fresh	2,000	2,000	2,000	2,000	2,000	2,000
Other Aquifer	Motley	Red	Brackish	13,000	13,000	13,000	13,000	13,000	13,000
Seymour Aquifer	Briscoe	Red	Brackish	312	312	312	312	312	312
Seymour Aquifer	Motley	Red	Fresh	6,679	4,830	4,830	3,961	3,961	4,830

Reuse Source Availability Total				**48,945**	**51,353**	**53,806**	**55,497**	**56,998**	**58,252**
Direct Reuse	Bailey	Brazos	Fresh	825	825	825	825	825	825
Direct Reuse	Castro	Brazos	Fresh	4,031	4,031	4,031	4,031	4,031	4,031
Direct Reuse	Cochran	Brazos	Fresh	267	267	267	267	267	267
Direct Reuse	Cochran	Colorado	Fresh	27	27	27	27	27	27
Direct Reuse	Crosby	Brazos	Fresh	583	583	583	583	583	583
Direct Reuse	Deaf Smith	Red	Fresh	2,810	2,810	2,810	2,810	2,810	2,810
Direct Reuse	Floyd	Brazos	Fresh	449	449	449	449	449	449
Direct Reuse	Hale	Brazos	Fresh	5,477	5,477	5,477	5,477	5,477	5,477
Direct Reuse	Hockley	Brazos	Fresh	1,359	1,359	1,359	1,359	1,359	1,359

* Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.
** Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

DRAFT Region O Source Total Availability

				Source Availability (acre-feet per year)					
Source Name	**County**	**Basin**	**Salinity***	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Direct Reuse	Hockley	Colorado	Fresh	162	162	162	162	162	162
Direct Reuse	Lamb	Brazos	Fresh	7,199	7,199	7,199	7,199	7,199	7,199
Direct Reuse	Lubbock	Brazos	Fresh	22,523	24,931	27,384	29,075	30,576	31,830
Direct Reuse	Lynn	Brazos	Fresh	346	346	346	346	346	346
Direct Reuse	Parmer	Brazos	Fresh	401	401	401	401	401	401
Direct Reuse	Parmer	Red	Fresh	2,486	2,486	2,486	2,486	2,486	2,486

Surface Water Source Availability Total				**14,318**	**14,018**	**13,718**	**13,418**	**13,118**	**12,818**
Alan Henry Lake/Reservoir	Reservoir**	Brazos	Fresh	11,300	11,000	10,700	10,400	10,100	9,800
Brazos Run-of-River	Crosby	Brazos	Fresh	0	0	0	0	0	0
Brazos Run-of-River	Dickens	Brazos	Fresh	0	0	0	0	0	0
Brazos Run-of-River	Garza	Brazos	Fresh	0	0	0	0	0	0
Brazos Run-of-River	Lubbock	Brazos	Fresh	0	0	0	0	0	0
Brazos Run-of-River	Lynn	Brazos	Fresh	0	0	0	0	0	0
Mackenzie Lake/Reservoir	Reservoir**	Red	Fresh	2,900	2,900	2,900	2,900	2,900	2,900
Red Run-of-River	Briscoe	Red	Fresh	96	96	96	96	96	96
Red Run-of-River	Floyd	Red	Fresh	18	18	18	18	18	18
Red Run-of-River	Motley	Red	Fresh	4	4	4	4	4	4
Red Run-of-River	Parmer	Red	Fresh	0	0	0	0	0	0
White River Lake/Reservoir	Reservoir**	Brazos	Fresh	0	0	0	0	0	0

Region O Source Availability Total	**2,117,726**	**1,642,653**	**1,365,227**	**1,205,581**	**1,111,890**	**1,053,428**

* Salinity field indicates whether the source availability is considered 'fresh' (less than 1,000 mg/L), 'brackish' (1,000 to 10,000 mg/L), 'saline' (10,001 mg/L to 34,999 mg/L), or 'seawater' (35,000 mg/L or greater). Sources can also be labeled as 'fresh/brackish' or 'brackish/saline', if a combination of the salinity types is appropriate.

** Since reservoir sources can exist across multiple counties, the county field value, 'reservoir' is applied to all reservoir sources.

DRAFT Region O Source Total Availability

* Salinity field indicates whether the source availability is considered 'fresh' (less than 1,000 mg/L), 'brackish' (1,000 to 10,000 mg/L), 'saline' (10,001 mg/L to 34,999 mg/L), or 'seawater' (35,000 mg/L or greater). Sources can also be labeled as 'fresh/brackish' or 'brackish/saline', if a combination of the salinity types is appropriate.

** Since reservoir sources can exist across multiple counties, the county field value, 'reservoir' is applied to all reservoir sources.

Appendix D. TWDB DB27 Report – 2026 RWP WUG Existing Water Supply

DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Bailey County WUG Total			**63,463**	**49,221**	**41,275**	**33,511**	**30,815**	**29,646**
Bailey County / Brazos Basin WUG Total			**63,463**	**49,221**	**41,275**	**33,511**	**30,815**	**29,646**
Muleshoe	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Bailey County	3,056	3,056	3,056	3,056	3,056	3,056
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Bailey County	228	228	228	228	228	228
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Bailey County	2,854	2,854	2,854	2,854	2,854	2,854
Irrigation	O	Direct Reuse	825	825	825	825	825	825
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Bailey County	56,500	42,258	34,312	26,548	23,852	22,683
Briscoe County WUG Total			**18,800**	**14,934**	**11,617**	**8,299**	**7,198**	**6,471**
Briscoe County / Red Basin WUG Total			**18,800**	**14,934**	**11,617**	**8,299**	**7,198**	**6,471**
Quitaque	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Briscoe County	318	318	318	318	318	318
Silverton	O	Mackenzie Lake/Reservoir	128	128	128	128	128	128
County-Other	O	Other Aquifer | Briscoe County	176	176	176	176	176	176
County-Other	O	Red Run-of-River	20	20	20	20	20	20
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Briscoe County	99	99	99	99	99	99
Livestock	O	Other Aquifer | Briscoe County	238	238	238	238	238	238
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Briscoe County	12,743	8,877	5,560	2,242	1,141	414
Irrigation	O	Other Aquifer | Briscoe County	4,690	4,690	4,690	4,690	4,690	4,690
Irrigation	O	Red Run-of-River	76	76	76	76	76	76
Irrigation	O	Seymour Aquifer | Briscoe County	312	312	312	312	312	312

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Castro County WUG Total			**184,383**	**123,529**	**74,654**	**39,902**	**27,262**	**21,494**
Castro County / Brazos Basin WUG Total			**111,001**	**75,595**	**44,523**	**26,665**	**18,449**	**15,039**
Dimmitt	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Castro County	3,923	3,923	3,923	3,923	3,923	3,923
Hart Municipal Water System	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Castro County	559	559	559	559	559	559
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Castro County	210	210	210	210	210	210
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Castro County	6,316	6,316	6,316	6,316	6,316	6,316
Irrigation	O	Direct Reuse	4,031	4,031	4,031	4,031	4,031	4,031
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Castro County	95,962	60,556	29,484	11,626	3,410	0
Castro County / Red Basin WUG Total			**73,382**	**47,934**	**30,131**	**13,237**	**8,813**	**6,455**
Nazareth	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Castro County	552	552	552	552	552	552
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Castro County	138	138	138	138	138	138
Manufacturing	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Castro County	81	81	81	81	81	81
Livestock	O	Dockum Aquifer | Castro County	425	425	425	425	425	425
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Castro County	3,611	3,611	3,611	3,611	3,611	3,611
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Castro County	68,575	43,127	25,324	8,430	4,006	1,648

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Cochran County WUG Total			**46,770**	**41,022**	**36,205**	**31,820**	**29,693**	**28,171**
Cochran County / Brazos Basin WUG Total			**20,487**	**18,564**	**17,301**	**16,471**	**15,922**	**15,550**
Morton PWS	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Cochran County	598	598	598	598	598	598
Whiteface	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Cochran County	314	314	314	314	314	314
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Cochran County	158	158	158	158	158	158
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Cochran County	42	42	42	42	42	42
Irrigation	O	Direct Reuse	267	267	267	267	267	267
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Cochran County	19,108	17,185	15,922	15,092	14,543	14,171
Cochran County / Colorado Basin WUG Total			**26,283**	**22,458**	**18,904**	**15,349**	**13,771**	**12,621**
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Cochran County	75	75	75	75	75	75
Mining	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Cochran County	166	166	166	166	166	166
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Cochran County	78	78	78	78	78	78
Irrigation	O	Direct Reuse	27	27	27	27	27	27
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Cochran County	25,937	22,112	18,558	15,003	13,425	12,275
Crosby County WUG Total			**62,730**	**62,730**	**51,469**	**40,209**	**32,901**	**28,329**
Crosby County / Brazos Basin WUG Total			**60,342**	**60,342**	**49,527**	**38,712**	**31,693**	**27,302**
Crosbyton	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Crosby County	382	382	382	382	382	382
Lorenzo	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Crosby County	904	904	904	904	904	904

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Ralls	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Crosby County	233	233	233	233	233	233
County-Other	O	Dockum Aquifer | Crosby County	1	1	1	1	1	1
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Crosby County	106	106	106	106	106	106
County-Other	O	Other Aquifer | Crosby County	1	1	1	1	1	1
Manufacturing	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Crosby County	1	1	1	1	1	1
Mining	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Crosby County	613	613	613	613	613	613
Livestock	O	Dockum Aquifer | Crosby County	84	84	84	84	84	84
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Crosby County	56	56	56	56	56	56
Livestock	O	Other Aquifer | Crosby County	55	55	55	55	55	55
Irrigation	O	Brazos Run-of-River	0	0	0	0	0	0
Irrigation	O	Direct Reuse	583	583	583	583	583	583
Irrigation	O	Dockum Aquifer | Crosby County	3,600	3,600	3,600	3,600	3,600	3,600
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Crosby County	45,318	45,318	34,503	23,688	16,669	12,278
Irrigation	O	Other Aquifer | Crosby County	8,405	8,405	8,405	8,405	8,405	8,405
Crosby County / Red Basin WUG Total			**2,388**	**2,388**	**1,942**	**1,497**	**1,208**	**1,027**
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Crosby County	1	1	1	1	1	1
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Crosby County	1	1	1	1	1	1

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Crosby County	2,386	2,386	1,940	1,495	1,206	1,025
Dawson County WUG Total			**74,980**	**74,881**	**74,794**	**74,716**	**70,632**	**67,218**
Dawson County / Brazos Basin WUG Total			**934**	**931**	**930**	**930**	**881**	**835**
ODonnell	A	Meredith Lake/Reservoir	4	3	3	3	3	3
ODonnell	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Dawson County	17	17	17	17	17	17
ODonnell	A	Ogallala Aquifer | Roberts County	10	8	7	7	6	5
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Dawson County	2	2	2	2	2	2
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Dawson County	1	1	1	1	1	1
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Dawson County	900	900	900	900	852	807
Dawson County / Colorado Basin WUG Total			**74,046**	**73,950**	**73,864**	**73,786**	**69,751**	**66,383**
Lamesa	A	Meredith Lake/Reservoir	345	219	310	306	303	300
Lamesa	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Dawson County	723	723	723	723	723	723
Lamesa	A	Ogallala Aquifer | Roberts County	912	942	765	691	614	607
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Dawson County	540	540	540	540	540	540
Mining	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Dawson County	6,146	6,146	6,146	6,146	6,146	6,146
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Dawson County	71	71	71	71	71	71
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Dawson County	65,309	65,309	65,309	65,309	61,354	57,996

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Deaf Smith County WUG Total			**141,517**	**102,059**	**76,609**	**57,207**	**48,701**	**43,466**
Deaf Smith County / Canadian Basin WUG Total			**2**	**2**	**2**	**2**	**2**	**2**
County-Other	O	Dockum Aquifer | Deaf Smith County	2	2	2	2	2	2
Irrigation		No water supply associated with WUG	0	0	0	0	0	0
Deaf Smith County / Red Basin WUG Total			**141,515**	**102,057**	**76,607**	**57,205**	**48,699**	**43,464**
Hereford	O	Dockum Aquifer | Deaf Smith County	3,422	3,422	3,422	3,422	3,422	3,422
Hereford	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Deaf Smith County	3,337	3,337	3,337	3,337	3,337	3,337
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Deaf Smith County	477	477	477	477	477	477
Manufacturing	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Deaf Smith County	1,796	1,796	1,796	1,796	1,796	1,796
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Deaf Smith County	14,105	14,105	14,105	14,105	14,105	14,105
Irrigation	O	Direct Reuse	2,810	2,810	2,810	2,810	2,810	2,810
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Deaf Smith County	115,568	76,110	50,660	31,258	22,752	17,517
Dickens County WUG Total			**10,049**	**10,049**	**10,049**	**10,049**	**10,049**	**10,048**
Dickens County / Brazos Basin WUG Total			**6,173**	**6,173**	**6,173**	**6,173**	**6,173**	**6,173**
Spur	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Crosby County	224	224	224	224	224	224
County-Other	O	Ogallala Aquifer | Dickens County	9	9	9	9	9	9
County-Other	O	Other Aquifer | Dickens County	99	99	99	99	99	99

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Livestock	O	Dockum Aquifer | Dickens County	35	35	35	35	35	35
Livestock	O	Ogallala Aquifer | Dickens County	36	36	36	36	36	36
Livestock	O	Other Aquifer | Dickens County	230	230	230	230	230	230
Irrigation	O	Brazos Run-of-River	0	0	0	0	0	0
Irrigation	O	Dockum Aquifer | Dickens County	22	22	22	22	22	22
Irrigation	O	Other Aquifer | Dickens County	5,518	5,518	5,518	5,518	5,518	5,518
Dickens County / Red Basin WUG Total			**3,876**	**3,876**	**3,876**	**3,876**	**3,876**	**3,875**
Red River Authority of Texas*	O	Other Aquifer | Dickens County	1	1	1	1	1	0
Red River Authority of Texas*	B	Red Indirect Reuse	0	0	0	0	0	0
Red River Authority of Texas*	B	Seymour Aquifer | Hardeman County	0	0	0	0	0	0
Red River Authority of Texas*	B	Trinity Aquifer | Montague County	0	0	0	0	0	0
County-Other	O	Other Aquifer | Dickens County	24	24	24	24	24	24
Livestock	O	Dockum Aquifer | Dickens County	24	24	24	24	24	24
Livestock	O	Other Aquifer | Dickens County	150	150	150	150	150	150
Irrigation	O	Dockum Aquifer | Dickens County	12	12	12	12	12	12
Irrigation	O	Other Aquifer | Dickens County	3,665	3,665	3,665	3,665	3,665	3,665
Floyd County WUG Total			**73,106**	**65,866**	**59,576**	**44,500**	**39,577**	**36,332**
Floyd County / Brazos Basin WUG Total			**37,156**	**30,341**	**24,380**	**18,420**	**16,648**	**15,480**
Floydada	O	Mackenzie Lake/Reservoir	155	155	155	155	155	155
Floydada	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Floyd County	1,801	1,801	1,801	1,801	1,801	1,801
Lockney	O	Mackenzie Lake/Reservoir	75	75	75	75	75	75

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Lockney	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Floyd County	464	464	464	464	464	464
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Floyd County	95	95	95	95	95	95
Mining	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Floyd County	10	10	10	10	10	10
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Floyd County	1,216	1,216	1,216	1,216	1,216	1,216
Irrigation	O	Direct Reuse	449	449	449	449	449	449
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Floyd County	32,891	26,076	20,115	14,155	12,383	11,215
Floyd County / Red Basin WUG Total			**35,950**	**35,525**	**35,196**	**26,080**	**22,929**	**20,852**
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Floyd County	46	46	46	46	46	46
Livestock	O	Dockum Aquifer | Floyd County	20	20	20	20	20	20
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Floyd County	31	31	31	31	31	31
Livestock	O	Other Aquifer | Floyd County	20	20	20	20	20	20
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Floyd County	20,411	19,986	19,657	10,541	7,390	5,313
Irrigation	O	Other Aquifer | Floyd County	15,404	15,404	15,404	15,404	15,404	15,404
Irrigation	O	Red Run-of-River	18	18	18	18	18	18
Gaines County WUG Total			**201,143**	**173,359**	**154,850**	**142,150**	**133,148**	**126,842**
Gaines County / Colorado Basin WUG Total			**201,143**	**173,359**	**154,850**	**142,150**	**133,148**	**126,842**
Seagraves	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Gaines County	969	969	969	969	969	969

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Seminole	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Gaines County	1,797	1,797	1,797	1,797	1,797	1,797
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Gaines County	4,638	4,638	4,638	4,638	4,638	4,638
Manufacturing	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Gaines County	617	617	617	617	617	617
Mining	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Gaines County	2,100	2,100	2,100	2,100	2,100	2,100
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Gaines County	156	156	156	156	156	156
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Gaines County	190,866	163,082	144,573	131,873	122,871	116,565
Garza County WUG Total			**11,116**	**11,116**	**11,116**	**11,116**	**11,116**	**11,116**
Garza County / Brazos Basin WUG Total			**11,116**	**11,116**	**11,116**	**11,116**	**11,116**	**11,116**
Post	O	Brazos Run-of-River	0	0	0	0	0	0
Post	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Crosby County	658	658	658	658	658	658
Post	A	Ogallala Aquifer | Roberts County	192	192	192	192	192	192
County-Other	O	Alan Henry Lake/Reservoir	25	25	25	25	25	25
County-Other	O	Dockum Aquifer | Garza County	31	31	31	31	31	31
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Garza County	122	122	122	122	122	122
Mining	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Garza County	19	19	19	19	19	19
Livestock	O	Dockum Aquifer | Garza County	100	100	100	100	100	100
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Garza County	50	50	50	50	50	50
Livestock	O	Other Aquifer | Garza County	20	20	20	20	20	20

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Irrigation	O	Dockum Aquifer | Garza County	234	234	234	234	234	234
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Garza County	8,255	8,255	8,255	8,255	8,255	8,255
Irrigation	O	Other Aquifer | Garza County	1,410	1,410	1,410	1,410	1,410	1,410
Hale County WUG Total			**123,819**	**82,253**	**60,406**	**40,695**	**33,853**	**29,691**
Hale County / Brazos Basin WUG Total			**123,444**	**81,927**	**60,147**	**40,493**	**33,695**	**29,565**
Abernathy	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hale County	1,379	1,355	1,326	1,288	1,267	1,241
Hale Center	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hale County	956	956	956	956	956	956
Petersburg Municipal Water System	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hale County	594	594	594	594	594	594
Plainview	A	Meredith Lake/Reservoir	306	246	624	675	712	678
Plainview	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hale County	6,206	6,206	6,206	6,206	6,206	6,206
Plainview	A	Ogallala Aquifer | Roberts County	1,901	1,926	1,540	1,521	1,443	1,373
Seth Ward WSC	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hale County	100	100	100	100	100	100
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hale County	496	496	496	496	496	496
Manufacturing	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hale County	876	876	876	876	876	876
Mining	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hale County	1	1	1	1	1	1
Steam Electric Power	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hale County	29	29	29	29	29	29
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hale County	3,049	3,049	3,049	3,049	3,049	3,049

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Irrigation	O	Direct Reuse	5,477	5,477	5,477	5,477	5,477	5,477
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hale County	102,074	60,616	38,873	19,225	12,489	8,489
Hale County / Red Basin WUG Total			**375**	**326**	**259**	**202**	**158**	**126**
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hale County	1	1	1	1	1	1
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hale County	374	325	258	201	157	125
Hockley County WUG Total			**96,936**	**77,058**	**66,731**	**60,294**	**56,081**	**53,587**
Hockley County / Brazos Basin WUG Total			**88,195**	**70,347**	**61,126**	**55,794**	**51,868**	**49,548**
Anton	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hockley County	835	835	835	835	835	835
Levelland	A	Meredith Lake/Reservoir	302	200	427	418	412	408
Levelland	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hockley County	3,164	3,164	3,164	3,164	3,164	3,164
Levelland	A	Ogallala Aquifer | Roberts County	1,528	1,445	1,054	942	834	826
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hockley County	835	835	835	835	835	835
Manufacturing	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hockley County	1,478	1,478	1,478	1,478	1,478	1,478
Mining	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hockley County	69	69	69	69	69	69
Livestock	O	Dockum Aquifer | Hockley County	28	28	28	28	28	28
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hockley County	119	119	119	119	119	119
Irrigation	O	Direct Reuse	1,359	1,359	1,359	1,359	1,359	1,359
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hockley County	78,478	60,815	51,758	46,547	42,735	40,427

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Hockley County / Colorado Basin WUG Total			**8,741**	**6,711**	**5,605**	**4,500**	**4,213**	**4,039**
Sundown	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hockley County	860	860	860	860	860	860
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hockley County	31	31	31	31	31	31
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hockley County	3	3	3	3	3	3
Irrigation	O	Direct Reuse	162	162	162	162	162	162
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hockley County	7,685	5,655	4,549	3,444	3,157	2,983
Lamb County WUG Total			**124,871**	**82,547**	**65,205**	**38,984**	**35,112**	**33,799**
Lamb County / Brazos Basin WUG Total			**124,871**	**82,547**	**65,205**	**38,984**	**35,112**	**33,799**
Amherst	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lamb County	234	234	234	234	234	234
Earth	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lamb County	690	690	690	690	690	690
Littlefield	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lamb County	2,378	2,378	2,378	2,378	2,378	2,378
Olton	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lamb County	1,352	1,352	1,352	1,352	1,352	1,352
Sudan	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lamb County	419	419	419	419	419	419
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lamb County	447	447	447	447	447	447
Manufacturing	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lamb County	477	477	477	477	477	477
Steam Electric Power	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lamb County	5,789	3,000	3,000	3,000	3,000	3,000

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lamb County	5,157	5,157	5,157	5,157	5,157	5,157
Irrigation	O	Direct Reuse	7,199	7,199	7,199	7,199	7,199	7,199
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lamb County	100,729	61,194	43,852	17,631	13,759	12,446
Lubbock County WUG Total			**183,018**	**166,416**	**156,271**	**143,055**	**135,066**	**132,443**
Lubbock County / Brazos Basin WUG Total			**183,018**	**166,416**	**156,271**	**143,055**	**135,066**	**132,443**
Abernathy	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Hale County	479	503	532	570	591	617
Idalou	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lubbock County	1,306	1,306	1,306	1,306	1,306	1,306
Lubbock	O	Alan Henry Lake/Reservoir	10,930	10,630	10,330	10,030	9,382	9,082
Lubbock	A	Meredith Lake/Reservoir	11,964	12,885	10,106	9,927	9,830	9,770
Lubbock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Bailey County	1,906	1,457	1,007	557	0	0
Lubbock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lamb County	2,156	1,706	1,257	807	0	0
Lubbock	A	Ogallala Aquifer | Roberts County	25,227	25,227	24,584	22,046	19,571	19,449
New Deal	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lubbock County	333	333	333	333	333	333
New Deal	A	Ogallala Aquifer | Roberts County	50	50	50	50	50	50
Ransom Canyon	O	Alan Henry Lake/Reservoir	143	143	143	143	293	293
Ransom Canyon	O	Brazos Run-of-River	0	0	0	0	0	0
Ransom Canyon	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Bailey County	142	142	142	142	0	0
Ransom Canyon	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lamb County	142	142	142	142	0	0
Ransom Canyon	A	Ogallala Aquifer | Roberts County	142	142	142	142	142	142

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Shallowater	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Bailey County	250	250	250	250	0	0
Shallowater	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lubbock County	416	416	416	416	416	416
Slaton	A	Meredith Lake/Reservoir	192	113	148	137	128	120
Slaton	A	Ogallala Aquifer | Roberts County	265	238	122	66	17	0
Wolfforth	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lubbock County	1,180	1,180	1,180	1,180	1,180	1,180
County-Other	O	Alan Henry Lake/Reservoir	202	202	202	202	400	400
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Bailey County	202	202	202	202	0	0
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lamb County	202	202	202	202	0	0
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lubbock County	6,000	6,000	6,000	6,000	6,000	6,000
County-Other	A	Ogallala Aquifer | Roberts County	200	200	200	200	200	200
Manufacturing	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lubbock County	1,407	1,407	1,407	1,407	1,407	1,407
Mining	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lubbock County	20	20	20	20	20	20
Steam Electric Power	O	Direct Reuse	10,080	10,080	10,080	7,840	7,840	7,840
Steam Electric Power	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lubbock County	18	18	18	18	18	18
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lubbock County	853	853	853	853	853	853
Irrigation	O	Direct Reuse	8,960	2,240	2,240	2,240	2,240	2,240
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lubbock County	97,651	88,129	82,657	75,627	72,849	70,707

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Lynn County WUG Total			**74,119**	**74,077**	**73,864**	**73,209**	**70,325**	**68,344**
Lynn County / Brazos Basin WUG Total			**69,010**	**68,968**	**68,768**	**68,574**	**66,117**	**64,420**
ODonnell	A	Meredith Lake/Reservoir	22	19	18	17	16	15
ODonnell	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Dawson County	98	98	98	98	98	98
ODonnell	A	Ogallala Aquifer | Roberts County	58	51	45	38	33	32
Tahoka Public Water System	A	Meredith Lake/Reservoir	82	73	70	69	68	68
Tahoka Public Water System	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lynn County	441	441	441	441	441	441
Tahoka Public Water System	A	Ogallala Aquifer | Roberts County	217	194	172	155	138	137
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lynn County	293	293	293	293	293	293
Mining	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lynn County	15	15	15	15	15	15
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lynn County	69	69	69	69	69	69
Irrigation	O	Brazos Run-of-River	0	0	0	0	0	0
Irrigation	O	Direct Reuse	346	346	346	346	346	346
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lynn County	67,369	67,369	67,201	67,033	64,600	62,906
Lynn County / Colorado Basin WUG Total			**5,109**	**5,109**	**5,096**	**4,635**	**4,208**	**3,924**
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lynn County	4	4	4	4	4	4
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lynn County	8	8	8	8	8	8
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Lynn County	5,097	5,097	5,084	4,623	4,196	3,912

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Motley County WUG Total			**13,117**	**13,116**	**13,116**	**13,116**	**13,116**	**13,116**
Motley County / Red Basin WUG Total			**13,117**	**13,116**	**13,116**	**13,116**	**13,116**	**13,116**
Matador	O	Other Aquifer | Motley County	192	192	192	192	192	192
Matador	O	Seymour Aquifer | Motley County	582	582	582	582	582	582
Red River Authority of Texas*	O	Other Aquifer | Motley County	2	1	1	1	1	1
Red River Authority of Texas*	B	Red Indirect Reuse	0	0	0	0	0	0
Red River Authority of Texas*	B	Seymour Aquifer | Hardeman County	0	0	0	0	0	0
Red River Authority of Texas*	B	Trinity Aquifer | Montague County	0	0	0	0	0	0
County-Other	O	Other Aquifer | Motley County	75	75	75	75	75	75
County-Other	O	Seymour Aquifer | Motley County	35	35	35	35	35	35
Livestock	O	Dockum Aquifer | Motley County	60	60	60	60	60	60
Livestock	O	Ogallala Aquifer | Motley County	19	19	19	19	19	19
Livestock	O	Other Aquifer | Motley County	296	296	296	296	296	296
Irrigation	O	Dockum Aquifer | Motley County	30	30	30	30	30	30
Irrigation	O	Other Aquifer | Motley County	11,739	11,739	11,739	11,739	11,739	11,739
Irrigation	O	Red Run-of-River	4	4	4	4	4	4
Irrigation	O	Seymour Aquifer | Motley County	83	83	83	83	83	83
Parmer County WUG Total			**85,172**	**65,061**	**48,291**	**32,723**	**28,212**	**25,640**
Parmer County / Brazos Basin WUG Total			**49,811**	**35,814**	**26,712**	**21,231**	**17,811**	**15,560**
Bovina	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Parmer County	571	571	571	571	571	571
Farwell	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Parmer County	858	858	858	858	858	858

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year) 2030	2040	2050	2060	2070	2080
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Parmer County	347	347	347	347	347	347
Livestock	O	Dockum Aquifer | Parmer County	900	900	900	900	900	900
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Parmer County	5,281	5,281	5,281	5,281	5,281	5,281
Irrigation	O	Direct Reuse	401	401	401	401	401	401
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Parmer County	41,453	27,456	18,354	12,873	9,453	7,202
Parmer County / Red Basin WUG Total			**35,361**	**29,247**	**21,579**	**11,492**	**10,401**	**10,080**
Friona	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Parmer County	2,163	2,163	2,163	2,163	2,163	2,163
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Parmer County	137	137	137	137	137	137
Manufacturing	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Parmer County	2,619	2,619	2,619	2,619	2,619	2,619
Livestock	O	Dockum Aquifer | Parmer County	325	325	325	325	325	325
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Parmer County	2,350	2,350	2,350	2,350	2,350	2,350
Irrigation	O	Direct Reuse	2,486	2,486	2,486	2,486	2,486	2,486
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Parmer County	25,281	19,167	11,499	1,412	321	0
Irrigation	O	Red Run-of-River	0	0	0	0	0	0
Swisher County WUG Total			**70,143**	**50,504**	**37,636**	**28,244**	**23,835**	**20,944**
Swisher County / Brazos Basin WUG Total			**11,508**	**6,845**	**4,598**	**3,421**	**2,759**	**2,360**
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Swisher County	40	40	40	40	40	40
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Swisher County	33	33	33	33	33	33

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Swisher County	11,435	6,772	4,525	3,348	2,686	2,287
Swisher County / Red Basin WUG Total			**58,635**	**43,659**	**33,038**	**24,823**	**21,076**	**18,584**
Happy*	O	Dockum Aquifer | Swisher County	476	475	474	473	472	470
Tulia	O	Dockum Aquifer | Swisher County	1,065	1,065	1,065	1,065	1,065	1,065
Tulia	O	Mackenzie Lake/Reservoir	210	210	210	210	210	210
Tulia	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Swisher County	529	529	529	529	529	529
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Swisher County	267	267	267	267	267	267
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Swisher County	3,271	3,271	3,271	3,271	3,271	3,271
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Swisher County	52,817	37,842	27,222	19,008	15,262	12,772
Terry County WUG Total			**106,036**	**89,972**	**89,896**	**89,643**	**86,027**	**83,770**
Terry County / Brazos Basin WUG Total			**5,205**	**4,411**	**4,411**	**4,411**	**4,313**	**4,199**
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Terry County	5	5	5	5	5	5
Manufacturing	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Terry County	17	17	17	17	17	17
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Terry County	79	79	79	79	79	79
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Terry County	5,104	4,310	4,310	4,310	4,212	4,098
Terry County / Colorado Basin WUG Total			**100,831**	**85,561**	**85,485**	**85,232**	**81,714**	**79,571**
Brownfield	A	Meredith Lake/Reservoir	344	218	312	317	325	336

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Brownfield	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Terry County	632	632	632	632	632	632
Brownfield	A	Ogallala Aquifer | Roberts County	908	939	769	715	659	680
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Terry County	358	358	358	358	358	358
Manufacturing	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Terry County	18	18	18	18	18	18
Mining	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Terry County	101	101	101	101	101	101
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Terry County	941	941	941	941	941	941
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Terry County	97,529	82,354	82,354	82,150	78,680	76,505
Yoakum County WUG Total			**90,982**	**70,809**	**59,345**	**52,537**	**48,722**	**46,222**
Yoakum County / Colorado Basin WUG Total			**90,982**	**70,809**	**59,345**	**52,537**	**48,722**	**46,222**
Denver City	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Yoakum County	5,313	5,313	5,313	5,313	5,313	5,313
Plains	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Yoakum County	1,138	1,138	1,138	1,138	1,138	1,138
County-Other	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Yoakum County	229	229	229	229	229	229
Mining	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Yoakum County	746	746	746	746	746	746
Steam Electric Power	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Yoakum County	1,596	1,596	1,596	1,100	1,100	1,100
Livestock	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Yoakum County	121	121	121	121	121	121

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DRAFT Region O Water User Group (WUG) Existing Water Supply

WUG Name	Source Region	Source Description	Existing Supply (acre-feet per year)					
			2030	2040	2050	2060	2070	2080
Irrigation	O	Ogallala and Edwards-Trinity-High Plains Aquifers | Yoakum County	81,839	61,666	50,202	43,890	40,075	37,575
Region O WUG Existing Water Supply Total			**1,856,270**	**1,500,579**	**1,272,975**	**1,065,979**	**971,441**	**916,689**

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Appendix E. TWDB DB27 Report – 2026 RWP WUG Needs/Surplus

DRAFT Region O Water User Group (WUG) Needs or Surplus

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Needs/Surplus report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Surplus volumes are shown as positive values, and needs are shown as negative values in parentheses.

			Water Supply Needs or Surplus (acre-feet per year)					
WUG Name	**County**	**Basin**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Muleshoe	Bailey	Brazos	2,043	2,020	1,996	1,962	1,915	1,849
County-Other	Bailey	Brazos	1	0	14	32	57	93
Livestock	Bailey	Brazos	383	25	0	64	124	181
Irrigation	Bailey	Brazos	(845)	(4,452)	(2,317)	0	0	0
Quitaque	Briscoe	Red	243	250	255	259	265	270
Silverton	Briscoe	Red	37	44	49	55	61	67
County-Other	Briscoe	Red	55	65	71	79	87	97
Livestock	Briscoe	Red	38	30	21	12	4	0
Irrigation	Briscoe	Red	0	0	0	0	0	0
Dimmitt	Castro	Brazos	3,092	3,104	3,119	3,127	3,134	3,139
Hart Municipal Water System	Castro	Brazos	453	458	462	466	468	467
County-Other	Castro	Brazos	0	9	21	31	43	59
Livestock	Castro	Brazos	729	79	0	74	139	199
Irrigation	Castro	Brazos	(64,174)	(65,278)	(39,246)	0	0	970
Nazareth	Castro	Red	454	452	451	448	445	440
County-Other	Castro	Red	0	7	15	21	29	39
Manufacturing	Castro	Red	14	12	9	6	3	0
Livestock	Castro	Red	465	50	0	48	89	127
Irrigation	Castro	Red	(19,821)	(26,800)	(13,854)	0	0	0
Morton PWS	Cochran	Brazos	281	302	322	341	360	380
Whiteface	Cochran	Brazos	248	253	255	257	260	262
County-Other	Cochran	Brazos	0	11	22	33	45	57
Livestock	Cochran	Brazos	4	3	2	1	1	0
Irrigation	Cochran	Brazos	(35,798)	(29,594)	(23,303)	(16,579)	(13,777)	(11,703)
County-Other	Cochran	Colorado	0	5	11	16	22	27
Mining	Cochran	Colorado	0	0	0	0	0	0
Livestock	Cochran	Colorado	6	4	3	2	0	0
Irrigation	Cochran	Colorado	0	0	0	0	0	0
Crosbyton	Crosby	Brazos	164	179	197	213	230	247
Lorenzo	Crosby	Brazos	745	756	769	782	794	808
Ralls	Crosby	Brazos	11	27	45	63	81	100
County-Other	Crosby	Brazos	3	11	21	30	39	50
Manufacturing	Crosby	Brazos	0	0	0	0	0	0

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DRAFT Region O Water User Group (WUG) Needs or Surplus

			Water Supply Needs or Surplus (acre-feet per year)					
WUG Name	**County**	**Basin**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Mining	Crosby	Brazos	130	104	78	50	24	0
Livestock	Crosby	Brazos	21	16	11	7	2	0
Irrigation	Crosby	Brazos	0	0	0	0	0	0
County-Other	Crosby	Red	0	0	0	0	0	0
Livestock	Crosby	Red	0	0	0	0	0	0
Irrigation	Crosby	Red	0	0	0	0	0	0
ODonnell	Dawson	Brazos	18	16	15	15	14	14
County-Other	Dawson	Brazos	0	0	0	0	0	0
Livestock	Dawson	Brazos	0	0	0	0	0	0
Irrigation	Dawson	Brazos	0	0	0	0	0	0
Lamesa	Dawson	Colorado	241	162	98	58	18	52
County-Other	Dawson	Colorado	0	1	1	3	4	4
Mining	Dawson	Colorado	219	133	95	0	3,530	3,489
Livestock	Dawson	Colorado	8	7	5	3	1	0
Irrigation	Dawson	Colorado	0	0	0	0	(495)	(581)
County-Other	Deaf Smith	Canadian	1	1	1	1	2	2
Irrigation	Deaf Smith	Canadian	(1,390)	(1,076)	(710)	(344)	(258)	(205)
Hereford	Deaf Smith	Red	3,407	3,323	3,255	3,201	3,118	2,988
County-Other	Deaf Smith	Red	0	37	96	176	272	396
Manufacturing	Deaf Smith	Red	298	243	186	126	64	0
Livestock	Deaf Smith	Red	1,427	493	244	176	92	0
Irrigation	Deaf Smith	Red	(19,152)	(27,626)	(16,837)	0	0	0
Spur	Dickens	Brazos	99	108	120	131	143	156
County-Other	Dickens	Brazos	22	29	37	45	53	61
Livestock	Dickens	Brazos	61	55	49	43	37	35
Irrigation	Dickens	Brazos	1,239	1,239	1,239	1,239	1,239	1,239
Red River Authority of Texas*	Dickens	Red	0	0	0	0	0	0
County-Other	Dickens	Red	0	2	4	6	9	11
Livestock	Dickens	Red	26	22	18	14	10	9
Irrigation	Dickens	Red	431	431	431	431	431	431
Floydada	Floyd	Brazos	1,538	1,555	1,567	1,577	1,585	1,591
Lockney	Floyd	Brazos	353	368	382	396	411	428
County-Other	Floyd	Brazos	0	7	16	23	32	41
Mining	Floyd	Brazos	1	1	1	0	0	0
Livestock	Floyd	Brazos	61	48	35	21	6	0
Irrigation	Floyd	Brazos	0	0	0	0	0	0
County-Other	Floyd	Red	0	4	7	11	15	20

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DRAFT Region O Water User Group (WUG) Needs or Surplus

			Water Supply Needs or Surplus (acre-feet per year)					
WUG Name	County	Basin	2030	2040	2050	2060	2070	2080
Livestock	Floyd	Red	4	3	2	1	1	0
Irrigation	Floyd	Red	(23,439)	(11,747)	(1,480)	0	0	0
Seagraves	Gaines	Colorado	672	705	734	767	795	818
Seminole	Gaines	Colorado	(539)	(694)	(840)	(933)	(1,043)	(1,168)
County-Other	Gaines	Colorado	2,755	2,235	1,707	1,169	601	0
Manufacturing	Gaines	Colorado	102	83	63	43	22	0
Mining	Gaines	Colorado	230	230	230	230	2,078	2,078
Livestock	Gaines	Colorado	13	10	8	5	2	0
Irrigation	Gaines	Colorado	(81,353)	(83,574)	(47,574)	(5,766)	(5,897)	(6,020)
Post	Garza	Brazos	274	294	318	350	384	419
County-Other	Garza	Brazos	42	46	53	64	75	87
Mining	Garza	Brazos	0	0	0	0	0	0
Livestock	Garza	Brazos	16	13	9	5	1	0
Irrigation	Garza	Brazos	0	0	0	0	0	0
Abernathy	Hale	Brazos	832	765	689	600	510	387
Hale Center	Hale	Brazos	730	737	746	757	768	780
Petersburg Municipal Water System	Hale	Brazos	360	366	376	387	398	411
Plainview	Hale	Brazos	4,338	4,318	4,310	4,342	4,484	4,570
Seth Ward WSC	Hale	Brazos	0	2	6	11	16	21
County-Other	Hale	Brazos	0	84	236	399	404	408
Manufacturing	Hale	Brazos	145	118	90	61	31	0
Mining	Hale	Brazos	0	0	0	0	0	0
Steam Electric Power	Hale	Brazos	0	0	0	0	0	0
Livestock	Hale	Brazos	375	9	0	88	171	253
Irrigation	Hale	Brazos	(100,121)	(111,976)	(57,036)	0	0	0
County-Other	Hale	Red	1	1	1	1	1	1
Irrigation	Hale	Red	(1,722)	(1,473)	(765)	(48)	(24)	(16)
Anton	Hockley	Brazos	732	734	735	737	738	738
Levelland	Hockley	Brazos	3,004	2,811	2,657	2,546	2,442	2,437
County-Other	Hockley	Brazos	0	4	18	33	50	68
Manufacturing	Hockley	Brazos	246	200	153	104	53	0
Mining	Hockley	Brazos	0	0	0	0	0	0
Livestock	Hockley	Brazos	12	9	7	4	1	0
Irrigation	Hockley	Brazos	(24,418)	(15,108)	(9,477)	0	0	0
Sundown	Hockley	Colorado	541	551	570	587	608	631

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DRAFT Region O Water User Group (WUG) Needs or Surplus

			Water Supply Needs or Surplus (acre-feet per year)					
WUG Name	**County**	**Basin**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
County-Other	Hockley	Colorado	0	0	1	2	2	3
Livestock	Hockley	Colorado	1	1	0	0	0	0
Irrigation	Hockley	Colorado	0	0	0	0	0	0
Amherst	Lamb	Brazos	153	154	154	154	155	155
Earth	Lamb	Brazos	547	553	557	560	561	560
Littlefield	Lamb	Brazos	1,573	1,593	1,604	1,610	1,605	1,587
Olton	Lamb	Brazos	965	980	991	999	1,003	1,000
Sudan	Lamb	Brazos	211	207	201	194	185	172
County-Other	Lamb	Brazos	25	13	27	53	96	164
Manufacturing	Lamb	Brazos	79	64	49	33	17	0
Steam Electric Power	Lamb	Brazos	0	0	0	0	0	0
Livestock	Lamb	Brazos	690	46	0	116	223	324
Irrigation	Lamb	Brazos	(60,818)	(73,776)	(32,449)	0	0	0
Abernathy	Lubbock	Brazos	298	317	339	371	385	403
Idalou	Lubbock	Brazos	933	949	962	979	995	1,010
Lubbock	Lubbock	Brazos	(319)	(6,181)	(16,665)	(28,047)	(40,631)	(49,685)
New Deal	Lubbock	Brazos	307	312	317	321	326	330
Ransom Canyon	Lubbock	Brazos	273	253	232	206	44	14
Shallowater	Lubbock	Brazos	184	129	71	(3)	(333)	(418)
Slaton	Lubbock	Brazos	(204)	(275)	(327)	(360)	(386)	(380)
Wolfforth	Lubbock	Brazos	(1,512)	(3,027)	(4,006)	(4,379)	(4,663)	(4,838)
County-Other	Lubbock	Brazos	2,818	3,165	3,067	2,272	1,131	38
Manufacturing	Lubbock	Brazos	233	190	145	98	50	0
Mining	Lubbock	Brazos	1	1	1	0	0	0
Steam Electric Power	Lubbock	Brazos	7,189	8,098	8,098	5,858	5,858	5,858
Livestock	Lubbock	Brazos	30	23	16	9	2	0
Irrigation	Lubbock	Brazos	(26,749)	(31,696)	(15,069)	0	0	0
ODonnell	Lynn	Brazos	102	94	88	82	79	80
Tahoka Public Water System	Lynn	Brazos	369	345	327	320	313	324
County-Other	Lynn	Brazos	0	8	14	22	32	41
Mining	Lynn	Brazos	0	0	0	0	0	0
Livestock	Lynn	Brazos	7	5	4	3	1	0
Irrigation	Lynn	Brazos	0	0	0	0	0	0
County-Other	Lynn	Colorado	0	0	0	1	1	1
Livestock	Lynn	Colorado	1	1	0	0	0	0

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DRAFT Region O Water User Group (WUG) Needs or Surplus

			Water Supply Needs or Surplus (acre-feet per year)					
WUG Name	**County**	**Basin**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Irrigation	Lynn	Colorado	0	0	0	(449)	(692)	(849)
Matador	Motley	Red	612	624	633	634	635	636
Red River Authority of Texas*	Motley	Red	0	0	0	0	0	0
County-Other	Motley	Red	22	28	33	34	34	35
Livestock	Motley	Red	98	91	84	77	69	67
Irrigation	Motley	Red	2,858	2,858	2,858	2,858	2,858	2,858
Bovina	Parmer	Brazos	314	339	373	409	450	500
Farwell	Parmer	Brazos	461	423	382	337	283	215
County-Other	Parmer	Brazos	0	50	111	179	255	346
Livestock	Parmer	Brazos	741	65	0	98	187	268
Irrigation	Parmer	Brazos	(69,215)	(68,430)	(37,184)	(2,318)	(1,376)	(800)
Friona	Parmer	Red	1,411	1,372	1,329	1,284	1,228	1,158
County-Other	Parmer	Red	0	19	44	70	100	136
Manufacturing	Parmer	Red	435	354	270	183	93	0
Livestock	Parmer	Red	322	29	0	43	81	117
Irrigation	Parmer	Red	0	(2,418)	0	0	0	385
County-Other	Swisher	Brazos	0	1	2	3	3	4
Livestock	Swisher	Brazos	4	3	2	2	1	0
Irrigation	Swisher	Brazos	(159)	(2,651)	(2,273)	(825)	(664)	(516)
Happy*	Swisher	Red	404	405	407	409	410	411
Tulia	Swisher	Red	1,151	1,182	1,220	1,252	1,285	1,321
County-Other	Swisher	Red	0	6	12	16	22	27
Livestock	Swisher	Red	389	315	238	159	78	0
Irrigation	Swisher	Red	0	(5,084)	(3,745)	0	0	0
County-Other	Terry	Brazos	0	0	0	0	1	1
Manufacturing	Terry	Brazos	3	2	2	1	1	0
Livestock	Terry	Brazos	11	1	0	2	4	6
Irrigation	Terry	Brazos	0	0	0	0	0	0
Brownfield	Terry	Colorado	501	386	290	213	132	125
County-Other	Terry	Colorado	0	2	19	46	76	112
Manufacturing	Terry	Colorado	2	2	1	1	0	0
Mining	Terry	Colorado	0	0	0	0	0	0
Livestock	Terry	Colorado	129	8	0	22	42	67
Irrigation	Terry	Colorado	0	0	0	(204)	(1,809)	(1,798)
Denver City	Yoakum	Colorado	3,923	3,863	3,807	3,758	3,708	3,655
Plains	Yoakum	Colorado	798	778	762	763	767	772
County-Other	Yoakum	Colorado	49	44	38	26	14	0

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DRAFT Region O Water User Group (WUG) Needs or Surplus

			Water Supply Needs or Surplus (acre-feet per year)					
WUG Name	**County**	**Basin**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Mining	Yoakum	Colorado	0	0	0	0	0	0
Steam Electric Power	Yoakum	Colorado	0	0	0	0	0	0
Livestock	Yoakum	Colorado	14	11	8	5	2	0
Irrigation	Yoakum	Colorado	(23,136)	(28,019)	(16,585)	0	0	0

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Appendix F. TWDB DB27 Report – 2026 RWP WUG Data Comparison to 2021 RWP

DRAFT Region O 2026 Regional Water Plan (RWP)
Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Bailey County| Municipal WUG Type						
Existing WUG supply total	3,467	3,284	-5.3%	3,467	3,284	-5.3%
Projected demand total	1,579	1,240	-21.5%	2,198	1,312	-40.3%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Bailey County| Livestock WUG Type						
Existing WUG supply total	3,077	2,854	-7.2%	3,077	2,854	-7.2%
Projected demand total	2,821	2,471	-12.4%	3,958	2,730	-31.0%
Water supply needs total**	0	0	0.0%	881	0	-100.0%
Bailey County| Irrigation WUG Type						
Existing WUG supply total	42,438	57,325	35.1%	9,946	24,677	148.1%
Projected demand total	88,108	58,170	-34.0%	55,616	24,677	-55.6%
Water supply needs total**	45,670	845	-98.1%	45,670	0	-100.0%
Briscoe County| Municipal WUG Type						
Existing WUG supply total	665	642	-3.5%	665	642	-3.5%
Projected demand total	384	307	-20.1%	375	229	-38.9%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Briscoe County| Livestock WUG Type						
Existing WUG supply total	353	337	-4.5%	353	337	-4.5%
Projected demand total	300	299	-0.3%	352	333	-5.4%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Briscoe County| Irrigation WUG Type						
Existing WUG supply total	22,183	17,821	-19.7%	10,997	6,219	-43.4%
Projected demand total	26,417	17,821	-32.5%	15,231	6,219	-59.2%
Water supply needs total**	4,234	0	-100.0%	4,234	0	-100.0%
Castro County| Municipal WUG Type						
Existing WUG supply total	5,494	5,382	-2.0%	5,494	5,382	-2.0%

*The 2030 and 2070 planning decades are used in this comparison because they represent the earliest and latest planning decades in both the 2021 and 2026 RWPs

**WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2021 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the water supply needs totals.

DRAFT Region O 2026 Regional Water Plan (RWP) Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Projected demand total	1,870	1,383	-26.0%	2,156	1,263	-41.4%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Castro County| Manufacturing WUG Type						
Existing WUG supply total	95	81	-14.7%	95	81	-14.7%
Projected demand total	66	67	1.5%	66	78	18.2%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Castro County| Livestock WUG Type						
Existing WUG supply total	11,339	10,352	-8.7%	11,339	10,352	-8.7%
Projected demand total	7,589	9,158	20.7%	10,261	10,124	-1.3%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Castro County| Irrigation WUG Type						
Existing WUG supply total	171,998	168,568	-2.0%	15,033	11,447	-23.9%
Projected demand total	379,863	252,563	-33.5%	222,898	11,447	-94.9%
Water supply needs total**	207,865	83,995	-59.6%	207,865	0	-100.0%
Cochran County| Municipal WUG Type						
Existing WUG supply total	1,294	1,145	-11.5%	1,294	1,145	-11.5%
Projected demand total	942	616	-34.6%	972	458	-52.9%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Cochran County| Mining WUG Type						
Existing WUG supply total	312	166	-46.8%	312	166	-46.8%
Projected demand total	208	166	-20.2%	81	166	104.9%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Cochran County| Livestock WUG Type						
Existing WUG supply total	674	120	-82.2%	674	120	-82.2%
Projected demand total	106	110	3.8%	118	119	0.8%
Water supply needs total**	0	0	0.0%	0	0	0.0%

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**WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2021 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the water supply needs totals.

DRAFT Region O 2026 Regional Water Plan (RWP)
Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Cochran County| Irrigation WUG Type						
Existing WUG supply total	70,098	45,339	-35.3%	40,689	28,262	-30.5%
Projected demand total	99,449	81,137	-18.4%	62,972	42,039	-33.2%
Water supply needs total**	47,340	35,798	-24.4%	28,190	13,777	-51.1%
Crosby County| Municipal WUG Type						
Existing WUG supply total	1,707	1,628	-4.6%	1,707	1,628	-4.6%
Projected demand total	1,035	705	-31.9%	1,250	484	-61.3%
Water supply needs total**	89	0	-100.0%	146	0	-100.0%
Crosby County| Manufacturing WUG Type						
Existing WUG supply total	3	1	-66.7%	3	1	-66.7%
Projected demand total	3	1	-66.7%	3	1	-66.7%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Crosby County| Mining WUG Type						
Existing WUG supply total	1,183	613	-48.2%	1,183	613	-48.2%
Projected demand total	980	483	-50.7%	568	589	3.7%
Water supply needs total**	363	0	-100.0%	210	0	-100.0%
Crosby County| Livestock WUG Type						
Existing WUG supply total	211	196	-7.1%	211	196	-7.1%
Projected demand total	179	175	-2.2%	209	194	-7.2%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Crosby County| Irrigation WUG Type						
Existing WUG supply total	119,683	60,292	-49.6%	39,393	30,463	-22.7%
Projected demand total	107,583	60,292	-44.0%	67,695	30,463	-55.0%
Water supply needs total**	1,246	0	-100.0%	28,302	0	-100.0%
Dawson County| Municipal WUG Type						
Existing WUG supply total	3,100	2,553	-17.6%	3,183	2,208	-30.6%

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**WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2021 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the water supply needs totals.

DRAFT Region O 2026 Regional Water Plan (RWP)
Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Projected demand total	2,918	2,294	-21.4%	3,148	2,172	-31.0%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Dawson County| Mining WUG Type						
Existing WUG supply total	266	6,146	2210.5%	266	6,146	2210.5%
Projected demand total	1,812	5,927	227.1%	1,812	2,616	44.4%
Water supply needs total**	1,546	0	-100.0%	1,546	0	-100.0%
Dawson County| Livestock WUG Type						
Existing WUG supply total	201	72	-64.2%	201	72	-64.2%
Projected demand total	55	64	16.4%	65	71	9.2%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Dawson County| Irrigation WUG Type						
Existing WUG supply total	119,749	66,209	-44.7%	66,200	62,206	-6.0%
Projected demand total	106,312	66,209	-37.7%	79,443	62,701	-21.1%
Water supply needs total**	0	0	0.0%	13,519	495	-96.3%
Deaf Smith County| Municipal WUG Type						
Existing WUG supply total	7,747	7,238	-6.6%	7,747	7,238	-6.6%
Projected demand total	5,005	3,830	-23.5%	7,727	3,846	-50.2%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Deaf Smith County| Manufacturing WUG Type						
Existing WUG supply total	4	1,796	44800.0%	4	1,796	44800.0%
Projected demand total	1,107	1,498	35.3%	1,107	1,732	56.5%
Water supply needs total**	1,103	0	-100.0%	1,103	0	-100.0%
Deaf Smith County| Livestock WUG Type						
Existing WUG supply total	12,089	14,105	16.7%	12,089	14,105	16.7%
Projected demand total	12,157	12,678	4.3%	15,604	14,013	-10.2%
Water supply needs total**	122	0	-100.0%	3,515	0	-100.0%

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DRAFT Region O 2026 Regional Water Plan (RWP) Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Deaf Smith County| Irrigation WUG Type						
Existing WUG supply total	122,247	118,378	-3.2%	30,550	25,562	-16.3%
Projected demand total	210,016	138,920	-33.9%	118,219	25,820	-78.2%
Water supply needs total**	87,769	20,542	-76.6%	87,669	258	-99.7%
Dickens County| Municipal WUG Type						
Existing WUG supply total	417	357	-14.4%	421	357	-15.2%
Projected demand total	325	236	-27.4%	319	152	-52.4%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Dickens County| Mining WUG Type						
Existing WUG supply total	29	0	-100.0%	29	0	-100.0%
Projected demand total	12	0	-100.0%	12	0	-100.0%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Dickens County| Livestock WUG Type						
Existing WUG supply total	487	475	-2.5%	487	475	-2.5%
Projected demand total	406	388	-4.4%	475	428	-9.9%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Dickens County| Irrigation WUG Type						
Existing WUG supply total	10,376	9,217	-11.2%	10,376	9,217	-11.2%
Projected demand total	9,039	7,547	-16.5%	9,039	7,547	-16.5%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Floyd County| Municipal WUG Type						
Existing WUG supply total	2,790	2,636	-5.5%	2,790	2,636	-5.5%
Projected demand total	1,053	745	-29.2%	1,145	593	-48.2%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Floyd County| Mining WUG Type						
Existing WUG supply total	492	10	-98.0%	492	10	-98.0%

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DRAFT Region O 2026 Regional Water Plan (RWP)
Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Projected demand total	492	9	-98.2%	485	10	-97.9%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Floyd County| Livestock WUG Type						
Existing WUG supply total	1,639	1,287	-21.5%	1,639	1,287	-21.5%
Projected demand total	1,189	1,222	2.8%	1,268	1,280	0.9%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Floyd County| Irrigation WUG Type						
Existing WUG supply total	105,650	69,173	-34.5%	53,048	35,644	-32.8%
Projected demand total	128,837	92,612	-28.1%	76,235	35,644	-53.2%
Water supply needs total**	42,645	23,439	-45.0%	23,187	0	-100.0%
Gaines County| Municipal WUG Type						
Existing WUG supply total	4,516	7,404	64.0%	4,516	7,404	64.0%
Projected demand total	4,764	4,516	-5.2%	7,811	7,051	-9.7%
Water supply needs total**	784	539	-31.3%	3,758	1,043	-72.2%
Gaines County| Manufacturing WUG Type						
Existing WUG supply total	544	617	13.4%	544	617	13.4%
Projected demand total	1,587	515	-67.5%	1,587	595	-62.5%
Water supply needs total**	1,043	0	-100.0%	1,043	0	-100.0%
Gaines County| Mining WUG Type						
Existing WUG supply total	7,729	2,100	-72.8%	7,729	2,100	-72.8%
Projected demand total	2,400	1,870	-22.1%	776	22	-97.2%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Gaines County| Livestock WUG Type						
Existing WUG supply total	203	156	-23.2%	203	156	-23.2%
Projected demand total	126	143	13.5%	137	154	12.4%
Water supply needs total**	0	0	0.0%	0	0	0.0%

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DRAFT Region O 2026 Regional Water Plan (RWP)
Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Gaines County| Irrigation WUG Type						
Existing WUG supply total	195,378	190,866	-2.3%	115,334	122,871	6.5%
Projected demand total	362,482	272,219	-24.9%	282,438	128,768	-54.4%
Water supply needs total**	167,104	81,353	-51.3%	167,104	5,897	-96.5%
Garza County| Municipal WUG Type						
Existing WUG supply total	1,135	1,028	-9.4%	1,135	1,028	-9.4%
Projected demand total	955	712	-25.4%	1,097	569	-48.1%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Garza County| Manufacturing WUG Type						
Existing WUG supply total	2	0	-100.0%	2	0	-100.0%
Projected demand total	2	0	-100.0%	2	0	-100.0%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Garza County| Mining WUG Type						
Existing WUG supply total	544	19	-96.5%	544	19	-96.5%
Projected demand total	544	19	-96.5%	164	19	-88.4%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Garza County| Livestock WUG Type						
Existing WUG supply total	184	170	-7.6%	184	170	-7.6%
Projected demand total	155	154	-0.6%	181	169	-6.6%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Garza County| Irrigation WUG Type						
Existing WUG supply total	14,620	9,899	-32.3%	11,827	9,899	-16.3%
Projected demand total	10,353	9,899	-4.4%	10,353	9,899	-4.4%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Hale County| Municipal WUG Type						
Existing WUG supply total	12,855	11,939	-7.1%	12,425	11,775	-5.2%

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DRAFT Region O 2026 Regional Water Plan (RWP) Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Projected demand total	6,859	5,678	-17.2%	6,934	5,194	-25.1%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Hale County| Manufacturing WUG Type						
Existing WUG supply total	1,416	876	-38.1%	1,416	876	-38.1%
Projected demand total	5,076	731	-85.6%	5,076	845	-83.4%
Water supply needs total**	3,660	0	-100.0%	3,660	0	-100.0%
Hale County| Mining WUG Type						
Existing WUG supply total	215	1	-99.5%	215	1	-99.5%
Projected demand total	1,152	1	-99.9%	662	1	-99.8%
Water supply needs total**	937	0	-100.0%	447	0	-100.0%
Hale County| Steam Electric Power WUG Type						
Existing WUG supply total	31	29	-6.5%	31	29	-6.5%
Projected demand total	31	29	-6.5%	31	29	-6.5%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Hale County| Livestock WUG Type						
Existing WUG supply total	4,098	3,049	-25.6%	4,098	3,049	-25.6%
Projected demand total	3,111	2,674	-14.0%	4,098	2,878	-29.8%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Hale County| Irrigation WUG Type						
Existing WUG supply total	98,777	107,925	9.3%	15,803	18,123	14.7%
Projected demand total	310,542	209,768	-32.5%	227,568	18,147	-92.0%
Water supply needs total**	211,765	101,843	-51.9%	211,765	24	-100.0%
Hockley County| Municipal WUG Type						
Existing WUG supply total	7,975	7,555	-5.3%	7,688	6,971	-9.3%
Projected demand total	4,064	3,278	-19.3%	4,397	3,131	-28.8%
Water supply needs total**	0	0	0.0%	0	0	0.0%

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**WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2021 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the water supply needs totals.

DRAFT Region O 2026 Regional Water Plan (RWP)
Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Hockley County| Manufacturing WUG Type						
Existing WUG supply total	700	1,478	111.1%	700	1,478	111.1%
Projected demand total	691	1,232	78.3%	691	1,425	106.2%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Hockley County| Mining WUG Type						
Existing WUG supply total	1,547	69	-95.5%	1,547	69	-95.5%
Projected demand total	18	69	283.3%	15	69	360.0%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Hockley County| Livestock WUG Type						
Existing WUG supply total	408	150	-63.2%	408	150	-63.2%
Projected demand total	138	137	-0.7%	157	149	-5.1%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Hockley County| Irrigation WUG Type						
Existing WUG supply total	93,617	87,684	-6.3%	46,493	47,413	2.0%
Projected demand total	131,866	112,102	-15.0%	73,589	47,413	-35.6%
Water supply needs total**	43,079	24,418	-43.3%	27,096	0	-100.0%
Lamb County| Municipal WUG Type						
Existing WUG supply total	5,648	5,520	-2.3%	5,648	5,520	-2.3%
Projected demand total	2,412	2,046	-15.2%	2,453	1,915	-21.9%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Lamb County| Manufacturing WUG Type						
Existing WUG supply total	1,000	477	-52.3%	1,000	477	-52.3%
Projected demand total	940	398	-57.7%	940	460	-51.1%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Lamb County| Mining WUG Type						
Existing WUG supply total	108	0	-100.0%	108	0	-100.0%

*The 2030 and 2070 planning decades are used in this comparison because they represent the earliest and latest planning decades in both the 2021 and 2026 RWPs

**WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2021 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the water supply needs totals.

DRAFT Region O 2026 Regional Water Plan (RWP)
Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Projected demand total	579	0	-100.0%	333	0	-100.0%
Water supply needs total**	471	0	-100.0%	225	0	-100.0%
Lamb County| Steam Electric Power WUG Type						
Existing WUG supply total	15,666	5,789	-63.0%	15,666	3,000	-80.9%
Projected demand total	13,450	5,789	-57.0%	13,450	3,000	-77.7%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Lamb County| Livestock WUG Type						
Existing WUG supply total	5,225	5,157	-1.3%	5,225	5,157	-1.3%
Projected demand total	4,529	4,467	-1.4%	6,271	4,934	-21.3%
Water supply needs total**	0	0	0.0%	1,046	0	-100.0%
Lamb County| Irrigation WUG Type						
Existing WUG supply total	72,680	107,928	48.5%	7,414	20,958	182.7%
Projected demand total	259,451	168,746	-35.0%	194,185	20,958	-89.2%
Water supply needs total**	186,771	60,818	-67.4%	186,771	0	-100.0%
Lubbock County| Municipal WUG Type						
Existing WUG supply total	55,962	64,029	14.4%	48,914	49,839	1.9%
Projected demand total	58,186	61,251	5.3%	79,048	92,971	17.6%
Water supply needs total**	8,472	2,035	-76.0%	32,736	46,013	40.6%
Lubbock County| Manufacturing WUG Type						
Existing WUG supply total	335	1,407	320.0%	335	1,407	320.0%
Projected demand total	1,011	1,174	16.1%	1,011	1,357	34.2%
Water supply needs total**	676	0	-100.0%	676	0	-100.0%
Lubbock County| Mining WUG Type						
Existing WUG supply total	982	20	-98.0%	982	20	-98.0%
Projected demand total	6,425	19	-99.7%	4,314	20	-99.5%
Water supply needs total**	5,443	0	-100.0%	3,332	0	-100.0%

*The 2030 and 2070 planning decades are used in this comparison because they represent the earliest and latest planning decades in both the 2021 and 2026 RWPs

**WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2021 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the water supply needs totals.

DRAFT Region O 2026 Regional Water Plan (RWP) Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Lubbock County| Steam Electric Power WUG Type						
Existing WUG supply total	10,098	10,098	0.0%	7,858	7,858	0.0%
Projected demand total	5,694	2,909	-48.9%	5,694	2,000	-64.9%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Lubbock County| Livestock WUG Type						
Existing WUG supply total	1,290	853	-33.9%	1,290	853	-33.9%
Projected demand total	1,138	823	-27.7%	1,287	851	-33.9%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Lubbock County| Irrigation WUG Type						
Existing WUG supply total	104,602	106,611	1.9%	73,196	75,089	2.6%
Projected demand total	144,866	133,360	-7.9%	114,260	75,089	-34.3%
Water supply needs total**	40,264	26,749	-33.6%	41,064	0	-100.0%
Lynn County| Municipal WUG Type						
Existing WUG supply total	1,412	1,215	-14.0%	1,304	1,091	-16.3%
Projected demand total	907	744	-18.0%	934	666	-28.7%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Lynn County| Mining WUG Type						
Existing WUG supply total	542	15	-97.2%	542	15	-97.2%
Projected demand total	1,327	15	-98.9%	660	15	-97.7%
Water supply needs total**	785	0	-100.0%	165	0	-100.0%
Lynn County| Livestock WUG Type						
Existing WUG supply total	167	77	-53.9%	167	77	-53.9%
Projected demand total	68	69	1.5%	79	76	-3.8%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Lynn County| Irrigation WUG Type						
Existing WUG supply total	93,961	72,812	-22.5%	69,647	69,142	-0.7%

*The 2030 and 2070 planning decades are used in this comparison because they represent the earliest and latest planning decades in both the 2021 and 2026 RWPs

**WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2021 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the water supply needs totals.

DRAFT Region O 2026 Regional Water Plan (RWP) Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Projected demand total	88,921	72,812	-18.1%	88,921	69,834	-21.5%
Water supply needs total**	0	0	0.0%	19,274	692	-96.4%
Motley County| Municipal WUG Type						
Existing WUG supply total	902	886	-1.8%	904	885	-2.1%
Projected demand total	321	252	-21.5%	317	216	-31.9%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Motley County| Mining WUG Type						
Existing WUG supply total	244	0	-100.0%	244	0	-100.0%
Projected demand total	213	0	-100.0%	161	0	-100.0%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Motley County| Livestock WUG Type						
Existing WUG supply total	375	375	0.0%	375	375	0.0%
Projected demand total	290	277	-4.5%	340	306	-10.0%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Motley County| Irrigation WUG Type						
Existing WUG supply total	12,107	11,856	-2.1%	12,106	11,856	-2.1%
Projected demand total	9,426	8,998	-4.5%	9,426	8,998	-4.5%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Parmer County| Municipal WUG Type						
Existing WUG supply total	4,538	4,076	-10.2%	4,538	4,076	-10.2%
Projected demand total	2,405	1,890	-21.4%	3,188	1,760	-44.8%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Parmer County| Manufacturing WUG Type						
Existing WUG supply total	1,866	2,619	40.4%	1,866	2,619	40.4%
Projected demand total	1,841	2,184	18.6%	1,841	2,526	37.2%
Water supply needs total**	0	0	0.0%	0	0	0.0%

*The 2030 and 2070 planning decades are used in this comparison because they represent the earliest and latest planning decades in both the 2021 and 2026 RWPs

**WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2021 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the water supply needs totals.

DRAFT Region O 2026 Regional Water Plan (RWP)
Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Parmer County| Livestock WUG Type						
Existing WUG supply total	11,329	8,856	-21.8%	11,329	8,856	-21.8%
Projected demand total	8,318	7,793	-6.3%	11,276	8,588	-23.8%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Parmer County| Irrigation WUG Type						
Existing WUG supply total	77,477	69,621	-10.1%	16,915	12,661	-25.1%
Projected demand total	239,225	138,836	-42.0%	177,802	14,037	-92.1%
Water supply needs total**	161,748	69,215	-57.2%	160,887	1,376	-99.1%
Swisher County| Municipal WUG Type						
Existing WUG supply total	2,726	2,587	-5.1%	2,721	2,583	-5.1%
Projected demand total	1,342	1,032	-23.1%	1,405	863	-38.6%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Swisher County| Livestock WUG Type						
Existing WUG supply total	6,089	3,304	-45.7%	5,767	3,304	-42.7%
Projected demand total	2,864	2,911	1.6%	3,469	3,225	-7.0%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Swisher County| Irrigation WUG Type						
Existing WUG supply total	64,574	64,252	-0.5%	16,040	17,948	11.9%
Projected demand total	135,396	64,411	-52.4%	86,540	18,612	-78.5%
Water supply needs total**	70,822	159	-99.8%	70,500	664	-99.1%
Terry County| Municipal WUG Type						
Existing WUG supply total	2,457	2,247	-8.5%	2,258	1,979	-12.4%
Projected demand total	2,109	1,746	-17.2%	2,480	1,770	-28.6%
Water supply needs total**	0	0	0.0%	291	0	-100.0%
Terry County| Manufacturing WUG Type						
Existing WUG supply total	17	35	105.9%	17	35	105.9%

*The 2030 and 2070 planning decades are used in this comparison because they represent the earliest and latest planning decades in both the 2021 and 2026 RWPs

**WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2021 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the water supply needs totals.

DRAFT Region O 2026 Regional Water Plan (RWP)
Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Projected demand total	17	30	76.5%	17	34	100.0%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Terry County| Mining WUG Type						
Existing WUG supply total	140	101	-27.9%	140	101	-27.9%
Projected demand total	525	101	-80.8%	206	101	-51.0%
Water supply needs total**	388	0	-100.0%	91	0	-100.0%
Terry County| Livestock WUG Type						
Existing WUG supply total	590	1,020	72.9%	590	1,020	72.9%
Projected demand total	461	880	90.9%	586	974	66.2%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Terry County| Irrigation WUG Type						
Existing WUG supply total	130,202	102,633	-21.2%	82,784	82,892	0.1%
Projected demand total	172,785	102,633	-40.6%	125,527	84,701	-32.5%
Water supply needs total**	42,583	0	-100.0%	42,743	1,809	-95.8%
Yoakum County| Municipal WUG Type						
Existing WUG supply total	6,850	6,680	-2.5%	6,850	6,680	-2.5%
Projected demand total	2,352	1,910	-18.8%	3,319	2,191	-34.0%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Yoakum County| Mining WUG Type						
Existing WUG supply total	764	746	-2.4%	764	746	-2.4%
Projected demand total	1,334	746	-44.1%	641	746	16.4%
Water supply needs total**	570	0	-100.0%	0	0	0.0%
Yoakum County| Steam Electric Power WUG Type						
Existing WUG supply total	2,000	1,596	-20.2%	2,000	1,100	-45.0%
Projected demand total	1,910	1,596	-16.4%	1,910	1,100	-42.4%
Water supply needs total**	0	0	0.0%	0	0	0.0%

*The 2030 and 2070 planning decades are used in this comparison because they represent the earliest and latest planning decades in both the 2021 and 2026 RWPs

**WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2021 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the water supply needs totals.

DRAFT Region O 2026 Regional Water Plan (RWP)
Water User Group (WUG) Data Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Yoakum County| Livestock WUG Type						
Existing WUG supply total	191	121	-36.6%	191	121	-36.6%
Projected demand total	96	107	11.5%	113	119	5.3%
Water supply needs total**	0	0	0.0%	0	0	0.0%
Yoakum County| Irrigation WUG Type						
Existing WUG supply total	82,507	81,839	-0.8%	38,495	40,075	4.1%
Projected demand total	161,693	104,975	-35.1%	117,681	40,075	-65.9%
Water supply needs total**	79,186	23,136	-70.8%	79,186	0	-100.0%
Region O Total						
Existing WUG supply total	2,067,674	1,856,270	-10.2%	1,014,486	971,441	-4.2%
Projected demand total	3,381,960	2,345,019	-30.7%	2,452,931	983,165	-59.9%
Water supply needs total**	1,466,543	554,884	-62.2%	1,499,897	72,048	-95.2%

*The 2030 and 2070 planning decades are used in this comparison because they represent the earliest and latest planning decades in both the 2021 and 2026 RWPs

**WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2021 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the water supply needs totals.

Appendix G. TWDB DB27 Report – 2026 RWP Source Data Comparison to 2021 RWP

DRAFT Region O 2026 Regional Water Plan (RWP) Source Availability Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Bailey County						
Groundwater availability total	68,140	66,087	-3.0%	35,648	35,673	0.1%
Reuse availability total	825	825	0.0%	825	825	0.0%
Briscoe County						
Groundwater availability total	23,950	24,171	0.9%	12,764	13,055	2.3%
Surface Water availability total	96	96	0.0%	96	96	0.0%
Castro County						
Groundwater availability total	184,895	180,412	-2.4%	27,930	32,175	15.2%
Reuse availability total	4,031	4,031	0.0%	4,031	4,031	0.0%
Cochran County						
Groundwater availability total	80,124	75,097	-6.3%	43,647	44,738	2.5%
Reuse availability total	294	294	0.0%	294	294	0.0%
Crosby County						
Groundwater availability total	124,438	121,458	-2.4%	44,148	47,124	6.7%
Reuse availability total	583	583	0.0%	583	583	0.0%
Dawson County						
Groundwater availability total	123,476	121,976	-1.2%	69,927	70,902	1.4%
Deaf Smith County						
Groundwater availability total	141,804	140,396	-1.0%	50,007	52,262	4.5%
Reuse availability total	2,810	2,810	0.0%	2,810	2,810	0.0%
Dickens County						
Groundwater availability total	11,500	15,229	32.4%	11,500	15,229	32.4%
Floyd County						
Groundwater availability total	113,365	113,627	0.2%	60,763	58,906	-3.1%
Reuse availability total	449	449	0.0%	449	449	0.0%
Surface Water availability total	18	18	0.0%	18	18	0.0%
Gaines County						
Groundwater availability total	218,338	206,366	-5.5%	138,294	139,037	0.5%
Garza County						
Groundwater availability total	16,559	16,546	-0.1%	13,766	13,986	1.6%

*The 2030 and 2070 planning decades are used in this comparison because they represent the earliest and latest planning decades in both the 2021 and 2026 RWPs.

**Since reservoir sources can exist across multiple counties, the county field value, 'reservoir' is applied to all reservoir sources.

DRAFT Region O 2026 Regional Water Plan (RWP) Source Availability Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

	2030 Planning Decade*			2070 Planning Decade*		
	2021 RWP	2026 RWP	Difference (%)	2021 RWP	2026 RWP	Difference (%)
Hale County						
Groundwater availability total	116,049	117,892	1.6%	33,075	35,585	7.6%
Reuse availability total	5,477	5,477	0.0%	5,477	5,477	0.0%
Hockley County						
Groundwater availability total	112,944	112,991	0.0%	54,667	56,086	2.6%
Reuse availability total	1,521	1,521	0.0%	1,521	1,521	0.0%
Lamb County						
Groundwater availability total	113,005	121,223	7.3%	47,739	48,919	2.5%
Reuse availability total	7,199	7,199	0.0%	7,199	7,199	0.0%
Lubbock County						
Groundwater availability total	122,490	111,708	-8.8%	91,884	90,113	-1.9%
Reuse availability total	24,931	22,523	-9.7%	31,830	30,576	-3.9%
Lynn County						
Groundwater availability total	97,063	89,807	-7.5%	72,552	71,746	-1.1%
Reuse availability total	346	346	0.0%	346	346	0.0%
Motley County						
Groundwater availability total	20,181	20,181	0.0%	17,462	17,462	0.0%
Surface Water availability total	4	4	0.0%	4	4	0.0%
Parmer County						
Groundwater availability total	96,548	98,232	1.7%	35,125	37,478	6.7%
Reuse availability total	2,887	2,887	0.0%	2,887	2,887	0.0%
Reservoir County**						
Surface Water availability total	25,470	14,200	-44.2%	23,630	13,000	-45.0%
Swisher County						
Groundwater availability total	73,215	75,203	2.7%	24,359	25,768	5.8%
Terry County						
Groundwater availability total	132,777	134,878	1.6%	85,519	86,343	1.0%
Yoakum County						
Groundwater availability total	92,952	90,983	-2.1%	48,940	49,187	0.5%
Region O Total						
Groundwater availability total	2,083,813	2,054,463	-1.4%	1,019,716	1,041,774	2.2%

*The 2030 and 2070 planning decades are used in this comparison because they represent the earliest and latest planning decades in both the 2021 and 2026 RWPs.

**Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

DRAFT Region O 2026 Regional Water Plan (RWP)
Source Availability Comparison to 2021 RWP

Water Volumes Shown in Acre-Feet per year

Reuse availability total	51,353	48,945	-4.7%	58,252	56,998	-2.2%
Surface Water availability total	25,588	14,318	-44.0%	23,748	13,118	-44.8%

*The 2030 and 2070 planning decades are used in this comparison because they represent the earliest and latest planning decades in both the 2021 and 2026 RWPs.

**Since reservoir sources can exist across multiple counties, the county field value, 'reservoir' is applied to all reservoir sources.

Appendix H. WAM input and output files

(electronic submittal)

Appendix I. Region O Hydrologic Variance Information

Llano Estacado
REGIONAL WATER PLANNING GROUP
REGION O

December 12, 2023

Jeff Walker
Executive Administrator
Texas Water Development Board
PO Box 13231
Austin, TX 78711

The Llano Estacado Regional Water Planning Group (LERWPG) met on November 30, 2023, and discussed the process to determine the amount of surface water available from existing water rights and future water management strategies. During this meeting, the LERWPG discussed specific deviations from the standard Texas Water Development Board (TWDB) guidance that will be employed to develop the 2026 Llano Estacado Regional Water Plan.

As you know, the guidance provided by the TWDB in the base scope of work for the Sixth Cycle of Regional Water Planning requires the use of the Run 3 (full authorization) version of Water Availability Models (WAMs) maintained by the Texas Commission on Environmental Quality (TCEQ). These river-basin-scale models are used by the TCEQ for evaluating legal water available to applications for new or amended water rights, and as such, include some aspects that are not appropriate for water planning.

The LERWPG requests that the TWDB allow specific variations from the base TCEQ WAMs for analyses that determine surface water available to existing rights.

1. Brazos WAM. The LERWPG requests permission to conduct analyses using the TCEQ Brazos River Basin WAM as modified by the Brazos G Regional Water Planning Group (Brazos G WAM) for determining surface water reliabilities for the sake of inter-regional consistency. This model includes limited return flows for its reliability evaluations.

2. Canadian WAM. Also, to promote inter-regional consistency, the LERWPG requests permission to use yield values developed by the Panhandle Regional Water Planning Group using the TCEQ Canadian River Basin WAM for determining firm yield in that basin for water supplies supporting LERWPG Water User Groups (WUGs), specifically Lake Meredith.

3. Colorado WAM. The LERWPG requests permission to use surface water reliability values developed by the Region F Regional Water Planning Group using the TCEQ Colorado River Basin WAM for determining reliability and yield in that basin for water supplies supporting LERWPG Water User Groups (WUGs) to promote inter-regional consistency.

4. Red River WAM. The LERWPG requests permission to use surface water reliability values developed by the Panhandle Regional Water Planning Group using the TCEQ Red River Basin WAM for determining reliability and yield in that basin for water supplies supporting Region O Water User Groups (WUGs), specifically Mackenzie Reservoir.

5. Utilize the same water supply model for strategy evaluations as is used to determine supplies available to existing water rights.

   TWDB guidance requires that evaluations of new water management strategies utilize a strict application of the TCEQ Run 3 WAM. The rationale for this guidance is to ensure that the supply from a water management strategy is consistent with what might be permitted by the TCEQ. However, TCEQ considers more information than a simple application of the WAM when making water right permitting decisions. Additionally, many water management strategies utilize or are intended to supplement existing supplies, and therefore should be evaluated consistent with the existing supplies they are intended to supplement. The existing supply and the supplementing water management strategy need to be evaluated consistently. Furthermore, the same aspects of the Run 3 WAM that limit its usefulness for determining supplies available to existing rights also limit its ability to determine supplies to new water management strategies. The TCEQ Run 3 WAM is a legal permitting tool that has only limited utility for water supply planning. The LERWPG requests that the Brazos G WAM be utilized to evaluate water management strategies instead of the base TCEQ Run 3 WAM.

   The benefit to this methodology is that it will provide a consistent basis of evaluation between existing supplies and new water management strategies.

6. Lake Alan Henry Analysis. The LERWPG requests permission to conduct analyses using the Brazos G WAM with a 2-year safe yield operation of Lake Alan Henry. The City of Lubbock currently operates the reservoir using a 2-year safe yield. Using this Lake Alan Henry yield would best reflect actual operations in water management strategy evaluations for the City of Lubbock.

The LERWPG thanks the TWDB for considering these alternative technical approaches for determining surface water supplies to existing water rights and new water management strategies. We welcome any questions you may have regarding this hydrologic variance request for surface water supplies.

Please direct any questions to the LERWPG technical consultant, Paula Jo Lemonds, HDR, at paula.lemonds@hdrinc.com or (512) 912-5127.

Sincerely,

Mark Kirkpatrick, Vice Chairman
Llano Estacado Regional Water Planning Group – Region O

Surface Water Hydrologic Variance Request Checklist

Texas Water Development Board (TWDB) rules[1] require that regional water planning groups (RWPG) use most current Water Availability Models (WAM) from the Texas Commission on Environmental Quality (TCEQ) and assume full utilization of existing water rights and no return flows for surface water supply analysis. Additionally, evaluation of existing stored surface water available during Drought of Record conditions must be based on Firm Yield using anticipated sedimentation rates. However, the TWDB rules also allow, and **we encourage**, RWPGs to use more representative, water availability modeling assumptions; better site-specific information; or justified operational procedures other than Firm Yield with written approval (via a Hydrologic Variance) from the Executive Administrator in order to better represent and therefore prepare for expected drought conditions.

RWPGs must use this checklist, which is intended to save time and reduce effort, to request a Hydrologic Variance for estimating the availability of surface water sources. For Questions 4 – 10, please indicate whether the requested variance is for determining Existing Supply, Strategy Supply, or both. <u>Please complete a separate checklist for each river basin in which variances are being requested.</u>

Water Planning Region: O

1. Which major river basin does the request apply to? Please specify if the request only applies part of the basin or only to certain reservoirs.

   Brazos River Basin
   Entire and Lake Alan Henry

2. Please give a brief, bulleted, description of the requested hydrologic variances including how the alternative availability assumptions vary from rule requirements, how the modifications will affect the associated annual availability volume(s) in the regional water plan, and why the variance is necessary or provides a better basis for planning. You must provide more-detailed descriptions in the subsequent checklist questions. Attach any available documentation supporting the request.

   Brazos WAM. The LERWPG requests permission to conduct analyses using the TCEQ Brazos River Basin WAM as modified by the Brazos G Regional Water Planning Group (Brazos G WAM) for determining surface water reliabilities for the sake of inter-regional consistency. This model includes limited return flows for its reliability evaluations.

   Utilize the same water supply model for strategy evaluations as is used to determine supplies available to existing water rights. TWDB guidance requires that evaluations of new water management strategies utilize a strict application of the TCEQ Run 3 WAM. The rationale for this guidance is to ensure that the supply from a water management strategy is consistent with what might be permitted by the TCEQ. However, TCEQ considers more information than a simple application of the WAM when making water right permitting decisions. Additionally,

[1] 31 Texas Administrative Code (TAC) §§ 357.10(14) and 357.32(c)

many water management strategies utilize or are intended to supplement existing supplies, and therefore should be evaluated consistent with the existing supplies they are intended to supplement. The existing supply and the supplementing water management strategy need to be evaluated consistently. Furthermore, the same aspects of the Run 3 WAM that limit its usefulness for determining supplies available to existing rights also limit its ability to determine supplies to new water management strategies. The TCEQ Run 3 WAM is a legal permitting tool that has only limited utility for water supply planning. The LERWPG requests that the Brazos G WAM be utilized to evaluate water management strategies instead of the base TCEQ Run 3 WAM.

Lake Alan Henry Analysis. The LERWPG requests permission to conduct analyses using the Brazos G WAM with a 2-year safe yield operation of Lake Alan Henry. The City of Lubbock currently operates the reservoir using a 2-year safe yield. Using this Lake Alan Henry yield would best reflect actual operations in water management strategy evaluations for the City of Lubbock.

3. Was this request submitted in a previous planning cycle? If yes, please indicate which cycle and note how it is different, if at all, from the previous request?

   Yes

   Previous cycle. Additional request to use for strategy evaluation and Lake Alan Henry analysis.

4. Are you requesting to extend the period of record beyond the current applicable WAM hydrologic period? If yes, please describe the proposed methodology. Indicate whether you believe there is a new drought of record in the basin.

   No

   Choose an item.

   Click or tap here to enter text.

5. Are you requesting to use a reservoir safe yield? If yes, please describe in detail how the safe yield would be calculated and defined, which reservoir(s) it would apply to, and why the modification is needed or preferrable for drought planning purposes.

   Yes

   Existing and Strategy Supply

   The City of Lubbock currently operates the reservoir using a 2-year safe yield. Using this Lake Alan Henry yield would best reflect actual operations in water management strategy evaluations for the City of Lubbock.

6. Are you requesting to use a reservoir yield other than firm yield or safe yield? If yes, please describe, in a bulleted list, each modification requested including how the alternative yield was calculated, which reservoir(s) it applies to, and why the modification is needed or preferrable for drought planning purposes. Examples of alternative reservoir yield analyses may include using an alternative reservoir level, conditional reliability, or other special reservoir operations.

   No

   Choose an item.

   Click or tap here to enter text.

7. Are you requesting to use a different model (such as a RiverWare or Excel-based models) than RUN 3 of the applicable TCEQ WAM? If yes, please describe the model being considered including how it incorporates water rights and prior appropriation and how it is more conservative than RUN 3 of the applicable TCEQ WAM.

   No

   Choose an item.

   Click or tap here to enter text.

8. Are you requesting to use a modified TCEQ WAM? If yes, please describe in a bulleted list all modifications in detail including all specific changes to the WAM and whether the modified WAM is more conservative than the TCEQ WAM RUN 3. Examples of WAM modifications may include adding subordination agreements, contracts, updated water rights, modified spring flows, updated lake evaporation, updated sedimentation[2], system or reservoir operations, or special operational procedures into the WAM.

   No

   Choose an item.

   Click or tap here to enter text.

9. Are you requesting to include return flows in the modeling? If yes, are you doing so to model an indirect reuse water management strategy (WMS)? Please provide complete details regarding the proposed methodology for determining reuse WMS availability.

   Yes

   Existing and Strategy Supply

---

[2] Updating anticipated sedimentation rates does not require a hydrologic variance under 31 TAC § 357.10(14). The Technical Memorandum will require providing details regarding the sedimentation methodology utilized. Please consider providing that information with this request.

The Brazos WAM includes limited return flows for its reliability evaluations.

10. Are any of the requested Hydrologic Variances also planned to be used by another region for the same basin? If yes, please indicate the other Region. Please indicate if unknown.

    Unknown

    Click or tap here to enter text.

11. Please describe any other variance requests not captured on this checklist or add any other information regarding the variance requests on this checklist.

    n/a

Surface Water Hydrologic Variance Request Checklist

Texas Water Development Board (TWDB) rules[1] require that regional water planning groups (RWPG) use most current Water Availability Models (WAM) from the Texas Commission on Environmental Quality (TCEQ) and assume full utilization of existing water rights and no return flows for surface water supply analysis. Additionally, evaluation of existing stored surface water available during Drought of Record conditions must be based on Firm Yield using anticipated sedimentation rates. However, the TWDB rules also allow, and **we encourage**, RWPGs to use more representative, water availability modeling assumptions; better site-specific information; or justified operational procedures other than Firm Yield with written approval (via a Hydrologic Variance) from the Executive Administrator in order to better represent and therefore prepare for expected drought conditions.

RWPGs must use this checklist, which is intended to save time and reduce effort, to request a Hydrologic Variance for estimating the availability of surface water sources. For Questions 4 – 10, please indicate whether the requested variance is for determining Existing Supply, Strategy Supply, or both. <u>Please complete a separate checklist for each river basin in which variances are being requested.</u>

Water Planning Region: O

1. Which major river basin does the request apply to? Please specify if the request only applies part of the basin or only to certain reservoirs.

   Canadian River Basin.
   Entire and Lake Meredith

2. Please give a brief, bulleted, description of the requested hydrologic variances including how the alternative availability assumptions vary from rule requirements, how the modifications will affect the associated annual availability volume(s) in the regional water plan, and why the variance is necessary or provides a better basis for planning. You must provide more-detailed descriptions in the subsequent checklist questions. Attach any available documentation supporting the request.

   Canadian WAM. Also, to promote inter-regional consistency, the LERWPG requests permission to use yield values developed by the Panhandle Regional Water Planning Group using the TCEQ Canadian River Basin WAM for determining firm yield in that basin for water supplies supporting LERWPG Water User Groups (WUGs), specifically Lake Meredith.

3. Was this request submitted in a previous planning cycle? If yes, please indicate which cycle and note how it is different, if at all, from the previous request?

   Yes

   Previous cycle. No difference.

[1] 31 Texas Administrative Code (TAC) §§ 357.10(14) and 357.32(c)

4. Are you requesting to extend the period of record beyond the current applicable WAM hydrologic period? If yes, please describe the proposed methodology. Indicate whether you believe there is a new drought of record in the basin.

   No

   Choose an item.

   Click or tap here to enter text.

5. Are you requesting to use a reservoir safe yield? If yes, please describe in detail how the safe yield would be calculated and defined, which reservoir(s) it would apply to, and why the modification is needed or preferrable for drought planning purposes.

   No

   Choose an item.

   Click or tap here to enter text.

6. Are you requesting to use a reservoir yield other than firm yield or safe yield? If yes, please describe, in a bulleted list, each modification requested including how the alternative yield was calculated, which reservoir(s) it applies to, and why the modification is needed or preferrable for drought planning purposes. Examples of alternative reservoir yield analyses may include using an alternative reservoir level, conditional reliability, or other special reservoir operations.

   No

   Choose an item.

   Click or tap here to enter text.

7. Are you requesting to use a different model (such as a RiverWare or Excel-based models) than RUN 3 of the applicable TCEQ WAM? If yes, please describe the model being considered including how it incorporates water rights and prior appropriation and how it is more conservative than RUN 3 of the applicable TCEQ WAM.

   No

   Choose an item.

   Click or tap here to enter text.

8. Are you requesting to use a modified TCEQ WAM? If yes, please describe in a bulleted list all modifications in detail including all specific changes to the WAM and whether the modified

WAM is more conservative than the TCEQ WAM RUN 3. Examples of WAM modifications may include adding subordination agreements, contracts, updated water rights, modified spring flows, updated lake evaporation, updated sedimentation[2], system or reservoir operations, or special operational procedures into the WAM.

No

Choose an item.

Click or tap here to enter text.

9. Are you requesting to include return flows in the modeling? If yes, are you doing so to model an indirect reuse water management strategy (WMS)? Please provide complete details regarding the proposed methodology for determining reuse WMS availability.

No

Choose an item.

Click or tap here to enter text.

10. Are any of the requested Hydrologic Variances also planned to be used by another region for the same basin? If yes, please indicate the other Region. Please indicate if unknown.

Unknown

Click or tap here to enter text.

11. Please describe any other variance requests not captured on this checklist or add any other information regarding the variance requests on this checklist.

n/a

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[2] Updating anticipated sedimentation rates does not require a hydrologic variance under 31 TAC § 357.10(14). The Technical Memorandum will require providing details regarding the sedimentation methodology utilized. Please consider providing that information with this request.

Surface Water Hydrologic Variance Request Checklist

Texas Water Development Board (TWDB) rules[1] require that regional water planning groups (RWPG) use most current Water Availability Models (WAM) from the Texas Commission on Environmental Quality (TCEQ) and assume full utilization of existing water rights and no return flows for surface water supply analysis. Additionally, evaluation of existing stored surface water available during Drought of Record conditions must be based on Firm Yield using anticipated sedimentation rates. However, the TWDB rules also allow, and **we encourage**, RWPGs to use more representative, water availability modeling assumptions; better site-specific information; or justified operational procedures other than Firm Yield with written approval (via a Hydrologic Variance) from the Executive Administrator in order to better represent and therefore prepare for expected drought conditions.

RWPGs must use this checklist, which is intended to save time and reduce effort, to request a Hydrologic Variance for estimating the availability of surface water sources. For Questions 4 – 10, please indicate whether the requested variance is for determining Existing Supply, Strategy Supply, or both. Please complete a separate checklist for each river basin in which variances are being requested.

Water Planning Region: O

1. Which major river basin does the request apply to? Please specify if the request only applies part of the basin or only to certain reservoirs.

   Colorado River Basin
   Entire

2. Please give a brief, bulleted, description of the requested hydrologic variances including how the alternative availability assumptions vary from rule requirements, how the modifications will affect the associated annual availability volume(s) in the regional water plan, and why the variance is necessary or provides a better basis for planning. You must provide more-detailed descriptions in the subsequent checklist questions. Attach any available documentation supporting the request.

   Colorado WAM. The LERWPG requests permission to use surface water reliability values developed by the Region F Regional Water Planning Group using the TCEQ Colorado River Basin WAM for determining reliability and yield in that basin for water supplies supporting LERWPG Water User Groups (WUGs) to promote inter-regional consistency.

3. Was this request submitted in a previous planning cycle? If yes, please indicate which cycle and note how it is different, if at all, from the previous request?

   Yes

   Previous cycle. No difference.

[1] 31 Texas Administrative Code (TAC) §§ 357.10(14) and 357.32(c)

4. Are you requesting to extend the period of record beyond the current applicable WAM hydrologic period? If yes, please describe the proposed methodology. Indicate whether you believe there is a new drought of record in the basin.

   No

   Choose an item.

   Click or tap here to enter text.

5. Are you requesting to use a reservoir safe yield? If yes, please describe in detail how the safe yield would be calculated and defined, which reservoir(s) it would apply to, and why the modification is needed or preferrable for drought planning purposes.

   No

   Choose an item.

   Click or tap here to enter text.

6. Are you requesting to use a reservoir yield other than firm yield or safe yield? If yes, please describe, in a bulleted list, each modification requested including how the alternative yield was calculated, which reservoir(s) it applies to, and why the modification is needed or preferrable for drought planning purposes. Examples of alternative reservoir yield analyses may include using an alternative reservoir level, conditional reliability, or other special reservoir operations.

   No

   Choose an item.

   Click or tap here to enter text.

7. Are you requesting to use a different model (such as a RiverWare or Excel-based models) than RUN 3 of the applicable TCEQ WAM? If yes, please describe the model being considered including how it incorporates water rights and prior appropriation and how it is more conservative than RUN 3 of the applicable TCEQ WAM.

   No

   Choose an item.

   Click or tap here to enter text.

8. Are you requesting to use a modified TCEQ WAM? If yes, please describe in a bulleted list all modifications in detail including all specific changes to the WAM and whether the modified

WAM is more conservative than the TCEQ WAM RUN 3. Examples of WAM modifications may include adding subordination agreements, contracts, updated water rights, modified spring flows, updated lake evaporation, updated sedimentation[2], system or reservoir operations, or special operational procedures into the WAM.

No

Choose an item.

Click or tap here to enter text.

9. Are you requesting to include return flows in the modeling? If yes, are you doing so to model an indirect reuse water management strategy (WMS)? Please provide complete details regarding the proposed methodology for determining reuse WMS availability.

No

Choose an item.

Click or tap here to enter text.

10. Are any of the requested Hydrologic Variances also planned to be used by another region for the same basin? If yes, please indicate the other Region. Please indicate if unknown.

Unknown

Click or tap here to enter text.

11. Please describe any other variance requests not captured on this checklist or add any other information regarding the variance requests on this checklist.

n/a

[2] Updating anticipated sedimentation rates does not require a hydrologic variance under 31 TAC § 357.10(14). The Technical Memorandum will require providing details regarding the sedimentation methodology utilized. Please consider providing that information with this request.

Surface Water Hydrologic Variance Request Checklist

Texas Water Development Board (TWDB) rules[1] require that regional water planning groups (RWPG) use most current Water Availability Models (WAM) from the Texas Commission on Environmental Quality (TCEQ) and assume full utilization of existing water rights and no return flows for surface water supply analysis. Additionally, evaluation of existing stored surface water available during Drought of Record conditions must be based on Firm Yield using anticipated sedimentation rates. However, the TWDB rules also allow, and **we encourage**, RWPGs to use more representative, water availability modeling assumptions; better site-specific information; or justified operational procedures other than Firm Yield with written approval (via a Hydrologic Variance) from the Executive Administrator in order to better represent and therefore prepare for expected drought conditions.

RWPGs must use this checklist, which is intended to save time and reduce effort, to request a Hydrologic Variance for estimating the availability of surface water sources. For Questions 4 – 10, please indicate whether the requested variance is for determining Existing Supply, Strategy Supply, or both. Please complete a separate checklist for each river basin in which variances are being requested.

Water Planning Region: O

1. Which major river basin does the request apply to? Please specify if the request only applies part of the basin or only to certain reservoirs.

   Red River Basin
   Entire and Mackenzie Reservoir

2. Please give a brief, bulleted, description of the requested hydrologic variances including how the alternative availability assumptions vary from rule requirements, how the modifications will affect the associated annual availability volume(s) in the regional water plan, and why the variance is necessary or provides a better basis for planning. You must provide more-detailed descriptions in the subsequent checklist questions. Attach any available documentation supporting the request.

   Red River WAM. The LERWPG requests permission to use surface water reliability values developed by the Panhandle Regional Water Planning Group using the TCEQ Red River Basin WAM for determining reliability and yield in that basin for water supplies supporting Region O Water User Groups (WUGs), specifically Mackenzie Reservoir.

3. Was this request submitted in a previous planning cycle? If yes, please indicate which cycle and note how it is different, if at all, from the previous request?

   Yes

   Previous cycle. No difference.

[1] 31 Texas Administrative Code (TAC) §§ 357.10(14) and 357.32(c)

4. Are you requesting to extend the period of record beyond the current applicable WAM hydrologic period? If yes, please describe the proposed methodology. Indicate whether you believe there is a new drought of record in the basin.

   No

   Choose an item.

   Click or tap here to enter text.

5. Are you requesting to use a reservoir safe yield? If yes, please describe in detail how the safe yield would be calculated and defined, which reservoir(s) it would apply to, and why the modification is needed or preferrable for drought planning purposes.

   No

   Choose an item.

   Click or tap here to enter text.

6. Are you requesting to use a reservoir yield other than firm yield or safe yield? If yes, please describe, in a bulleted list, each modification requested including how the alternative yield was calculated, which reservoir(s) it applies to, and why the modification is needed or preferrable for drought planning purposes. Examples of alternative reservoir yield analyses may include using an alternative reservoir level, conditional reliability, or other special reservoir operations.

   No

   Choose an item.

   Click or tap here to enter text.

7. Are you requesting to use a different model (such as a RiverWare or Excel-based models) than RUN 3 of the applicable TCEQ WAM? If yes, please describe the model being considered including how it incorporates water rights and prior appropriation and how it is more conservative than RUN 3 of the applicable TCEQ WAM.

   No

   Choose an item.

   Click or tap here to enter text.

8. Are you requesting to use a modified TCEQ WAM? If yes, please describe in a bulleted list all modifications in detail including all specific changes to the WAM and whether the modified

WAM is more conservative than the TCEQ WAM RUN 3. Examples of WAM modifications may include adding subordination agreements, contracts, updated water rights, modified spring flows, updated lake evaporation, updated sedimentation[2], system or reservoir operations, or special operational procedures into the WAM.

No

Choose an item.

Click or tap here to enter text.

9. Are you requesting to include return flows in the modeling? If yes, are you doing so to model an indirect reuse water management strategy (WMS)? Please provide complete details regarding the proposed methodology for determining reuse WMS availability.

   No

   Choose an item.

   Click or tap here to enter text.

10. Are any of the requested Hydrologic Variances also planned to be used by another region for the same basin? If yes, please indicate the other Region. Please indicate if unknown.

    Unknown

    Click or tap here to enter text.

11. Please describe any other variance requests not captured on this checklist or add any other information regarding the variance requests on this checklist.

    n/a

[2] Updating anticipated sedimentation rates does not require a hydrologic variance under 31 TAC § 357.10(14). The Technical Memorandum will require providing details regarding the sedimentation methodology utilized. Please consider providing that information with this request.

Texas Water Development Board
P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

February 16, 2024

Mark Kirkpatrick
Vice Chairman
Llano Estacado (Region O) Regional Water Planning Group
c/o South Plains Association of Governments
1323 58th Street
Lubbock, TX 79412

Dear Vice Chairman Kirkpatrick:

I have reviewed your request dated January 10, 2024, for approval of alternative water supply assumptions to be used in determining existing and future surface water availability. This letter confirms that the TWDB approves the following assumptions that require a variance:

1. Conduct analysis using the TCEQ Brazos River Basin WAM as modified by the Brazos G RWPG (Brazos G WAM) for both existing water supply and strategy supply evaluation, as approved by the TWDB for Region G.
2. Use limited return flows, as included in the Brazos G WAM, for the evaluation of existing and strategy supplies.
3. Use yield values developed by the Panhandle RWPG using the TCEQ Canadian River Basin WAM for determining firm yield of water supplies in the Canadian Basin that support Region O Water User Groups (WUGs), specifically Lake Meredith.
4. Use a two-year safe yield for Lake Alan Henry in the evaluation of existing and strategy supply.

Although the TWDB approves the use of a two-year safe yield for developing estimates of Lake Alan Henry, the firm yield must still be reported to TWDB in the online planning database and plan documents.

While the use of these modified conditions may be reasonable for planning purposes, WAM RUN3 would be utilized by the Texas Commission on Environmental Quality for analyzing permit applications. It is acceptable to use the modified conditions for WMS supply evaluations only if the yield produced is more conservative (less) for surface water appropriations than WAM RUN3.

While the TWDB authorizes these modifications to evaluate existing and future water supplies for development of the 2026 Region O RWP, it is the responsibility of the RWPG to ensure that the resulting estimates of water availability are reasonable for drought planning purposes and will reflect conditions expected in the event of actual drought conditions; and in all other regards will be evaluated in accordance with the most recent version of regional water planning contract Exhibit C, *General Guidelines for Development of the 2026 Regional Water Plans.*

Please do not hesitate to contact John Maurer of our Regional Water Planning staff at (512) 475-1613 or john.maurer@twdb.texas.gov if you have any questions.

Sincerely,

Matt Nelson
Deputy Executive Administrator

c: Kelly Davila, South Plains Association of Governments
Paula Jo Lemonds, HDR
Dr. Ken Rainwater, Region O Secretary-Treasurer
John Maurer, Water Supply Planning
Sarah Lee, Water Supply Planning
Nelun Fernando, Ph.D., Surface Water
Simone Kiel, Freese & Nichols, Inc. (Region A Consultant)
Tony Smith, Carollo Engineers, (Region G Consultant)

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D

Endangered, Threatened, Candidate, and Species of Greatest Conservation Need

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Appendix D. Endangered, Threatened, Candidate, and Species of Greatest Conservation Need (SGCN)

D.1 Bailey County

The follow species list (Table D.1) for only Bailey County, Texas, applies to the following water management strategies discussed in Chapter 5.

Potentially Feasible Groundwater Management Strategies:

- Brackish Supplemental Water Supply for Bailey County Well Field
- Bailey County Well Field Capacity Maintenance for City of Lubbock

Table D.1. Endangered, Threatened, Candidate and SGCN Listed for Bailey County, Texas[1]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Amphibians					
Woodhouse's toad	*Anaxyrus woodhousii*	Wide variety of terrestrial habitats are used, including forests, grasslands, and barrier island sand dunes. Aquatic habitats are	--	--	Resident
Birds					
Baird's sparrow	*Centronyx bairdii*	Shortgrass prairie with scattered low bushes and matted vegetation; mostly migratory in western half of the U.S., and winters in in Mexico.	--	--	Possible Migrant
Bank swallow	*Riparia riparia*	Low areas along rivers, streams, ocean coasts. and reservoirs.	--	--	Resident
Brewer's blackbird	*Euphagus cyanocephalus*	Shrubby and bushy areas (especially near water), riparian woodland, aspen parklands, cultivated lands, marshes, and around human habitation, in migration and winter also in pastures and fields.	--	--	Resident
Chestnut-collared longspur	*Calcarius ornatus*	Occurs in open shortgrass settings especially in patches with some bare ground.	--	--	Resident

[1] TPWD. 2025. Annotated County Lists of Rare Species – Bailey County. Revised February 5, 2025.

Table D.1. Endangered, Threatened, Candidate and SGCN Listed for Bailey County, Texas[1]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Common nighthawk	*Chordeiles minor*	Nest in both rural and urban habitats including coastal sand dunes and beaches, logged forest, recently burned forest, woodland clearings, prairies, plains, sagebrush, grasslands, open forests, and rock outcrops.	--	--	Resident
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries, and along sandy beaches.	--	--	Possible migrant
Lark bunting	*Calamospiza melanocorys*	Adaptable to a variety of short grassland environments, including those with a brushy component, as well as certain agricultural landscapes featuring grain sorghum.	--	--	Resident
Lesser prairie-chicken	*Tympanuchus pallidicinctus*	Arid grasslands, generally interspersed with shrubs.	E	E	Resident
Loggerhead shrike	*Lanius ludovicianus*	Commonly found in agricultural fields, pastures, orchards, prairies, scrublands, and urban spaces like golf courses and cemeteries.	--	--	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Northern bobwhite	*Colinus virginianus*	Occurs in croplands, grasslands, pastures, fallow fields, grass brush rangelands, open pinelands and open mixed pine-hardwood.	--	--	Resident
Pyrrhuloxia	*Cardinalis sinuatus*	Upland deserts, mesquite savannas, riparian (streamside) woodlands, desert scrublands, farm fields with hedgerows, and residential areas with nearby mesquite.	--	--	Resident
Scaled quail	*Callipepla squamata*	Preferred habitat is arid-semiarid, mixed shrub-grassland.	--	--	Resident
Snowy plover	*Charadrius nivosus*	Algal flats provide high-quality habitat due to their inaccessibility and year-round availability across tidal conditions. Once an uncommon breeder in the Panhandle, they now migrate through and winter along the coast.	--	--	Possible migrant

Table D.1. Endangered, Threatened, Candidate and SGCN Listed for Bailey County, Texas[1]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
White-faced Ibis	*Plegadis chihi*	Prefers freshwater marshes, sloughs, and irrigated rice fields. Currently confined to rookeries in near-coastal areas.	--	T	Possible migrant
Willet	*Tringa semipalmata*	Marshes, tidal mudflats, beaches, lake margins, mangroves, tidal channels, river mouths, coastal lagoons, sandy or rocky shores, and, less frequently, open grassland.	--	--	Possible migrant
Wilson's warbler	*Cardellina pusilla*	Forests and scrubby areas along streams during migration.	--	--	Possible migrant
Yellow-billed cuckoo	*Coccyzus americanus*	In Texas, the population of concern (Western Distinct Population) is found breeding in riparian areas in the Trans Pecos.	T	--	Possible migrant
Insects					
Migratory monarch butterfly	*Danaus plexippus plexippus*	During the breeding season, monarchs lay their eggs on their obligate milkweed host plants (primarily Asclepias spp.), which occur primarily in open areas or wooded edges. Adults require nectar-producing flowers for feeding and migration.	PT	--	Possible migrant
Mammals					
Big free-tailed bat	*Nyctinomops macrotis*	Prefers to roost in crevices and cracks in high canyon walls.	--	--	Resident
Black-tailed prairie dog	*Cynomys ludovicianus*	Dry, flat, short grassland with low, sparse vegetation.	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, etc.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodland in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Mountain lion	*Puma concolor*	Generalist, most commonly found in rugged mountains and riparian zones.	--	--	Resident
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Low and mid-elevation shrub, pinyon-juniper, and ponderosa pine types, and probably includes all forest types up to 10,000 feet.	--	--	Resident

Table D.1. Endangered, Threatened, Candidate and SGCN Listed for Bailey County, Texas[1]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Plains spotted skunk	*Spilogale putorius interrupta*	Prefers wooded, brushy areas and tallgrass prairie.	--	--	Resident
Pronghorn	*Antilocapra americana*	Prefers hilly and plateau areas of open grassland, desert grassland and desert scrub.	--	--	Resident
Swift fox	*Vulpes velox*	Restricted to current and historic shortgrass prairie.	--	--	Resident
Townsend's big-eared bat	*Corynorhinus townsendii*	Variety of habitats including forests, deserts, native prairies, riparian communities, active agricultural areas, and coastal habitats.	--	--	Resident
Western pipistrelle	*Parastrellus hesperus*	Desert to pine-oak woodland. Cliffs and rock crevices provide roosts.	--	--	Resident
Reptiles					
Texas horned lizard	*Phrynosoma cornutum*	Open, arid, and semi-arid regions with sparse vegetation.	--	T	Resident
Western box turtle	*Terrapene ornata*	Prairie grassland, pasture, fields, sandhills, and open woodland.	--	--	Resident
Plants					
Cienega false clappia-bush	*Pseudoclappia arenaria*	Mostly in alkali sacaton grasslands on alkaline, gypseous or saline soils of alluvial flats around cinegas, playa lakes and other desert wetlands.	--	--	Resident
Texas barberry	*Berberis swaseyi*	Shallow calcareous stony clay of upland grasslands/shrublands over limestone as well as in loamier soils in openly wooded canyons and on creek terraces.	--	--	Resident

Notes:
Acronyms: SGCN = species of greatest conservation need; USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department
Statuses: PT= Potentially Threatened, T = Threatened, PE = Potentially Endangered, E = Endangered, -- = SGCN or Rare

Gaines County

The follow species list (Table D.2) for only Gaines County, Texas, applies to the following water management strategies discussed in Chapter 5.

Potentially Feasible Groundwater Management Strategies:

- City of Seminole Groundwater
- City of Seminole Brackish Groundwater Desalination

Table D.2. Endangered, Threatened, Candidate and SGCN Listed for Gaines County, Texas[2]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Amphibians					
Woodhouse's toad	*Anaxyrus woodhousii*	Wide variety of terrestrial habitats are used, including forests, grasslands, and barrier island sand dunes. Aquatic habitats are equally varied.	--	--	Resident
Birds					
Baird's sparrow	*Centronyx bairdii*	Shortgrass prairie with scattered low bushes and matted vegetation; mostly migratory in western half of the U.S., and winters in in Mexico.	--	--	Possible migrant
Bank swallow	*Riparia riparia*	Low areas along rivers, streams, ocean coasts, and reservoirs.	--	--	Resident
Brewer's blackbird	*Euphagus cyanocephalus*	Shrubby and bushy areas (especially near water), riparian woodland, aspen parkland, cultivated lands, marshes and around human habitation. Winter resident.	--	--	Resident
Cactus wren	*Campylorhynchus brunneicapillus*	Desert, mesquite, arid scrub, coastal sage scrub, and in trees in towns in arid regions.	--	--	Resident
Chestnut-collard longspur	*Calcarius ornatus*	Occurs in open shortgrass settings especially in patches with some bare ground.	--	--	Resident
Common nighthawk	*Chordeiles minor*	Nests in both rural and urban habitats including coastal sand dunes and beaches, logged forest, recently burned forest, woodland clearings, prairies, plains, sagebrush, grasslands, and rock outcrops.	--	--	Resident

[2] TPWD. 2025. Annotated County Lists of Rare Species – Gaines County. Revised February 3, 2025

Table D.2. Endangered, Threatened, Candidate and SGCN Listed for Gaines County, Texas[2]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries and along sandy beaches.	--	--	Possible migrant
Lark bunting	*Calamospiza melanocorys*	Adaptable to a variety of short grassland environments, including those with a brushy component, as well as certain agricultural landscapes featuring grain sorghum.	--	--	Resident
Lesser prairie-chicken	*Tympanuchus pallidicinctus*	Arid grasslands, generally interspersed with shrubs.	E	E	Resident
Loggerhead shrike	*Lanius ludovicianus*	Commonly found in agricultural fields, pastures, orchards, prairies, scrublands, and urban spaces like golf courses and cemeteries.	--	--	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Northern bobwhite	*Colinus virginianus*	Occurs in croplands, grasslands, pastures, fallow fields, grass-brush rangelands, open pinelands and open mixed pine-hardwood.	--	--	Resident
Pyrrhuloxia	*Cardinalis sinuatus*	Upland deserts, mesquite savannas, riparian (streamside) woodlands, desert scrublands, farm fields with hedgerows, and residential areas with nearby mesquite.	--	--	Resident
Sanderling	*Calidris alba*	Nonbreeding: primarily sandy beaches, less frequently on mud flats and shores of lakes or rivers.	--	--	Possible migrant
Scaled quail	*Callipepla squamata*	Preferred habitat is arid-semiarid, mixed shrub-grassland.	--	--	Resident
Snowy plover	*Charadrius nivosus*	Algal flats provide high-quality habitat due to their inaccessibility and year-round availability across tidal conditions. Once an uncommon breeder in the Panhandle, they now migrate through and winter along the coast.	--	--	Possible migrant

Table D.2. Endangered, Threatened, Candidate and SGCN Listed for Gaines County, Texas[2]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
White-faced Ibis	*Plegadis chihi*	Prefers freshwater marshes, sloughs, and irrigated rice fields. Currently confined to near-coastal rookeries, nests in marshes.	--	T	Possible migrant
Willet	*Tringa semipalmata*	Marshes, tidal mudflats, beaches, lake margins, mangroves, tidal channels, river mouths, coastal lagoons, sandy or rocky shores, and, less frequently, open grassland.	--	--	Possible migrant
Wilson's warbler	*Cardellina pusilla*	Forests and scrubby areas along streams during migration.	--	--	Possible migrant
Yellow-billed cuckoo	*Coccyzus americanus*	In Texas, the population of concern (Western Distinct Population) is found breeding in riparian areas in the Trans Pecos.	T	--	Possible migrant
Insects					
Migratory monarch butterfly	*Danaus plexippus plexippus*	During the breeding season, monarchs lay their eggs on their obligate milkweed host plants (primarily Asclepias spp.), which occur primarily in open areas or wooded edges. Adults require nectar-producing flowers for feeding and migration.	PT	--	Possible migrant
Mammals					
Big free-tailed bat	*Nyctinomops macrotis*	Prefers to roost in crevices and cracks in high canyon walls.	--	--	Resident
Black-tailed prairie dog	*Cynomys ludovicianus*	Dry, flat, short grassland with low, sparse vegetation.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Jones's pocket gopher	*Geomys knoxjonesi*	Fossorial rodent restricted to areas with deep, sandy, aeolian soils; usually in native yucca-grassland habitat.	--	--	Resident
Mountain lion	*Puma concolor*	Generalist, most commonly found in rugged mountains and riparian zones.	--	--	Resident

Table D.2. Endangered, Threatened, Candidate and SGCN Listed for Gaines County, Texas[2]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Low and mid-elevation shrub, pinyon-juniper, and ponderosa pine types, and probably includes all forest types up to 10,000 feet.	--	--	Resident
Pronghorn	*Antilocapra americana*	Prefers hilly and plateau areas of open grassland, desert grassland and desert scrub.	--	--	Resident
Western pipistrelle	*Parastrellus hesperus*	Desert to pine-oak woodland. Cliffs and rock crevices provide roosts.	--	--	Resident
Reptiles					
Dune's sagebrush lizard	*Sceloporus arenicolus*	Confined to active sand dunes near Monahans; dwarf shin-oak sandhills with sagebrush and yucca.	E	E	Resident
Texas horned lizard	*Phrynosoma cornutum*	Open, arid, and semi-arid regions with sparse vegetation.	--	T	Resident
Western box turtle	*Terrapene ornata*	Prairie grassland, pasture, fields, sandhills and open woodland.	--	--	Resident
Western massasauga	*Sistrurus tergeminus*	Shortgrass or mixed grass prairie, with gravel or sandy soils. Often found associated with draws, floodplains, and more mesic habitats within the arid landscape.	--	--	Resident
Plants					
Cienega false clappia-bush	*Pseudoclappia arenaria*	Mostly in alkali sacaton grasslands on alkaline, gypseous or saline soils of alluvial flats around cinegas, playa lakes and other desert wetlands.	--	--	Resident
Cory's ephedra	*Ephedra coryi*	Dune areas and dry grasslands in southern Plains Country.	--	--	Resident

Notes:
Acronyms: SGCN = species of greatest conservation need; USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department
Statuses: PT= Potentially Threatened, T = Threatened, PE = Potentially Endangered, E = Endangered, -- = SGCN or Rare

Garza County

The follow species list (Table D.3) for only Garza County, Texas, applies to the following water management strategies discussed in Chapter 5.

Potentially Feasible Surface Water Management Strategies:

- Post Reservoir
- North Fork Scalping Operation
- North Fork Diversion to Lake Alan Henry Pump Station

Table D.3. Endangered, Threatened, Candidate and SGCN Listed for Garza County, Texas [3]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Birds					
Bank swallow	*Riparia riparia*	Low areas along rivers, streams, ocean coasts, and reservoirs.	--	--	Resident
Black rail	*Laterallus jamaicensis*	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps. Nests in or along the edge of marsh.	T	T	Resident
Brewer's blackbird	*Euphagus cyanocephalus*	Shrubby and bushy areas (especially near water), riparian woodland, aspen parkland, cultivated lands, marshes and around human habitation. Winter resident.	--	--	Resident
Cactus wren	*Campylorhynchus brunneicapillus*	Desert, mesquite, arid scrub, coastal sage scrub, and in trees in towns in arid regions.	--	--	Resident
Chestnut-collared longspur	*Calcarius ornatus*	Occurs in open shortgrass settings especially in patches with some bare ground.	--	--	Resident
Common nighthawk	*Chordeiles minor*	Nests in both rural and urban habitats including coastal sand dunes and beaches, logged forest, recently burned forest, woodland clearings, prairies, plains, sagebrush, grasslands, and rock outcrops.	--	--	Resident
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries, and along sandy beaches.	--	--	Possible migrantent

[3] TPWD. 2025. Annotated County Lists of Rare Species – Garza County. Revised February 4, 2025.

Table D.3. Endangered, Threatened, Candidate and SGCN Listed for Garza County, Texas [3]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Lark bunting	*Calamospiza melanocorys*	Adaptable to a variety of short grassland environments, including those with a brushy component, as well as certain agricultural landscapes featuring grain sorghum.	--	--	Resident
Loggerhead shrike	*Lanius ludovicianus*	Commonly found in agricultural fields, pastures, orchards, prairies, scrublands, and urban spaces like golf courses and cemeteries.	--	--	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Northern bobwhite	*Colinus virginianus*	Occurs in croplands, grasslands, pastures, fallow fields, grass-brush rangelands, open pinelands and open mixed pine-hardwood.	--	--	Resident
Pyrrhuloxia	*Cardinalis sinuatus*	Upland deserts, mesquite savannas, riparian (streamside) woodlands, desert scrublands, farm fields with hedgerows, and residential areas with nearby mesquite.	--	--	Resident
Sanderling	*Calidris alba*	Nonbreeding: primarily sandy beaches, less frequently on mud flats and shores of lakes or rivers.	--	--	Possible migrant
Scaled quail	*Callipepla squamata*	Preferred habitat is arid-semiarid, mixed shrub-grassland.	--	--	Resident
Snowy plover	*Charadrius nivosus*	Algal flats provide high-quality habitat due to their inaccessibility and year-round availability across tidal conditions. Once an uncommon breeder in the Panhandle, they now migrate through and winter along the coast.	--	--	Resident

Table D.3. Endangered, Threatened, Candidate and SGCN Listed for Garza County, Texas [3]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Sprague's pipit	*Anthus spragueii*	Habitat during migration and in winter consists of pastures and weedy fields, including grasslands with dense herbaceous vegetation or grassy agricultural fields.	--	--	Possible migrant
White-faced ibis	*Plegadis chihi*	Prefers freshwater marshes, sloughs, and irrigated rice fields. Currently confined to near-coastal rookeries, nests in marshes.	--	T	Possible migrant
Willet	*Tringa semipalmata*	Marshes, tidal mudflats, beaches, lake margins, mangroves, tidal channels, river mouths, coastal lagoons, sandy or rocky shores, and, less frequently, open grassland.	--	--	Possible migrant
Wilson's warbler	*Cardellina pusilla*	Forests and scrubby areas along streams during migration.	--	--	Possible migrant
Yellow rail	*Coturnicops noveboracensis*	Grain fields in winter and when migrating.	--	--	Possible migrant
Yellow-billed cuckoo	*Coccyzus americanus*	In Texas, the population of concern (Western Distinct Population) is found breeding in riparian areas in the Trans Pecos.	T	--	Possible migrant
Fishes					
Chub shiner	*Notropis potteri*	Large, turbid rivers and smaller tributaries. Found in flowing water with silt or sand substrate. Tolerant of high salinities.	--	T	Resident
Red River pupfish	*Cyprinodon rubrofluviatilis*	Headwater streams of xeric grasslands. River edges, channels, backwaters, over sand bottoms. Euryhaline and eurythermal.	--	T	Resident
Sharpnose shiner	*Notropis oxyrhynchus*	Endemic to Brazos River drainage and introduced in Colorado River drainage. Large turbid rivers with bottom a combination of sand, gravel, and clay-mud.	E	E	Resident

Table D.3. Endangered, Threatened, Candidate and SGCN Listed for Garza County, Texas [3]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Smalleye shiner	*Notropis buccula*	Endemic to upper Brazos River system and its tributaries. Medium to large prairie streams with sandy substrate and turbid to clear warm water.	E	E	Resident
Insects					
American bumblebee	*Bombus pensylvanicus*	Habitat description is not available at this time.	--	--	Resident
Migratory monarch butterfly	*Danaus plexippus plexippus*	During the breeding season, monarchs lay their eggs on their obligate milkweed host plants (primarily Asclepias spp.), which occur primarily in open areas or wooded edges. Adults require nectar-producing flowers for feeding and migration.	PT	--	Possible migrant
Mammals					
Big free-tailed bat	*Nyctinomops macrotis*	Prefers to roost in crevices and cracks in high canyon walls.	--	--	Resident
Black-tailed prairie dog	*Cynomys ludovicianus*	Dry, flat, short grassland with low, sparse vegetation.	--	--	Resident
Cave myotis bat	*Myotis velifer*	Colonial and cave dwelling, also roosts in rock crevices, old buildings, under bridges and old Cliff Swallow nests.	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, etc.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Mountain lion	*Puma concolor*	Generalist, most commonly found in rugged mountains and riparian zones.	--	--	Resident
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Low and mid-elevation shrub, pinyon-juniper, and ponderosa pine types, and probably includes all forest types up to 10,000 feet.	--	--	Resident
Plains spotted skunk	*Spilogale putorius interrupta*	Prefers wooded, brushy areas and tallgrass prairie.	--	--	Resident
Swift fox	*Vulpes velox*	Restricted to current and historic shortgrass prairie.	--	--	Resident

Table D.3. Endangered, Threatened, Candidate and SGCN Listed for Garza County, Texas [3]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Townsend's big-eared bat	*Corynorhinus townsendii*	Variety of habitats including forests, deserts, native prairies, riparian communities, active agricultural areas, and coastal habitats.	--	--	Resident
Tricolored bat	*Perimyotis subflavus*	Forest, woodland and riparian areas. Caves are important to this species.	PE	--	Resident
Western pipistrelle	*Parastrellus hesperus*	Desert to pine-oak woodland. Cliffs and rock crevices provide roosts.	--	--	Resident
Reptiles					
Texas horned lizard	*Phrynosoma cornutum*	Open, arid, and semi-arid regions with sparse vegetation.	--	T	Resident
Western box turtle	*Terrapene ornata*	Prairie grassland, pasture, fields, sandhills and open woodland.	--	--	Resident
Plants					
Cory's evening-primrose	*Oenothera coryi*	Calcarous prairies in the Plains County of north Texas and in the Panhandle.	--	--	Resident

Notes:
Acronyms: SGCN = species of greatest conservation need; USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department
Statuses: PT= Potentially Threatened, T = Threatened, PE = Potentially Endangered, E = Endangered, -- = SGCN or Rare

Garza, Kent, Lubbock, and Lynn Counties

The follow species list (Table D.4) for Garza, Kent, Lubbock, and Lynn counties, Texas, applies to the following surface water management strategy, Lake Alan Henry Phase 2, discussed in Chapter 5.

Table D.4. Endangered, Threatened, Candidate and SGCN Listed for Garza[4], Kent[5], Lubbock[6], and Lynn Counties, Texas [7]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Amphibians					
Woodhouse's toad	*Anaxyrus woodhousii*	Wide variety of terrestrial habitats are used, including forests, grasslands, and barrier island sand dunes. Aquatic habitats are equally	--	--	Resident
Birds					
Baird's Sparrow	*Centronyx bairdii*	Shortgrass prairie with scattered low bushes and matted vegetation; mostly migratory in western half of the U.S., and winters in in Mexico.	--	--	Possible migrant
Bank swallow	*Riparia riparia*	Low areas along rivers, streams, ocean coasts, and reservoirs.	--	--	Resident
Black rail	*Laterallus jamaicensis*	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps. Nests in or along edge of marsh.	T	T	Possible migrant
Brewer's blackbird	*Euphagus cyanocephalus*	Shrubby and bushy areas (especially near water), riparian woodland, aspen parkland, cultivated lands, marshes and around human habitation. Winter resident.	--	--	Resident
Cactus wren	*Campylorhynchus brunneicapillus*	Desert, mesquite, arid scrub, coastal sage scrub, and in trees in towns in arid regions.	--	--	Resident
Chestnut-collard longspur	*Calcarius ornatus*	Occurs in open shortgrass settings especially in patches with some bare ground.	--	--	Resident

[4] TPWD. 2025. Annotated County Lists of Rare Species – Garza County. Revised February 4, 2025.
[5] TPWD. 2025. Annotated County Lists of Rare Species – Kent County. Revised February 4, 2025.
[6] TPWD. 2025. Annotated County Lists of Rare Species – Lubbock County. Revised February 4, 2025.
[7] TPWD. 2025. Annotated County Lists of Rare Species – Lynn County. Revised February 4, 2025.

Table D.4. Endangered, Threatened, Candidate and SGCN Listed for Garza[4], Kent[5], Lubbock[6], and Lynn Counties, Texas [7]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Common nighthawk	*Chordeiles minor*	Nests in both rural and urban habitats including coastal sand dunes and beaches, logged forest, recently burned forest, woodland clearings, prairies, plains, sagebrush, grasslands, and rock outcrops.	--	--	Resident
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries and along sandy beaches.	--	--	Possible migrant
Lark bunting	*Calamospiza melanocorys*	Adaptable to a variety of short grassland environments, including those with a brushy component, as well as certain agricultural landscapes featuring grain sorghum.	--	--	Resident
Loggerhead shrike	*Lanius ludovicianus*	Commonly found in agricultural fields, pastures, orchards, prairies, scrublands, and urban spaces like golf courses and cemeteries.	--	--	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Northern bobwhite	*Colinus virginianus*	Occurs in croplands, grasslands, pastures, fallow fields, grass-brush rangelands, open pinelands and open mixed pine-hardwood.	--	--	Resident
Pyrrhuloxia	*Cardinalis sinuatus*	Upland deserts, mesquite savannas, riparian (streamside) woodlands, desert scrublands, farm fields with hedgerows, and residential areas with nearby mesquite.	--	--	Resident
Sanderling	*Calidris alba*	Nonbreeding: primarily sandy beaches, less frequently on mud flats and shores of lakes or rivers.	--	--	Possible migrant
Scaled quail	*Callipepla squamata*	Preferred habitat is arid-semiarid, mixed shrub-grassland.	--	--	Resident

Table D.4. Endangered, Threatened, Candidate and SGCN Listed for Garza[4], Kent[5], Lubbock[6], and Lynn Counties, Texas [7]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Snowy plover	*Charadrius nivosus*	Algal flats provide high-quality habitat due to their inaccessibility and year-round availability across tidal conditions. Once an uncommon breeder in the Panhandle, they now migrate through and winter along the coast.	--	--	Possible migrant
Sprague's pipit	*Anthus spragueii*	Habitat during migration and in winter consists of pastures and weedy fields, including grasslands with dense herbaceous vegetation or grassy agricultural fields.	--	--	Possible migrant
White-faced ibis	*Plegadis chihi*	Prefers freshwater marshes, sloughs, and irrigated rice fields. Currently confined to near-coastal rookeries, nests in marshes.	--	T	Possible migrant
Whooping crane	*Grus americana*	Potential migrant, winters in coastal marshes.	E	E	Possible migrant
Willet	*Tringa semipalmata*	Marshes, tidal mudflats, beaches, lake margins, mangroves, tidal channels, river mouths, coastal lagoons, sandy or rocky shores, and, less frequently, open grassland.	--	--	Possible migrant
Wilson's warbler	*Cardellina pusilla*	Forests and scrubby areas along streams during migration.	--	--	Possible migrant
Yellow rail	*Coturnicops noveboracensis*	Grain fields in winter and when migrating.	--	--	Possible migrant
Yellow-billed cuckoo	*Coccyzus americanus*	In Texas, the population of concern (Western Distinct Population) is found breeding in riparian areas in the Trans Pecos.	T	--	Possible migrant
Crustaceans					
Salt playa fairy shrimp	*Phallocryptus sublettei*	Saline playa lakes, usually very shallow with depth of water a function of rainfall.	--	--	Resident

Table D.4. Endangered, Threatened, Candidate and SGCN Listed for Garza[4], Kent[5], Lubbock[6], and Lynn Counties, Texas [7]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Fish					
Chub shiner	*Notropis potteri*	Large, turbid rivers and smaller tributaries. Found in flowing water with silt or sand substrate. Tolerant of high salinities.	--	T	Resident
Red River pupfish	*Cyprinodon rubrofluviatilis*	Headwater streams of xeric grasslands. River edges, channels, backwaters, over sand bottoms. Euryhaline and eurythermal.	--	T	Resident
Sharpnose shiner	*Notropis oxyrhynchus*	Endemic to Brazos River drainage. Introduced in Colorado River drainage. Large turbid river, with bottom a combination of sand, gravel, and clay-mud.	E	E	Resident
Smalleye shiner	*Notropis buccula*	Endemic to upper Brazos River system and its tributaries. Introduced in Colorado River drainage. Medium to large prairie streams with sandy substrate and turbid to clear warm water.	E	E	Resident
Insects					
American bumblebee	*Bombus pensylvanicus*	Habitat description is not available at this time.	--	--	Resident
Migratory monarch butterfly	*Danaus plexippus plexippus*	During the breeding season, monarchs lay their eggs on their obligate milkweed host plants (primarily Asclepias spp.), which occur primarily in open areas or wooded edges. Adults require nectar-producing flowers for feeding and migration	PT	--	Possible migrant
Mammals					
Big free-tailed bat	*Nyctinomops macrotis*	Prefers to roost in crevices and cracks in high canyon walls.	--	--	Resident
Black-tailed prairie dog	*Cynomys ludovicianus*	Dry, flat, short grassland with low, sparse vegetation.	--	--	Resident
Cave myotis bat	*Myotis velifer*	Colonial and cave dwelling, also roosts in rock crevices, old buildings, under bridges and old Cliff Swallow nests.	--	--	Resident

Table D.4. Endangered, Threatened, Candidate and SGCN Listed for Garza[4], Kent[5], Lubbock[6], and Lynn Counties, Texas [7]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, etc.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Jones's pocket gopher	*Geomys knoxjonesi*	Fossorial rodent restricted to areas with deep, sandy, aeolian soils; usually in native yucca-grassland habitat.	--	--	Resident
Mountain lion	*Puma concolor*	Generalist, most commonly found in rugged mountains and riparian zones.	--	--	Resident
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Low and mid-elevation shrub, pinyon-juniper, and ponderosa pine types, and probably includes all forest types up to 10,000 feet.	--	--	Resident
Palo Duro mouse	*Peromyscus truei comanche*	Rocky, juniper-mesquite covered slopes of steep-walled canyons.	--	T	Resident
Plains spotted skunk	*Spilogale putorius interrupta*	Prefers wooded, brushy areas and tallgrass prairie.	--	--	Resident
Prairie vole	*Microtus ochrogaster taylori*	Upland herbaceous fields, grasslands, old agricultural lands and thickets. Places where there is suitable cover for runways.	--	--	Resident
Pronghorn	*Antilocapra americana*	Prefers hilly and plateau areas of open grassland, desert grassland and desert scrub.	--	--	Resident
Swift fox	*Vulpes velox*	Restricted to current and historic shortgrass prairie.	--	--	Resident
Townsend's big-eared bat	*Corynorhinus townsendii*	Variety of habitats including forests, deserts, native prairies, riparian communities, active agricultural areas, and coastal habitats.	--	--	Resident
Tricolored bat	*Perimyotis subflavus*	Forest, woodland and riparian areas. Caves are important to this species.	--	--	Resident

Table D.4. Endangered, Threatened, Candidate and SGCN Listed for Garza[4], Kent[5], Lubbock[6], and Lynn Counties, Texas [7]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Western pipistrelle	*Parastrellus Hesperus*	Desert to pine-oak woodland. Cliffs and rock crevices provide roosts.	--	--	Resident
Reptiles					
Common garter snake	*Thamnophis sirtalis*	Irrigation canals and riparian-corridor farmlands. Marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water.	--	--	Resident
Keeled earless lizard	*Holbrookia propinqua*	Coastal dunes, barrier islands, and other sandy areas.	--	--	Resident
Western massasauga	*Sistrurus tergeminus*	Shortgrass or mixed grass prairie, with gravel or sandy soils. Often found associated with draws, floodplains, and more mesic habitats within the arid landscape.	--	--	Resident
Texas horned lizard	*Phrynosoma cornutum*	Open, arid, and semi-arid regions with sparse vegetation.	--	T	Resident
Texas map turtle	*Graptemys versa*	Rivers with moderate current, abundant aquatic vegetation, and basking logs.	--	--	Resident
Western box turtle	*Terrapene ornata*	Prairie grassland, pasture, fields, sandhills and open woodland.	--	--	Resident
Plants					
Cory's ephedra	*Ephedra coryi*	Dune areas and dry grasslands in southern Plains Country.	--	--	Resident
Cory's evening-primrose	*Oenothera coryi*	Calcareous prairies in the Plains Country.	--	--	Resident
Johnston's phlox	*Phlox drummondii ssp. Johnstonii*	Found on sandy soils	--	--	Resident
Mexican mud-plantain	*Heteranthera mexicana*	Wet clayey soils along margins of playas in the Panhandle	--	--	Resident

Notes:
Acronyms: SGCN = species of greatest conservation need; USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department
Statuses: PT= Potentially Threatened, T = Threatened, PE = Potentially Endangered, E = Endangered, -- = SGCN or Rare

D.2 Hale County

The follow species list (Table D.5) for only Hale County, Texas, applies to the following water management strategies discussed in Chapter 5.

Potentially Feasible Surface Water Management Strategy:

- City of Plainview Reuse

Potentially Feasible Groundwater Management Strategy:

- CRMWA to Plainview Aquifer Storage and Recovery

Table D.5. Endangered, Threatened, Candidate and SGCN Listed for Hale County, Texas [8]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Amphibians					
Woodhouse's toad	*Anaxyrus woodhousii*	Wide variety of terrestrial habitats are used, including forests, grasslands, and barrier island sand dunes. Aquatic habitats are equally varied.	--	--	Resident
Birds					
Bank swallow	*Riparia riparia*	Low areas along rivers, streams, ocean coasts, and reservoirs.	--	--	Resident
Black rail	*Laterallus jamaicensis*	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps. Nests in or along edge of marsh.	T	T	Possible migrant
Brewer's blackbird	*Euphagus cyanocephalus*	Shrubby and bushy areas (especially near water), riparian woodland, aspen parkland, cultivated lands, marshes and around human habitation. Winter resident.	--	--	Resident
Chestnut-collared longspur	*Calcarius ornatus*	Occurs in open shortgrass settings especially in patches with some bare ground.	--	--	Resident
Common nighthawk	*Chordeiles minor*	Nest in both rural and urban habitats including coastal sand dunes and beaches, logged forest, recently burned forest, woodland clearings, prairies, plains, sagebrush, grasslands, open forests, and rock outcrops.	--	--	Resident

[8] TPWD. 2025. Annotated County Lists of Rare Species – Hale County. Revised February 5, 2025.

Table D.5. Endangered, Threatened, Candidate and SGCN Listed for Hale County, Texas [8]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Lark bunting	*Calamospiza melanocorys*	Adaptable to a variety of short grassland environments, including those with a brushy component, as well as certain agricultural landscapes featuring grain sorghum.	--	--	Resident
Loggerhead shrike	*Lanius ludovicianus*	Commonly found in agricultural fields, pastures, orchards, prairies, scrublands, and urban spaces like golf courses and cemeteries.	--	--	Resident
Mountain Plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Northern bobwhite	*Colinus virginianus*	Occurs in croplands, grasslands, pastures, fallow fields, grass-brush rangelands, open pinelands and open mixed pine-hardwood.	--	--	Resident
Pyrrhuloxia	*Cardinalis sinuatus*	Upland deserts, mesquite savannas, riparian (streamside) woodlands, desert scrublands, farm fields with hedgerows, and residential areas with nearby mesquite.	--	--	Resident
Sanderling	*Calidris alba*	Nonbreeding: primarily sandy beaches, less frequently on mud flats and shores of lakes or rivers.	--	--	Possible migrant
Scaled quail	*Callipepla squamata*	Preferred habitat is arid-semiarid, mixed shrub-grassland.	--	--	Resident
Snowy plover	*Charadrius nivosus*	Algal flats provide high-quality habitat due to their inaccessibility and year-round availability across tidal conditions. Once an uncommon breeder in the Panhandle, they now migrate through and winter along the coast.	--	--	Possible migrant
White-faced Ibis	*Plegadis chihi*	Prefers freshwater marshes, sloughs, and irrigated rice fields. Currently confined to near-coastal rookeries, nests in marshes.	--	T	Possible migrant

Table D.5. Endangered, Threatened, Candidate and SGCN Listed for Hale County, Texas [8]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Willet	*Tringa semipalmata*	Marshes, tidal mudflats, beaches, lake margins, mangroves, tidal channels, river mouths, coastal lagoons, sandy or rocky shores, and, less frequently, open grassland.	--	--	Resident
Wilson's warbler	*Cardellina pusilla*	Forests and scrubby areas along streams during migration.	--	--	Possible migrant
Yellow rail	*Coturnicops noveboracensis*	Grain fields in winter and when migrating.	--	--	Possible migrant
Yellow-billed cuckoo	*Coccyzus americanus*	In Texas, the population of concern (Western Distinct Population) is found breeding in riparian areas in the Trans Pecos.	T	--	Possible migrant
Insects					
American bumblebee	*Bombus pensylvanicus*	Habitat description is not available at this time.	--	--	Resident
Migratory monarch butterfly	*Danaus plexippus plexippus*	During the breeding season, monarchs lay their eggs on their obligate milkweed host plants (primarily Asclepias spp.), which occur primarily in open areas or wooded edges. Adults require nectar-producing flowers for feeding and migration.	PT	--	Possible migrant
Mammals					
Big free-tailed bat	*Nyctinomops macrotis*	Prefers to roost in crevices and cracks in high canyon walls.	--	--	Resident
Black-tailed prairie dog	*Cynomys ludovicianus*	Dry, flat, short grassland with low, sparse vegetation.	--	--	Resident
Cave myotis bat	*Myotis velifer*	Colonial and cave dwelling, also roosts in rock crevices, old buildings, under bridges and old Cliff Swallow nests.	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, etc.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident

Table D.5. Endangered, Threatened, Candidate and SGCN Listed for Hale County, Texas [8]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Mountain lion	*Puma concolor*	Generalist, most commonly found in rugged mountains and riparian zones.	--	--	Resident
Plains spotted skunk	*Spilogale putorius interrupta*	Prefers wooded, brushy areas and tallgrass prairie.	--	--	Resident
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Low and mid-elevation shrub, pinyon-juniper, and ponderosa pine types, and probably includes all forest types up to 10,000 feet.	--	--	Resident
Plains spotted skunk	*Spilogale interrupta*	Prefers wooded, brushy areas and tallgrass prairie.	--	--	Resident
Swift fox	*Vulpes velox*	Restricted to current and historic shortgrass prairie.	--	--	Resident
Townsend's big-eared bat	*Corynorhinus townsendii*	Variety of habitats including forests, deserts, native prairies, riparian communities, active agricultural areas, and coastal habitats.	--	--	Resident
Tricolored bat	*Perimyotis subflavus*	Forest, woodland and riparian areas. Caves are important to this species.	--	--	Resident
Western pipistrelle	*Parastrellus hesperus*	Desert to pine-oak woodland. Cliffs and rock crevices provide roosts.	--	--	Resident
Reptiles					
Slender glass lizard	*Ophisaurus attenuatus*	Prefers relatively dry microhabitats, usually associated with grassy areas.	--	--	Resident
Texas horned lizard	*Phrynosoma cornutum*	Open, arid, and semi-arid regions with sparse vegetation.	--	T	Resident
Western box turtle	*Terrapene ornata*	Prairie grassland, pasture, fields, sandhills and open woodland.	--	--	Resident

Notes:
Acronyms: SGCN = species of greatest conservation need; USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department
Statuses: PT= Potentially Threatened, T = Threatened, PE = Potentially Endangered, E = Endangered, -- = SGCN or Rare

Lubbock County

The follow species list (Table D.6) for only Lubbock County, Texas, applies to the following water management strategies discussed in Chapter 5.

Potentially Feasible Surface Water Management Strategies:

- Jim Bertram Lake 7 Reuse
- Direct Potable Reuse to North Water Treatment Plant
- Direct Potable Reuse to South Water Treatment Plant
- North Fork Diversion at CR 7300

Potentially Feasible Groundwater Management Strategies:

- CRMWA to Lubbock Aquifer Storage and Recovery
- South Lubbock Well Field

Table D.6. Endangered, Threatened, Candidate and SGCN Listed for Lubbock County, Texas [9]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Amphibians					
Woodhouse's toad	*Anaxyrus woodhousii*	Wide variety of terrestrial habitats are used, including forests, grasslands, and barrier island sand dunes. Aquatic habitats are equally varied.	--	--	Resident
Birds					
Baird's sparrow	*Centronyx bairdii*	Shortgrass prairie with scattered low bushes and matted vegetation; mostly migratory in western half of the U.S., and winters in in Mexico.	--	--	Possible migrant
Bald eagle	*Haliaeetus leucocephalus*	Found primarily near rivers and large lakes	--	--	Resident
Bank swallow	*Riparia riparia*	Low areas along rivers, streams, ocean coasts, and reservoirs.	--	--	Resident
Black rail	*Laterallus jamaicensis*	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps. Nests in or along edge of marsh.	T	T	Possible migrant

[9] Texas Parks and Wildlife Department (TPWD). 2025. Annotated County Lists of Rare Species – Lubbock County. Revised January 15, 2025.

Table D.6. Endangered, Threatened, Candidate and SGCN Listed for Lubbock County, Texas [9]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Brewer's blackbird	*Euphagus cyanocephalus*	Shrubby and bushy areas (especially near water), riparian woodland, aspen parkland, cultivated lands, marshes and around human habitation. Winter resident.	--	--	Resident
Cactus wren	*Campylorhynchus brunneicapillus*	Desert, mesquite, arid scrub, coastal sage scrub, and in trees in towns in arid regions.	--	--	Resident
Chestnut-collared longspur	*Calcarius ornatus*	Occurs in open shortgrass settings especially in patches with some bare ground.	--	--	Resident
Common nighthawk	*Chordeiles minor*	Nests in both rural and urban habitats including coastal sand dunes and beaches, logged forest, recently burned forest, woodland clearings, prairies, plains, sagebrush, grasslands, and rock outcrops.	--	--	Resident
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries and along sandy beaches.	--	--	Possible migrant
Golden eagle	*Aquila chrysaetos*	Open and semi-open country such as prairies, sagebrush, savannah or sparse woodland, and barren areas, especially in hilly or mountainous regions.	--	--	Resident
Lark bunting	*Calamospiza melanocorys*	Adaptable to a variety of short grassland environments, including those with a brushy component, as well as certain agricultural landscapes featuring grain sorghum.	--	--	Resident
Loggerhead shrike	*Lanius ludovicianus*	Commonly found in agricultural fields, pastures, orchards, prairies, scrublands, and urban spaces like golf courses and cemeteries.	--	--	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident

Table D.6. Endangered, Threatened, Candidate and SGCN Listed for Lubbock County, Texas [9]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Northern bobwhite	*Colinus virginianus*	Occurs in croplands, grasslands, pastures, fallow fields, grass-brush rangelands, open pinelands and open mixed pine-hardwood.	--	--	Resident
Pyrrhuloxia	*Cardinalis sinuatus*	Upland deserts, mesquite savannas, riparian (streamside) woodlands, desert scrublands, farm fields with hedgerows, and residential areas with nearby mesquite.	--	--	Resident
Sanderling	*Calidris alba*	Nonbreeding: primarily sandy beaches, less frequently on mud flats and shores of lakes or rivers.	--	--	Possible migrant
Scaled quail	*Callipepla squamata*	Preferred habitat is arid-semiarid, mixed shrub-grassland.	--	--	Resident
Snowy plover	*Charadrius nivosus*	Algal flats provide high-quality habitat due to their inaccessibility and year-round availability across tidal conditions. Once an uncommon breeder in the Panhandle, they now migrate through and winter along the coast.	--	--	Possible migrant
White-faced ibis	*Plegadis chihi*	Prefers freshwater marshes, sloughs, and irrigated rice fields. Currently confined to near-coastal rookeries, nests in marshes.	--	T	Possible migrant
Whooping crane	*Grus americana*	Potential migrant, winters in coastal marshes.	E	E	Possible migrant
Willet	*Tringa semipalmata*	Marshes, tidal mudflats, beaches, lake margins, mangroves, tidal channels, river mouths, coastal lagoons, sandy or rocky shores, and, less frequently, open grassland.	--	--	Possible migrant
Wilson’s warbler	*Cardellina pusilla*	Forests and scrubby areas along streams during migration.	--	--	Possible migrant
Yellow rail	*Coturnicops noveboracensis*	Grain fields in winter and when migrating.	--	--	Possible migrant

Table D.6. Endangered, Threatened, Candidate and SGCN Listed for Lubbock County, Texas [9]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Yellow-billed cuckoo	*Coccyzus americanus*	In Texas, the population of concern (Western Distinct Population) is found breeding in riparian areas in the Trans Pecos.	T	--	Possible migrant
Insects					
American bumblebee	*Bombus pensylvanicus*	Habitat description is not available at this time.	--	--	Resident
Migratory monarch butterfly	*Danaus Plexippus Plexippus*	During the breeding season, monarchs lay their eggs on their obligate milkweed host plants (primarily Asclepias spp.), which occur primarily in open areas or wooded edges. Adults require nectar-producing flowers for feeding and migration.	PT	--	Possible migrant
Mammals					
Big free-tailed bat	*Nyctinomops macrotis*	Prefers to roost in crevices and cracks in high canyon walls.	--	--	Resident
Black-tailed prairie dog	*Cynomys ludovicianus*	Dry, flat, short grassland with low, sparse vegetation.	--	--	Resident
Cave myotis bat	*Myotis velifer*	Colonial and cave dwelling, also roosts in rock crevices, old buildings, under bridges and old Cliff Swallow nests	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, etc.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Mountain lion	*Puma concolor*	Generalist, most commonly found in rugged mountains and riparian zones.	--	--	Resident
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Low and mid-elevation shrub, pinyon-juniper, and ponderosa pine types, and probably includes all forest types up to 10,000 feet.	--	--	Resident
Plains spotted skunk	*Spilogale putorius interrupta*	Prefers wooded, brushy areas and tallgrass prairie.	--	--	Resident

Table D.6. Endangered, Threatened, Candidate and SGCN Listed for Lubbock County, Texas [9]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Pronghorn	*Antilocapra americana*	Prefers hilly and plateau areas of open grassland, desert grassland and desert scrub.	--	--	Resident
Swift fox	*Vulpes velox*	Restricted to current and historic shortgrass prairie.	--	--	Resident
Townsend's big-eared bat	*Corynorhinus townsendii*	Variety of habitats including forests, deserts, native prairies, riparian communities, active agricultural areas, and coastal habitats.	--	--	Resident
Tricolored bat	*Perimyotis subflavus*	Forest, woodland and riparian areas. Caves are important to this species.	PE	--	Resident
Western pipistrelle	*Parastrellus hesperus*	Desert to pine-oak woodland. Cliffs and rock crevices provide roosts.	--	--	Resident
Reptiles					
Common garter snake	*Thamnophis sirtalis*	Irrigation canals and riparian-corridor farmlands. Marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water.	--	--	Resident
Keeled earless lizard	*Holbrookia propinqua*	Coastal dunes, barrier islands, and other sandy areas.	--	--	Resident
Texas horned lizard	*Phrynosoma cornutum*	Open, arid, and semi-arid regions with sparse vegetation.	--	T	Resident
Texas map turtle	*Graptemys versa*	Rivers with moderate current, abundant aquatic vegetation, and basking logs.	--	--	Resident
Western box turtle	*Terrapene ornata*	Prairie grassland, pasture, fields, sandhills and open woodland.	--	--	Resident
Western massasauga	*Sisturus tergeminus*	Shortgrass or mixed grass prairie, with gravel or sandy soils. Often found associated with draws, floodplains, and more mesic habitats within the arid landscape.	--	--	Resident
Plants					
Cory's ephedra	*Ephedra coryi*	Dune areas and dry grasslands in southern Plains Country.	--	--	Resident

Table D.6. Endangered, Threatened, Candidate and SGCN Listed for Lubbock County, Texas [9]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Mexican mud-plantain	*Heteranthera mexicana*	Wet clayey soils along margins of playas in the Panhandle	--	--	Resident

Notes:
Acronyms: SGCN = species of greatest conservation need; USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department
Statuses: PT= Potentially Threatened, T = Threatened, PE = Potentially Endangered, E = Endangered, -- = SGCN or Rare

D.3 Lubbock and Lynn Counties

The follow species list (Table D.7) for Lubbock and Lynn counties, Texas, applies to surface water management strategy, South Fork Discharge, discussed in Chapter 5.

Table D.7. Endangered, Threatened, Candidate and SGCN Listed for Lubbock and Lynn Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Amphibians					
Woodhouse's toad	*Anaxyrus woodhousii*	Wide variety of terrestrial habitats are used, including forests, grasslands, and barrier island sand dunes. Aquatic habitats are equally varied.	--	--	Resident
Birds					
Baird's sparrow	*Centronyx bairdii*	Shortgrass prairie with scattered low bushes and matted vegetation; mostly migratory in western half of the U.S., and winters in in Mexico.	--	--	Possible migrant
Bald eagle	*Haliaeetus leucocephalus*	Found primarily near rivers and large lakes	--	--	Resident
Bank swallow	*Riparia riparia*	Low areas along rivers, streams, ocean coasts, and reservoirs.	--	--	Resident
Black rail	*Laterallus jamaicensis*	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps. Nests in or along edge of marsh.	T	T	Possible migrant
Brewer's blackbird	*Euphagus cyanocephalus*	Shrubby and bushy areas (especially near water), riparian woodland, aspen parkland, cultivated lands, marshes and around human habitation. Winter resident.	--	--	Resident
Cactus wren	*Campylorhynchus brunneicapillus*	Desert, mesquite, arid scrub, coastal sage scrub, and in trees in towns in arid regions.	--	--	Resident
Chestnut-collared longspur	*Calcarius ornatus*	Occurs in open shortgrass settings especially in patches with some bare ground.	--	--	Resident
Common nighthawk	*Chordeiles minor*	Nests in both rural and urban habitats including coastal sand dunes and beaches,	--	--	Resident

Table D.7. Endangered, Threatened, Candidate and SGCN Listed for Lubbock and Lynn Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
		logged forest, recently burned forest, woodland clearings, prairies, plains, sagebrush, grasslands, and rock outcrops.			
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries and along sandy beaches.	--	--	Possible migrant
Golden eagle	*Aquila chrysaetos*	Open and semi-open country such as prairies, sagebrush, savannah or sparse woodland, and barren areas, especially in hilly or mountainous regions.	--	--	Resident
Lark bunting	*Calamospiza melanocorys*	Adaptable to a variety of short grassland environments, including those with a brushy component, as well as certain agricultural landscapes featuring grain sorghum.	--	--	Resident
Loggerhead shrike	*Lanius ludovicianus*	Commonly found in agricultural fields, pastures, orchards, prairies, scrublands, and urban spaces like golf courses and cemeteries.	--	--	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Northern bobwhite	*Colinus virginianus*	Occurs in croplands, grasslands, pastures, fallow fields, grass-brush rangelands, open pinelands and open mixed pine-hardwood.	--	--	Resident
Pyrrhuloxia	*Cardinalis sinuatus*	Upland deserts, mesquite savannas, riparian (streamside) woodlands, desert scrublands, farm fields with hedgerows, and residential areas with nearby mesquite.	--	--	Resident
Sanderling	*Calidris alba*	Nonbreeding: primarily sandy beaches, less frequently on mud flats and shores of lakes or rivers.	--	--	Possible migrant
Scaled quail	*Callipepla squamata*	Preferred habitat is arid-semiarid, mixed shrub-grassland.	--	--	Resident

Table D.7. Endangered, Threatened, Candidate and SGCN Listed for Lubbock and Lynn Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Snowy plover	*Charadrius nivosus*	Algal flats provide high-quality habitat due to their inaccessibility and year-round availability across tidal conditions. Once an uncommon breeder in the Panhandle, they now migrate through and winter along the coast.	--	--	Possible migrant
White-faced ibis	*Plegadis chihi*	Prefers freshwater marshes, sloughs, and irrigated rice fields. Currently confined to near-coastal rookeries, nests in marshes.	--	T	Possible migrant
Whooping crane	*Grus americana*	Potential migrant, winters in coastal marshes	E	E	Possible migrant
Willet	*Tringa semipalmata*	Marshes, tidal mudflats, beaches, lake margins, mangroves, tidal channels, river mouths, coastal lagoons, sandy or rocky shores, and, less frequently, open grassland.	--	--	Possible migrant
Wilson's warbler	*Cardellina pusilla*	Forests and scrubby areas along streams during migration.	--	--	Possible migrant
Yellow rail	*Coturnicops noveboracensis*	Grain fields in winter and when migrating.	--	--	Possible migrant
Yellow-billed cuckoo	*Coccyzus americanus*	In Texas, the population of concern (Western Distinct Population) is found breeding in riparian areas in the Trans Pecos.	T	--	Possible migrant
Crustaceans					
Salt Playa fairy shrimp	*Phallocryptus sublettei*	Saline playa lakes, usually very shallow with depth of water a function of rainfall.	--	--	Resident
Insects					
American bumblebee	*Bombus pensylvanicus*	Habitat description is not available at this time.	--	--	Resident
Migratory monarch butterfly	*Danaus Plexippus Plexippus*	During the breeding season, monarchs lay their eggs on their obligate milkweed host plants (primarily Asclepias spp.), which occur primarily in open areas or wooded edges. Adults require nectar-	PT	--	Possible migrant

Table D.7. Endangered, Threatened, Candidate and SGCN Listed for Lubbock and Lynn Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
		producing flowers for feeding and migration.			
Mammals					
Big free-tailed bat	*Nyctinomops macrotis*	Prefers to roost in crevices and cracks in high canyon walls.	--	--	Resident
Black-tailed prairie dog	*Cynomys ludovicianus*	Dry, flat, short grassland with low, sparse vegetation.	--	--	Resident
Cave myotis bat	*Myotis velifer*	Colonial and cave dwelling, also roosts in rock crevices, old buildings, under bridges and old Cliff Swallow nests.	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, etc.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Jones's pocket gopher	*Geomys knoxjonesi*	Fossorial rodent restricted to areas with deep, sandy, aeolian soils; usually in native yucca-grassland habitat.	--	--	Resident
Mountain lion	*Puma concolor*	Generalist, most commonly found in rugged mountains and riparian zones.	--	--	Resident
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Low and mid-elevation shrub, pinyon-juniper, and ponderosa pine types, and probably includes all forest types up to 10,000 feet	--	--	Resident
Palo Duro mouse	*Peromyscus truei comanche*	Rocky, juniper-mesquite covered slopes of steep-walled canyons.	--	T	Resident
Plains spotted skunk	*Spilogale putorius interrupta*	Prefers wooded, brushy areas and tallgrass prairie.	--	--	Resident
Pronghorn	*Antilocapra americana*	Prefers hilly and plateau areas of open grassland, desert grassland and desert scrub.	--	--	Resident
Swift fox	*Vulpes velox*	Restricted to current and historic shortgrass prairie.	--	--	Resident
Townsend's big-eared bat	*Corynorhinus townsendii*	Variety of habitats including forests, deserts, native prairies, riparian communities,	--	--	Resident

Table D.7. Endangered, Threatened, Candidate and SGCN Listed for Lubbock and Lynn Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
		active agricultural areas, and coastal habitats.			
Tricolored bat	*Perimyotis subflavus*	Forest, woodland and riparian areas. Caves are important to this species.	PE	--	Resident
Western pipistrelle	*Parastrellus hesperus*	Desert to pine-oak woodland. Cliffs and rock crevices provide roosts.	--	--	Resident
Reptiles					
Common garter snake	*Thamnophis sirtalis*	Irrigation canals and riparian-corridor farmlands. Marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water.	--	--	Resident
Keeled earless lizard	*Holbrookia propinqua*	Coastal dunes, barrier islands, and other sandy areas.	--	--	Resident
Texas horned lizard	*Phrynosoma cornutum*	Open, arid, and semi-arid regions with sparse vegetation.	--	T	Resident
Texas map turtle	*Graptemys versa*	Rivers with moderate current, abundant aquatic vegetation, and basking logs.	--	--	Resident
Western box turtle	*Terrapene ornata*	Prairie grassland, pasture, fields, sandhills and open woodland.	--	--	Resident
Western massasauga	*Sisturus tergeminus*	Shortgrass or mixed grass prairie, with gravel or sandy soils. Often found associated with draws, floodplains, and more mesic habitats within the arid landscape.	--	--	Resident
Plants					
Cory's ephedra	*Ephedra coryi*	Dune areas and dry grasslands in southern Plains Country.	--	--	Resident
Mexican mud-plantain	*Heteranthera mexicana*	Wet clayey soils along margins of playas in the Panhandle	--	--	Resident

Notes:
Acronyms: SGCN = species of greatest conservation need; USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department
Statuses: PT= Potentially Threatened, T = Threatened, PE = Potentially Endangered, E = Endangered, -- = SGCN or Rare

D.4 Roberts County

The follow species list (Table D.8) for only Roberts County, Texas, applies to the following groundwater management strategy, CRMWA Aquifer Storage and Recovery, discussed in Chapter 5.

Table D.8. Endangered, Threatened, Candidate and SGCN Listed for Roberts County, Texas[10]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Amphibians					
Woodhouse's toad	*Anaxyrus woodhousii*	Wide variety of terrestrial habitats are used, including forests, grasslands, and barrier island sand dunes. Aquatic habitats are equally varied.	--	--	Resident
Birds					
Bald eagle	*Haliaeetus leucocephalus*	Found primarily near rivers and large lakes	--	--	Resident
Bank swallow	*Riparia riparia*	Low areas along rivers, streams, ocean coasts, and reservoirs.	--	--	Resident
Black rail	*Laterallus jamaicensis*	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps. Nests in or along edge of marsh.	T	T	Possible migrant
Brewer's blackbird	*Euphagus cyanocephalus*	Shrubby and bushy areas (especially near water), riparian woodland, aspen parklands, cultivated lands, marshes, and around human habitation, in migration and winter also in pastures and fields.	--	--	Resident
Chestnut-collared longspur	*Calcarius ornatus*	Occurs in open shortgrass settings especially in patches with some bare ground.	--	--	Resident
Common nighthawk	*Chordeiles minor*	Nests in both rural and urban habitats including coastal sand dunes and beaches, logged forest, recently burned forest, woodland clearings, prairies, plains, sagebrush, grasslands, and rock outcrops.	--	--	Resident

[10] TPWD. 2025. Annotated County Lists of Rare Species – Roberts County. Revised January 15, 2025.

Table D.8. Endangered, Threatened, Candidate and SGCN Listed for Roberts County, Texas[10]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries and along sandy beaches.	--	--	Possible migrant
Golden eagle	*Aquila chrysaetos*	Open and semi-open country such as prairies, sagebrush, savannah or sparse woodland, and barren areas, especially in hilly or mountainous regions.	--	--	Resident
Interior least tern	*Sternula antillarum athalassos*	Sand beaches, flats, bays, inlets, lagoons, gravel bars within braided streams and rivers. Also known to nest on man-made structures.	E	E	Resident
Lark bunting	*Calamospiza melanocorys*	Adaptable to a variety of short grassland environments, including those with a brushy component, as well as certain agricultural landscapes featuring grain sorghum.	--	--	Resident
Least tern	*Stermula antillarum*	Sand beaches, flats, bays, inlets, lagoons, islands, river sandbars and flat gravel rooftops in urban areas.	--	--	Possible migrant
Lesser prairie-chicken	*Tympanuchus pallidicinctus*	Arid grasslands, generally interspersed with shrubs.	E	E	Resident
Loggerhead shrike	*Lanius ludovicianus*	Commonly found in agricultural fields, pastures, orchards, prairies, scrublands, and urban spaces like golf courses and cemeteries.	--	--	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Northern bobwhite	*Colinus virginianus*	Occurs in croplands, grasslands, pastures, fallow fields, grass-brush rangelands, open pinelands and open mixed pine-hardwood.	--	--	Resident
Sanderling	*Calidris alba*	Nonbreeding: primarily sandy beaches, less frequently on mud flats and shores of lakes or rivers.	--	--	Possible migrant
Scaled quail	*Callipepla squamata*	Arid-semiarid, mixed shrub-grassland.	--	--	Resident

Table D.8. Endangered, Threatened, Candidate and SGCN Listed for Roberts County, Texas[10]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Snowy plover	*Charadrius nivosus*	Algal flats provide high-quality habitat due to their inaccessibility and year-round availability across tidal conditions. Once an uncommon breeder in the Panhandle, they now migrate through and winter along the coast.	--	--	Possible migrant
Sprague's pipit	*Anthus spragueii*	Habitat during migration and in winter consists of pastures and weedy fields, including grasslands with dense herbaceous vegetation or grassy agricultural fields.	--	--	Possible migrant
White-faced Ibis	*Plegadis chihi*	Prefers freshwater marshes, sloughs, and irrigated rice fields. Currently confined to near-coastal rookeries, nests in marshes.	--	T	Possible migrant
Whooping crane	*Grus americana*	Small ponds, marshes, and flooded grain fields. Potential migrant through plains, winters in coastal marshes of Aransas, Calhoun and Refugio counties.	E	E	Possible migrant
Willet	*Tringa semipalmata*	Marshes, tidal mudflats, beaches, lake margins, mangroves, tidal channels, river mouths, coastal lagoons, sandy or rocky shores, and, less frequently, open grassland.	--	--	Possible migrant
Wilson's warbler	*Cardellina pusilla*	Forests and scrubby areas along streams during migration.	--	--	Possible migrant
Yellow rail	*Coturnicops noveboracensis*	Grain fields in winter and when migrating.	--	--	Possible migrant
Yellow-billed cuckoo	*Coccyzus americanus*	In Texas, the population of concern (Western Distinct Population) is found breeding in riparian areas in the Trans Pecos.	--	--	Possible migrant
Arkansas River shiner	*Notropis girardi*	Typically in turbid waters of broad shallow channels of main streams over mostly silt and shifting sand bottom.	T	T	Resident

Table D.8. Endangered, Threatened, Candidate and SGCN Listed for Roberts County, Texas[10]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Peppered chub	*Macrhybopsis tetranema*	Large low gradient streams, usually over fine gravel or sand. Middle Canadian and Beaver River basins	E	E	Resident
Red River pupfish	*Cyprinodon ubrofluviatilis*	Headwater streams of xeric grasslands. River edges, channels, backwaters, over sand bottoms. Euryhaline and eurythermal.	--	T	Potential Resident
Insects					
Migratory monarch butterfly	*Danaus plexippus plexippus*	During the breeding season, monarchs lay their eggs on their obligate milkweed host plants (primarily Asclepias spp.), which occur primarily in open areas or wooded edges. Adults require nectar-producing flowers for feeding and migration.	PT	--	Possible migrant
Mammals					
Big free-tailed bat	*Nyctinomops macrotis*	Prefers to roost in crevices and cracks in high canyon walls.	--	--	Resident
Black-tailed prairie dog	*Cynomys ludovicianus*	Dry, flat, short grassland with low, sparse vegetation.	--	--	Resident
Cave myotis bat	*Myotis velifer*	Colonial and cave dwelling, also roosts in rock crevices, old buildings, under bridges and old Cliff Swallow nests.	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, etc.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Mountain lion	*Puma concolor*	Generalist, most commonly found in rugged mountains and riparian zones.	--	--	Resident
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Low and mid-elevation shrub, pinyon-juniper, and ponderosa pine types, and probably includes all forest types up to 10,000 feet.	--	--	Resident
Plains spotted skunk	*Spilogale putorius interrupta*	Prefers wooded, brushy areas and tallgrass prairie		--	Resident

Table D.8. Endangered, Threatened, Candidate and SGCN Listed for Roberts County, Texas[10]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Pronghorn	*Antilocapra americana*	Prefers hilly and plateau areas of open grassland, desert grassland and desert scrub.	--	--	Resident
Swift fox	*Vulpes velox*	Restricted to current and historic shortgrass prairie.	--	--	Resident
Townsend's big-eared bat	*Corynorhinus townsendii*	Variety of habitats including forests, deserts, native prairies, riparian communities, active agricultural areas, and coastal habitats.	--	--	Resident
Tricolored bat	*Perimyotis subflavus*	Forest, woodland and riparian areas. Caves are important to this species.	PE	--	Resident
Reptiles					
Slender glass lizard	*Ophisaurus attenuates*	Prefers relatively dry microhabitats, usually associated with grassy areas. Open grasslands, prairie woodland, scrubby areas, fallow fields, and areas near streams and ponds. Often associated with sandy soils	--	--	Resident
Smooth softshell	*Apalone mutica*	Large rivers and streams; in some areas also found in lakes and impoundments. Usually in water with sandy or mud bottom and few aquatic plants.	--	--	Resident
Texas horned lizard	*Phrynosoma cornutum*	Open, arid, and semi-arid regions with sparse vegetation.	--	T	Resident
Western box turtle	*Terrapene ornata*	Prairie grassland, pasture, fields, sandhills and open woodland.	--	--	Resident
Western massasauga	*Sistrurus tergeminus*	Shortgrass or mixed grass prairie, with gravel or sandy soils. Often found associated with draws, floodplains, and more mesic habitats within the arid landscape.	--	--	Resident

Notes:
Acronyms: SGCN = species of greatest conservation need; USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department
Statuses: PT= Potentially Threatened, T = Threatened, PE = Potentially Endangered, E = Endangered, -- = SGCN or Rare

D.5 Roberts, Hutchison, Gray, Carson, and Potter Counties

The follow species list (Table D.9) for only Roberts, Hutchison, Gray, Carson, and Potter counties, Texas, applies to the following groundwater management strategy, New Transmission Line to Aqueduct for Roberts County Well Field, discussed in Chapter 5.

Table D.9. Endangered, Threatened, Candidate and SGCN Listed for Roberts[11], Hutchison[12], Gray[13], Carson[14] and Potter[15] Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Amphibians					
Woodhouse's toad	*Anaxyrus woodhousii*	Wide variety of terrestrial habitats are used, including forests, grasslands, and barrier island sand dunes. Aquatic	--	--	Resident
Birds					
Bald eagle	*Haliaeetus leucocephalus*	Found primarily near rivers and large lakes	--	--	Resident
Bank swallow	*Riparia riparia*	Low areas along rivers, streams, ocean coasts, and reservoirs.	--	--	Resident
Black rail	*Laterallus jamaicensis*	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps. Nests in or along edge of marsh.	T	T	Possible migrant
Brewer's blackbird	*Euphagus cyanocephalus*	Shrubby and bushy areas (especially near water), riparian woodland, aspen parklands, cultivated lands, marshes, and around human habitation, in migration and winter also in pastures and fields.	--	--	Resident
Chestnut-collared longspur	*Calcarius ornatus*	Occurs in open shortgrass settings especially in patches with some bare ground.	--	--	Resident
Common nighthawk	*Chordeiles minor*	Nests in both rural and urban habitats including coastal sand dunes and beaches, logged forest, recently burned forest, woodland clearings, prairies, plains, sagebrush, grasslands, and rock outcrops.	--	--	Resident

[11] TPWD. 2025. Annotated County Lists of Rare Species – Roberts County. Revised January 15, 2025.
[12] TPWD. 2025b. Annotated County Lists of Rare Species – Hutchison County. Revised January 15, 2025.
[13] TPWD. 2025c. Annotated County Lists of Rare Species – Gray County. Revised January 15, 2025.
[14] TPWD. 2025d. Annotated County Lists of Rare Species – Carson County. Revised January 15, 2025.
[15] TPWD. 2025e. Annotated County Lists of Rare Species – Potter County. Revised January 15, 2025.

Table D.9. Endangered, Threatened, Candidate and SGCN Listed for Roberts[11], Hutchison[12], Gray[13], Carson[14] and Potter[15] Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries and along sandy beaches.	--	--	Possible migrant
Golden eagle	*Aquila chrysaetos*	Open and semi-open country such as prairies, sagebrush, savannah or sparse woodland, and barren areas, especially in hilly or mountainous regions.	--	--	Resident
Interior least tern	*Sternula antillarum athalassos*	Sand beaches, flats, bays, inlets, lagoons, gravel bars within braided streams and rivers. Also known to nest on man-made structures.	E	E	Resident
Lark bunting	*Calamospiza melanocorys*	Adaptable to a variety of short grassland environments, including those with a brushy component, as well as certain agricultural landscapes featuring grain sorghum.	--	--	Resident
Least tern	*Stermula antillarum*	Sand beaches, flats, bays, inlets, lagoons, islands, river sandbars and flat gravel rooftops in urban areas.	--	--	Possible migrant
Lesser prairie-chicken	*Tympanuchus pallidicinctus*	Arid grasslands, generally interspersed with shrubs.	E	E	Resident
Loggerhead shrike	*Lanius ludovicianus*	Commonly found in agricultural fields, pastures, orchards, prairies, scrublands, and urban spaces like golf courses and cemeteries.	--	--	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Northern bobwhite	*Colinus virginianus*	Occurs in croplands, grasslands, pastures, fallow fields, grass-brush rangelands, open pinelands and open mixed pine-hardwood.	--	--	Resident
Pyrrhuloxia	*Cardinalis sinuatus*	Upland deserts, mesquite savannas, riparian (streamside) woodlands, desert scrublands, farm fields with hedgerows, and residential areas with nearby mesquite.	--	--	Resident
Sanderling	*Calidris alba*	Nonbreeding: primarily sandy beaches, less frequently on mud flats and shores of lakes or rivers.	--	--	Possible migrant

Table D.9. Endangered, Threatened, Candidate and SGCN Listed for Roberts[11], Hutchison[12], Gray[13], Carson[14] and Potter[15] Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Scaled quail	*Callipepla squamata*	Arid-semiarid, mixed shrub-grassland.	--	--	Resident
Snowy plover	*Charadrius nivosus*	Algal flats provide high-quality habitat due to their inaccessibility and year-round availability across tidal conditions. Once an uncommon breeder in the Panhandle, they now migrate through and winter along the coast.	--	--	Possible migrant
Sprague's pipit	*Anthus spragueii*	Habitat during migration and in winter consists of pastures and weedy fields, including grasslands with dense herbaceous vegetation or grassy agricultural fields.	--	--	Possible migrant
White-faced Ibis	*Plegadis chihi*	Prefers freshwater marshes, sloughs, and irrigated rice fields. Currently confined to near-coastal rookeries, nests in marshes.	--	T	Possible migrant
Whooping crane	*Grus americana*	Small ponds, marshes, and flooded grain fields. Potential migrant through plains, winters in coastal marshes of Aransas, Calhoun and Refugio counties.	E	E	Possible migrant
Willet	*Tringa semipalmata*	Marshes, tidal mudflats, beaches, lake margins, mangroves, tidal channels, river mouths, coastal lagoons, sandy or rocky shores, and, less frequently, open grassland.	--	--	Possible migrant
Wilson's warbler	*Cardellina pusilla*	Forests and scrubby areas along streams during migration.	--	--	Possible migrant
Yellow-billed cuckoo	*Coccyzus americanus*	In Texas, the population of concern (Western Distinct Population) is found breeding in riparian areas in the Trans Pecos.	--	--	Possible migrant
Yellow rail	*Coturnicops noveboracensis*	Grain fields in winter and when migrating.	--	--	Possible migrant
Fishes					
Arkansas River shiner	*Notropis girardi*	Typically in turbid waters of broad shallow channels of main streams over mostly silt and shifting sand bottom.	T	T	Resident

Table D.9. Endangered, Threatened, Candidate and SGCN Listed for Roberts[11], Hutchison[12], Gray[13], Carson[14] and Potter[15] Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Flathead chub	*Platygobio gracilis*	Found in strong currents over sandy bottoms and in pools.	--	--	Likely extirpated
Mississippi silvery minnow	*Hybognathus nuchalis*	Found in eastern Texas streams, from the Brazos River eastward and northward to the Red River; found in moderate current; silty, muddy, or rocky substrate. In Texas, adults likely to inhabit smaller tributary streams.	--	--	Resident
Peppered chub	*Macrhybopsis tetranema*	Large low gradient streams, usually over fine gravel or sand. Middle Canadian and Beaver River basins	E	E	Resident
Red River pupfish	*Cyprinodon rubrofluviatilis*	Headwater streams of xeric grasslands. River edges, channels, backwaters, over sand bottoms. Euryhaline and eurythermal.	--	--	Resident
Insects					
American bumblebee	*Bombus pensylvanicus*	Habitat description is not available at this time.	--	--	Resident
Migratory monarch butterfly	*Danaus plexippus plexippus*	During the breeding season, monarchs lay their eggs on their obligate milkweed host plants (primarily Asclepias spp.), which occur primarily in open areas or wooded edges. Adults require nectar-producing flowers for feeding and migration.	PT	--	Possible migrant
Mammals					
Big free-tailed bat	*Nyctinomops macrotis*	Prefers to roost in crevices and cracks in high canyon walls.	--	--	Resident
Black bear	*Ursus americanus*	Generalist. Habitats include higher elevation pinyon-oaks, desert scrub, and juniper-oak habitat. Bottomland hardwoods, floodplain forests, upland hardwoods with mixed pine, marsh.	--	T	Resident
Black-tailed prairie dog	*Cynomys ludovicianus*	Dry, flat, short grassland with low, sparse vegetation.	--	--	Resident
Cave myotis bat	*Myotis velifer*	Colonial and cave dwelling, also roosts in rock crevices, old buildings, under bridges and old Cliff Swallow nests.	--	--	Resident

Table D.9. Endangered, Threatened, Candidate and SGCN Listed for Roberts[11], Hutchison[12], Gray[13], Carson[14] and Potter[15] Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, etc.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Mountain lion	*Puma concolor*	Generalist, most commonly found in rugged mountains and riparian zones.	--	--	Resident
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Low and mid-elevation shrub, pinyon-juniper, and ponderosa pine types, and probably includes all forest types up to 10,000 feet.	--	--	Resident
Palo Duro mouse	*Peromyscus truei comanche*	Rocky, juniper-mesquite-covered slopes of steep-walled canyons.	--	T	Resident
Plains spotted skunk	*Spilogale putorius interrupta*	Prefers wooded, brushy areas and tallgrass prairie.	--	--	Resident
Pronghorn	*Antilocapra americana*	Prefers hilly and plateau areas of open grassland, desert grassland and desert scrub.	--	--	Resident
Swift fox	*Vulpes velox*	Restricted to current and historic shortgrass prairie.	--	--	Resident
Townsend's big-eared bat	*Corynorhinus townsendii*	Variety of habitats including forests, deserts, native prairies, riparian communities, active agricultural areas, and coastal habitats.	--	--	Resident
Tricolored bat	*Perimyotis subflavus*	Forest, woodland and riparian areas. Caves are important to this species.	PE	--	Resident
Western pipistrelle	*Parastrellus hesperus*	Desert to pine-oak woodland. Cliffs and rock crevices provide roosts.	--	--	Resident
Western small-footed myotis bat	*Myotis ciliolabrum*	Mountainous regions of the Trans-Pecos, usually in wooded areas. Also found in grassland and desert scrub habitats.	--	--	Resident

Table D.9. Endangered, Threatened, Candidate and SGCN Listed for Roberts[11], Hutchison[12], Gray[13], Carson[14] and Potter[15] Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Reptiles					
Common garter snake	*Thamnophis sirtalis*	Irrigation canals and riparian-corridor farmlands in west. Marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water, and coastal salt marshes.	--	--	Resident
Slender glass lizard	*Ophisaurus attenuates*	Prefers relatively dry microhabitats, usually associated with grassy areas. Open grasslands, prairie woodland, scrubby areas, fallow fields, and areas near streams and ponds. Often associated with sandy soils	--	--	Resident
Smooth softshell	*Apalone mutica*	Any permanent bosy of water. Large rivers and streams. In some areas also found in lakes, impoundments and shallow bogs.	--	--	Resident
Texas horned lizard	*Phrynosoma cornutum*	Open, arid, and semi-arid regions with sparse vegetation.	--	T	Resident
Western box turtle	*Terrapene ornata*	Prairie grassland, pasture, fields, sandhills and open woodland.	--	--	Resident
Western massasauga	*Sistrurus tergeminus*	Shortgrass or mixed grass prairie, with gravel or sandy soils. Often found associated with draws, floodplains, and more mesic habitats within the arid landscape.	--	--	Resident
Mollusks					
Mapleleaf	*Quadrula quadrula*	Reported from streams to rivers, lakes, and reservoirs.	--	--	Resident
Plants					
Mexican mud-plantain	*Heteranthera mexicana*	Wet clayey soils of resacas and ephemeral wetlands in South Texas and along margins of playas in the Panhandle.	--	--	Resident
Tall plains spurge	*Euphorbia strictior*	Wet clayey soils of resacas and ephemeral wetlands in South Texas and along margins of playas in the Panhandle; flowering June-December, only after sufficient rainfall,	--	--	Resident

Table D.9. Endangered, Threatened, Candidate and SGCN Listed for Roberts[11], Hutchison[12], Gray[13], Carson[14] and Potter[15] Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties

Notes:
Acronyms: SGCN = species of greatest conservation need; USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department
Statuses: PT= Potentially Threatened, T = Threatened, PE = Potentially Endangered, E = Endangered, -- = SGCN or Rare

E

Water Management Strategy Evaluation – Agricultural Resources and Environmental Factors

Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors

In accordance with Texas Water Development Board (TWDB) rules and guidelines, quantitative impacts analysis of environmental factors and agricultural resources for each water management strategy (WMS) is described in this appendix. Impacts to agricultural resources are quantified based on the permanent impacts to water supplies to irrigation users or direct impacts to irrigated acreage. For example, projects with only temporary impacts, such as pipeline projects, are classified as having a low impact. Specific resources analyzed include the following.

- **Environmental water needs** - The water necessary to sustain a sound ecological environment. Surface water strategies could potentially use this water source. Reuse supplies could potentially use water that would have otherwise been discharged into a surface water body. Groundwater strategies are assumed to not have an impact on surface water needed for environmental needs.
- **Wildlife habitat** – The area disrupted from implementation of a strategy.
- **Threatened and Endangered Species** – The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess the proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. The threated, endangered, candidate and species of greatest conservation need (SGCN) located in a county where a potential strategy is located were identified and used to quantitatively assess potential impacts.
- **Wetlands** – The area classified as wetlands that is disrupted form the implementation of a strategy. Pipelines, wells, pump stations, and water treatment plants are anticipated to be located outside of wetland areas. Therefore, only reservoir footprints and surface water intakes are considered to impact wetlands.
- **Cultural resources** – The physical evidence or place of past human activity that may be disrupted from the implementation of a strategy. A quantitative assessment of cultural resources is provided in the Section 5 of the Llano Estacado Regional Water Plan (LERWP).
- **Bays and estuaries water needs –** The freshwater inflow necessary to sustain a sound ecological environment in the bays, estuaries, and arms of the Gulf of Mexico. Potential strategies included in the LERWP are located a substantial distance from the coast and are not anticipated to impact water needs of bays and estuaries.
- **Agricultural resources –** The land required for agricultural production related to farming and ranching. Potential strategies located in rural locations are assumed to impact agricultural resources. The South Lubbock Well Field is the only potential strategy not located in a rural area in the LERWP.

Each resource was quantitatively assessed and scored using the following parameters. The amount of area impacted by the implementation of a strategy is estimated using the following assumptions.

- Reservoir footprint acreage

- Groundwater wells (2 acres)
- Intakes and pump stations (5 acres)
- Pipeline rights of way
- Well field connection pipelines and pipelines less than 24 inches in diameter are assumed to have negligible impacts and are not included in the total area impacted.

Scoring of the criteria ranges from a value of 1 (highest impacts) to 3 (lowest impacts). Table 1 provides the scoring criteria used to evaluate the potential strategies for impacts to environmental and agricultural resources.

Table 1. Summary of Scoring Criteria Used for Environmental and Agricultural Impacts Quantitative Assessment

Score	Impact	Environmental Water Needs	Wildlife Habitat (total acres impacted)	Wetlands (wetland acres impacted)	Threatened, Endangered, or Candidate Species Located in County or Counties of Strategy	Bays and Estuaries (River Miles from Coast)[a]	Agricultural Resources (Rural acres impacted)
1	High	None	>10,000	>1,000	>100	0-100	>10,000
2	Medium	Reuse & Surface Water Strategies	1,000-10,000	1-1,000	50-100	100-200	1,000-10,000
3	Low	Conservation & Groundwater Strategies	0-1000	0	0-50	>200	0-1000

[a]All potential strategies located in LERWP are located more than 200 river miles from the coast.

Table 2 summarizes the scoring results of the quantitative assessment of environmental and agricultural resources. No potential strategies in the LERWP include major reservoirs with footprints greater than 1,000 acres. Therefore, no strategies are anticipated to have significant impacts on environmental and agricultural resources.

Table 2. Quantitative Assessment Summary of Potential Impacts to Environmental and Agricultural Resources

Section	Strategy	County	Type	Total Impacted Area (acres)	Reservoir Footprint (acres)	Wetlands Impacted (acres)	Agricultural Resources Impacted (acres)	Threatened and Endangered Species Present	Scoring					
									Environmental Water Needs	Wildlife Habitat	Wetlands	Threatened and Endangered Species	Bays and Estuaries	Agricultural Resources
---	Conservation - General	Multiple	Conservation	0	0	0	0	0	3	3	3	3	3	3
5.2	Jim Bertram Lake 7 Reuse	Lubbock	Surface Water/Reuse	34	774	779	34	48	2	3	2	3	3	3
5.3	Lake Alan Henry Phase 2	Garza, Kent, Lubbock, Lynn[a]	Surface Water	5	0	0	5	57	2	3	3	2	3	3
5.5	North Fork Scalping Operation	Garza	Surface Water	37	650	655	37	42	2	3	2	3	3	3
5.6	Direct Potable Reuse to North Water Treatment Plant	Lubbock	Reuse	48	0	0	48	48	2	3	3	3	3	3
5.7	Direct Potable Reuse to South Water Treatment Plant	Lubbock	Reuse	56	0	0	56	48	2	3	3	3	3	3
5.8	North Fork Diversion at CR 7300	Lubbock	Reuse	103	0	5	103	48	2	3	2	3	3	3
5.9	North Fork Diversion to Lake Alan Henry Pump Station	Garza	Reuse	40	0	5	40	42	2	3	2	3	3	3
5.10	South Fork Discharge	Lubbock, Lynn	Reuse	121	0	0	121	48	2	3	3	3	3	3
5.11	City of Plainview Reuse	Hale	Reuse	23	0	0	23	37	2	3	3	3	3	3
5.12	City of Plainview Reuse Effluent and Brackish Dockum Aquifer Supply for Industrial Facility Operation	Hale, Briscoe	Reuse/Groundwater	170	0	0	170	37	2	3	3	3	3	3
5.13	Direct Potable Reuse from Northwest Water Reclamation Plant to North Water Treatment Plant	Lubbock	Reuse	13	0	0	13	48	2	3	3	3	3	3
5.14	Direct Potable Reuse from Northwest Water Reclamation Plant to Pump Station 9	Lubbock	Reuse	9	0	0	9	48	2	3	3	3	3	3
5.15	Lubbock Land Application Site Groundwater Potable Reuse	Lubbock	Reuse	50	0	0	50	48	2	3	3	3	3	3
---	Groundwater - General[b]	Multiple	Groundwater	2	0	0	2	Variable	3	3	3	3	3	3
5.17	Brackish Supplemental Water Supply for Bailey County Well Field	Bailey	Groundwater	45	0	0	45	35	3	3	3	3	3	3
5.18	Bailey County Well Field Capacity Maintenance	Bailey	Groundwater	170	0	0	170	35	3	3	3	3	3	3
5.19	CRMWA to Lubbock ASR	Lubbock	Groundwater	175	0	0	175	48	3	3	3	3	3	3
5.20	CRMWA to Plainview ASR	Hale	Groundwater	22	0	0	22	37	3	3	3	3	3	3
5.21	South Lubbock Well Field	Lubbock	Groundwater	43	0	0	43	48	3	3	3	3	3	3
5.22	New Transmission Line to Aqueduct for Roberts County Well Field	Roberts, Hutchison, Gray, Carson, Potter	Groundwater	498	0	0	498	59	3	3	3	2	3	3
5.23	Roberts County Well Field Capacity Maintenance	Roberts	Groundwater	38	0	0	38	47	3	3	3	3	3	3
5.24	City Seminole Groundwater	Gaines	Groundwater	25	0	0	25	36	3	3	3	3	3	3
5.27	City of Wolfforth Groundwater	Lubbock	Groundwater	17	0	0	17	48	3	3	3	3	3	3
5.35	City of Shallowater Groundwater	Lubbock	Groundwater	4	0	0	4	48	3	3	3	3	3	3
5.42	Playa Lakes Enhanced Recharge	Multiple	Groundwater	30	0	0	30	Variable	3	3	3	3	3	3
5.43	South Garza Water Supply	Lubbock	Groundwater	5	0	0	5	48	3	3	3	3	3	3

Section	Strategy	County	Type	Total Impacted Area (acres)	Reservoir Footprint (acres)	Wetlands Impacted (acres)	Agricultural Resources Impacted (acres)	Threatened and Endangered Species Present	Scoring					
									Environmental Water Needs	Wildlife Habitat	Wetlands	Threatened and Endangered Species	Bays and Estuaries	Agricultural Resources
5.44.1	Expanded Development of Roberts County Well Field	Roberts	Groundwater	827	0	0	827	47	3	3	3	3	3	3
5.44.2	CRMWA ASR	Lubbock	Groundwater	54	0	0	54	48	3	3	3	3	3	3
5.46	City of Seminole Brackish Groundwater Desalination	Gaines	Groundwater	34	0	0	34	36	3	3	3	3	3	3

[a]Infrastructure improvements only occur in Garza County
[b]Strategies that include single wells placed near location of need.

F

TWDB Socioeconomic Impacts of Projected Water Shortages Report

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TWDB Socioeconomic Impacts of Projected Water Shortages Report

The TWDB Socioeconomic Impacts of Projected Water Shortages Report will be provided by the TWDB before submission of the Final Regional Water Plan in October 2025.

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G

Water User Group Information Verification Survey

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Water User Group (WUG) Information Verification Survey

Date:	Friday, July 19, 2024
Project:	2026 Llano Estacado Regional Water Plan
To:	Water Utility Manager
From:	HDR, Inc. on behalf of the Llano Estacado (Region O) Regional Water Planning Group and the South Plains Association of Governments (SPAG)
Subject:	Water User Group (WUG) Information Verification Survey

The Llano Estacado Regional Water Planning Group is in the process of developing water management strategies, conservation, and drought recommendations for use in the 2026 Llano Estacado Regional Water Plan (2026 Plan).

In this survey, we are requesting confirmation of water supplies and needs, water management strategies, emergency water supply connections, and drought planning information for your water user group (WUG).

Please direct your response to Kelly Davila, 806.762.8721 or Kdavila@spag.org before September 16, 2024.

If no feedback is received by you for your utility, then we will use the information currently available, based primarily on the 2021 Plan and new population data. If you have received this information in error, or if there is a more appropriate contact for our use, please contact Kelly Davila.

We appreciate your assistance in sharing information about your utility, and we look forward to working with you as we develop the 2026 Llano Estacado Regional Water Plan. The Llano Estacado Regional Water Planning Group, the South Plains Association of Governments, and our technical consultant, HDR, are committed to assisting you in the regional water planning process.

For information regarding the planning process and to access the former 2016 Llano Estacado Regional Water Plan, please visit the Llano Estacado Regional Water Planning Group webpage at www.llanoplan.org.

Water User Group (WUG) Information Verification Survey

Please complete the survey, scan or take a photo of your survey, and send your response to Kelly Davila, 806.762.8721 or Kdavila@spag.org by September 16, 2024.

Water Supplies

1. Please describe any current water reuse projects, including capacity and supply.

   ____

Water User Group (WUG) Information Verification Survey

2. Check any special constraints your utility's current water supply system experiences.

   _____ Difficulty meeting peak day demands / summer seasonal usage

   _____ Water quality issues (please explain) ____

   _____ Cost of existing supplies are increasing and becoming too high

   _____ Leaks / Water loss issues / Aging infrastructure

   _____ Other (please specify): ____

   _____ No special constraints.

   _____ We expect good water quality and sufficient quantity through at least Year ________ (insert future year)

3. Do you have a Water Conservation Plan? Yes / No

   If yes, who is responsible for implementing the Plan? ______________________________________
   If yes, has the plan been sent to the Texas Commission on Environmental Quality (TCEQ)? Yes / No

4. Please send a copy of your utility's Water Conservation Plan to Kelly Davila, SPAG, at kdavila@spag.org

Aging Infrastructure / Asset Management

5. Does your utility have higher than normal water use that could indicate leaks? Yes / No

6. Could your utility could benefit from financing? Yes / No

7. Would you be interested in low-interest loans from the TWDB, if available? Yes / No

8. Are your utility's meters manually or automatically read (through AMI)? Automated / Manual

Conservation

9. Has your utility found it difficult to implement water conservation efforts?

   If yes, please explain ____

10. Is public awareness / buy-in for water conservation a problem for your utility? Yes / No

11. Does your utility have difficulty in balancing revenue vs. water conservation? Yes / No

Water Management Strategies

12. Please indicate potential, future sources of water supply for your utility and indicate if these are being actively pursued or are only being considered, check those that apply.

Strategy	Considered	Actively Being Pursued
______________________________	☐	☐
______________________________	☐	☐
______________________________	☐	☐

Water User Group (WUG) Information Verification Survey

Drought Response Measures

13. How has your utility prepared for future drought conditions? (Check all that apply)

_____ Adoption of Safe Yield as a basis for supply

_____ Emergency Connections

_____ Supply System Redundancy

_____ Implementation of drought plan/water restrictions

_____ Other (please specify): ____

14. Do you have a Drought Contingency Plan? Yes / No

If yes, who is responsible for implementing the Plan? _______________________________________

15. Please send a copy of your utility's Drought Contingency Plan to Kelly Davila, SPAG, at kdavila@spag.org

Emergency Water Use Connections

16. Does your utility currently have emergency water supply connections? Yes / No

If yes, with whom? ____

If no, what provisions does your utility take in case of emergency water supply needs?

____

If no, is your utility pursuing opportunities to develop emergency connections? Yes / No

If yes, with whom? ____

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H

Model Drought Contingency Plans

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Region O Model
Drought Contingency Plan
For a Small (population less than 15,000)
Retail Public Water Supplier
Sole Source Local Groundwater

Disclaimer: The following form is a model drought contingency plan for a retail public water supplier with a sole water source from groundwater that was developed by the Region O regional water planning group as a part of the 2016 regional water planning process. This model is supplied for your convenience as a template and includes more than the state requires. Not all items may apply to your utility's situation, but this template may be modified as needed to address your specific issues. At a minimum the red text portions of this model plan should be thoroughly reviewed and updated with appropriate information for your utility. Your utility will be responsible for making sure that your completed drought contingency plan is approved by the Texas Commission on Environmental Quality (TCEQ).

____
(Name of Utility)

____
(Address, City, Zip Code)

____
(CCN#)

____
(PWS #s)

____
(Date)

Section I: Declaration of Policy, Purpose, and Intent

In order to conserve the available water supply and protect the integrity of water supply facilities—with particular regard for domestic water use, sanitation, and fire protection—and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, the (name of water supplier) hereby adopts the following regulations and restrictions on the delivery and consumption of water through an ordinance and/or resolution (cite or attach ordinance/or resolution).

Water uses regulated or prohibited under this Drought Contingency Plan (the Plan) are considered to be non-essential, and continuation of such uses during times of water shortage or other emergency water supply condition are deemed to constitute a waste of water that subjects the offender(s) to penalties as defined in Section XI of this Plan.

Section II: Public Involvement

Opportunity for the public to provide input into the preparation of the Plan was provided by the (name of water supplier) by means of (describe methods used to inform the public about the preparation of the plan and provide opportunities for input; *for example, scheduling and providing public notice of a public meeting to accept input on the Plan*).

Section III: Public Education

The (name of water supplier) will periodically provide the public with information about the Plan as developed under their continuing public education program along with information regarding this drought contingency plan. The drought information will include the conditions under which each stage of the Plan is to be initiated or terminated and the drought response measures to be implemented in each stage. This information will be provided by means of (describe methods to be used to provide information to the public about the Plan; *for example, public events, press releases or utility bill inserts*).

Section IV: Coordination with Regional Water Planning Groups

The service area of the (name of water supplier) is located within the Llano Estacado Regional Water Planning Group (Region O), and (name of water supplier) has provided a copy of this Plan to the Llano Estacado Regional Water Planning Group.

Section V: Authorization

The (designated official*; for example, the mayor, city manager, utility director, general manager, etc.*) or his/her designee is hereby authorized and directed to implement the applicable provisions of this Plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The (designated official) or his/her designee shall have the authority to initiate or terminate drought or other water supply emergency response measures as described in this Plan.

Section VI: Application

The provisions of this Plan shall apply to all persons, customers, and property utilizing water provided by the (name of water supplier). The terms "person" and "customer" as used in the Plan include individuals, corporations, partnerships, associations, and all other legal entities.

Section VII: Definitions

For the purposes of this Plan, the following definitions shall apply:

Aesthetic water use: water use for ornamental or decorative purposes such as fountains, reflecting pools, and water gardens.

Commercial and institutional water use: water use that is integral to the operations of commercial and non-profit establishments and governmental entities such as retail establishments, hotels and motels, restaurants, and office buildings.

Conservation: those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a supply is conserved and made available for future or alternative uses.

Customer: any person, company, or organization using water supplied by (name of water supplier).

Domestic water use: water use for personal needs or for household or sanitary purposes such as drinking, bathing, heating, cooking, sanitation, or for cleaning a residence, business, industry, or institution.

Even-numbered address: street addresses, box numbers, or rural postal route numbers ending in 0, 2, 4, 6, or 8 and locations without addresses.

Firm system capacity: the system delivery capacity with the largest single water well or production unit out of service.

Industrial water use: the use of water in processes designed to convert materials of lower value into forms having greater usability and value.

Landscape irrigation use: water used for the irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns, gardens, golf courses, parks, and rights-of-way and medians.

Non-essential water use: water uses that are not essential nor required for the protection of public, health, safety, and welfare, including:

(a) irrigation of landscape areas, including parks, athletic fields, and golf courses, except as otherwise provided under this Plan;
(b) use of water to wash any motor vehicle, motorbike, boat, trailer, airplane, or other vehicle;
(c) use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
(d) use of water to wash down buildings or structures for purposes other than immediate fire protection;
(e) flushing of gutters or permitting water to run or accumulate in any gutter or street;
(f) use of water to fill, refill, or add to any indoor or outdoor swimming pools or Jacuzzi-type pools;
(g) use of water in a fountain or pond for aesthetic or scenic purposes except where necessary to support aquatic life;

(h) failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s); and
(i) use of water from hydrants for construction purposes or any other purposes other than fire fighting.

Odd-numbered address: street addresses, box numbers, or rural postal route numbers ending in 1, 3, 5, 7, or 9.

Total system peak capacity: the maximum system delivery capacity with all water wells and production units in service.

Section VIII: Criteria for Initiation and Termination of Drought Response Stages
The (designated official) or his/her designee shall monitor water supply and/or demand conditions on a daily basis and shall determine when conditions warrant initiation or termination of each stage of the Plan, that is, when the specified "triggers" are reached.

The triggering criteria described below are based on state and local regulation, pertaining to the water supplied by city wells and the water system capacity, and analysis of the vulnerability of the water source under drought of record conditions.

Drought Response Triggers

Stage 1 Triggers — MILD Water Shortage Conditions

Requirements for initiation
Customers shall be requested to voluntarily conserve water and adhere to the prescribed restrictions on certain water uses, defined in Section VII-Definitions, when:

- *Weather conditions, time of year and system pressures indicate that a mild drought condition exists.*
- *The daily water use exceeds 75 percent of the total system peak capacity for 10 consecutive days.*
- *The static water level in the (name of water supplier) well(s) is more than xxx feet below the measuring point.*
- *The total daily water demand equals or exceeds xxx million gallons for 10 consecutive days.*

The public water supplier may devise other triggering criteria that are tailored to its system.

Requirements for termination
Stage 1 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of 5 consecutive days.

Stage 2 Triggers — MODERATE Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses provided in Section IX of this Plan when:

- *The daily water use exceeds 85 percent of the total system peak capacity for 10 consecutive days.*
- *The static water level in the (name of water supplier) well(s) is more than xxx feet below the measuring point.*
- *The total daily water demand equals or exceeds xxx million gallons for 10 consecutive days.*

The public water supplier may devise other triggering criteria that are tailored to its system.

Requirements for termination
Stage 2 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of 5 consecutive days. Upon termination of Stage 2, Stage 1 restrictions will apply.

Stage 3 Triggers — SEVERE Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 3 of this Plan when:

- *The daily water use exceeds 95 percent of the total system peak capacity for 5 consecutive days.*
- *The static water level in the (name of water supplier) well(s) is more than xxx feet below the measuring point.*
- *The total daily water demand equals or exceeds xxx million gallons for 5 consecutive days.*

The public water supplier may devise other triggering criteria that are tailored to its system.

Requirements for termination
Stage 3 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of 3 consecutive days. Upon termination of Stage 3, Stage 2 restrictions will apply.

Stage 4 Triggers — CRITICAL Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 4 of this Plan when:

- *Water demand exceeds the firm system capacity for 5consecutive days. As a result, supply cannot keep up with demand, and primary wells or storage facilities do not recover sufficiently to allow for continued pumping into the system.*

The public water supplier may devise other triggering criteria that are tailored to its system.

Requirements for termination
Stage 4 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of 3 consecutive days. Upon termination of Stage 4, Stage 3 restrictions will apply.

Stage 5 Triggers — EMERGENCY Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions for Stage 5 of this Plan when (designated official) or his/her designee determines that a water supply emergency exists based on:

- Major water line breaks or pump or system failures that cause unprecedented loss of capability to provide water service; ***or***

- Natural or man-made contamination of the water supply source(s).

Requirements for termination
Stage 5 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of 3 consecutive days. Upon termination of Stage 5, Stage 4 restrictions will apply.

Stage 6 Triggers — WATER ALLOCATION

Note: The inclusion of WATER ALLOCATION as part of a drought contingency plan may not be required in all cases. For example, for a given water supplier, an analysis of water supply availability under drought of record conditions may indicate that there is essentially no risk of water supply shortage. Hence, a drought contingency plan for such a water supplier might only address facility capacity limitations and emergency conditions (e.g., supply source contamination and system capacity limitations).

Requirements for initiation
Customers shall be required to comply with the water allocation plan prescribed in Section IX of this Plan and comply with the requirements and restrictions for Stage 6 of this Plan when:

- *Water demand exceeds the firm system capacity for more than 10 consecutive days despite the restrictions in place under Stage 5. As a result, supply cannot keep up with demand, and primary wells or storage facilities do not recover sufficiently to allow for continued pumping into the system.*

Requirements for termination
The water allocation plan prescribed in Section IX may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of 3 consecutive days. Upon termination of Stage 6, Stage 5 restrictions will apply.

Section IX: Drought Response Stages
The (designated official), or his/her designee, shall monitor water supply and/or demand conditions on a daily basis and, in accordance with the triggering criteria set forth in Section VIII of this Plan, shall determine that a mild, moderate, severe, critical, emergency, or water allocation condition exists and shall implement the following notification procedures:

Drought Response Notification

Notification of the Public:
The (designated official) or his/ her designee shall notify the public by means of:

- *publication in a newspaper of general circulation;*
- *direct mail to each customer;*
- *public service announcements;*
- *signs posted in public places; and/or*
- *take-home fliers at schools.*

Additional Notification:
The (designated official) or his/ her designee shall notify directly, or cause to be notified directly, the following individuals and entities:

- *Mayor / Chairman and members of the City Council / Utility Board*
- *Fire Chief(s)*
- *City and/or County Emergency Management Coordinator(s)*
- *County Judge and Commissioner(s)*
- *State Disaster District / Department of Public Safety*
- *TCEQ (required when mandatory restrictions are imposed or when going to a less restrictive stage)*
- *Major water users*

- *Critical water users (e.g., hospitals)*
- *Parks / street superintendents and public facilities managers*

Note: The plan should specify direct notice only as appropriate to respective drought stages.

Drought Responses

Stage 1 Response — MILD Water Shortage Conditions

Target: Achieve a voluntary 10 percent reduction in daily water demand.

Best Management Practices for Supply Management:
Describe measures, if any, to be implemented directly by (name of water supplier) to manage limited water supplies and/or reduce water demand. Examples include:

- *Reduction of flushing of water mains (if more than required monthly frequency).*
- *Reduction of watering in public landscaped areas (e.g., parks).*
- *Reduction of water usage during fire training exercises.*
- *Activation and use of an alternative supply source(s).*

Voluntary Water Use Restrictions for Reducing Demand:

(a) Water customers are requested to voluntarily limit the irrigation of landscaped areas to Sundays and Thursdays for water customers with an even-numbered address and Saturdays and Wednesdays for water customers with an odd-numbered address, and to irrigate landscapes only between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight on designated watering days.

(b) All operations of the (name of water supplier) shall adhere to water use restrictions prescribed for Stage 2 of the Plan.

(c) Water customers are requested to practice water conservation and to minimize or discontinue water use for non-essential purposes.

Stage 2 Response — MODERATE Water Shortage Conditions

Target: Achieve a 25 percent reduction in daily water demand.

Best Management Practices for Supply Management:
Describe additional measures, if any, to be implemented directly by (name of water supplier) to manage limited water supplies and/or reduce water demand. Examples include:

- *Temporary discontinuation of flushing of water mains except for monthly flushing.*
- *Temporary discontinuation of watering in public landscaped areas (e.g., parks).*
- *Use of an alternative supply source(s).*
- *Use of reclaimed water for non-potable purposes.*

Mandatory Water Use Restrictions for Demand Reduction:
Under threat of penalty for violation, the following water use restrictions shall apply to all persons:

(a) Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to Sundays or Thursdays for customers with an even-numbered address and Saturdays or Wednesdays for water customers with an odd-numbered address, and irrigation of landscaped areas is further limited to the hours from 12:00 midnight until 10:00 a.m. and from 8:00 p.m. to 12:00 midnight on designated watering days. However, irrigation of landscaped areas is permitted at any time if it is by means of a hand-held hose, a faucet-filled bucket or watering can of 5 gallons or less, or a drip irrigation system.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is prohibited except between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight on designated watering days. Such washing, when allowed, shall be done with a hand-held bucket or a hand-held hose equipped with a positive shutoff nozzle for quick rinses. Vehicle washing may be done at any time on the immediate premises of a commercial car wash or commercial service station. Further, such washing may be exempted from these regulations if the health, safety, and welfare of the public is contingent upon frequent vehicle cleansing, such as garbage trucks and vehicles used to transport food and perishables.

(c) Use of water to fill, refill, or add to any indoor or outdoor swimming pools, wading pools, or Jacuzzi-type pools is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight.

(d) Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system.

(e) Use of water from hydrants shall be limited to firefighting-related activities or other activities necessary to maintain public health, safety, and welfare, except that use of water from designated fire hydrants for construction purposes may be allowed under special permit from the (name of water supplier).

(f) Use of water for the irrigation of golf course greens, tees, and fairways is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight. If the golf course utilizes a water source other than that provided by the (name of water supplier), the facility shall not be subject to these regulations.

(g) All restaurants are prohibited from serving water to patrons except upon request of the patron.

(h) The following uses of water are defined as non-essential and are prohibited:

1. Wash down of any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
2. Use of water to wash down buildings or structures for purposes other than immediate fire protection;
3. Use of water for dust control (with the exception of non-potable water);
4. Flushing of gutters or permitting water to run or accumulate in any gutter or street; and
5. Failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s).

Stage 3 Response — SEVERE Water Shortage Conditions

Target: Achieve a 50 percent reduction in daily water demand.

Best Management Practices for Supply Management:
Describe additional measures, if any, to be implemented directly by (name of water supplier) to manage limited water supplies and/or reduce water demand. Examples include:

- *Reduce flushing of water mains to when required only.*
- *Cease watering in public landscaped areas (e.g., city parks).*
- *Cease use of water for fire training.*

Mandatory Water Use Restrictions for Demand Reduction:
All requirements of Stage 2 shall remain in effect during Stage 3 with the following additional restrictions:

(a) Irrigation of landscaped areas shall be limited to one designated watering day per two week period (based on address number) between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight and shall be by means of hand-held hoses, hand-held buckets, drip irrigation, or permanently installed automatic sprinkler system only. The use of hose-end sprinklers is prohibited at all times.

(b) The watering of golf course tees is prohibited unless the golf course utilizes a water source other than that provided by the (name of water supplier).

(c) The use of water for construction purposes from designated fire hydrants under special permit is prohibited.

(d) The filling, refilling, or adding of water to swimming pools, wading pools, and Jacuzzi-type pools is prohibited.

Stage 4 Response — CRITICAL Water Shortage Conditions

<u>Target</u>: Achieve a 75 percent reduction in daily water demand.

<u>Best Management Practices for Supply Management</u>:
Describe additional measures, if any, to be implemented directly by (name of water supplier) to manage limited water supplies and/or reduce water demand. Examples include:

- *Minimize unnecessary water uses in and around the system.*
- *Monitor progress of actions.*
- *Prohibit outside water use.*

<u>Mandatory Water Use Restrictions for Reducing Demand</u>:
All requirements of Stage 2 and 3 shall remain in effect during Stage 4 with the following additional restrictions:

(a) Irrigation of landscaped areas shall be limited to the hours between 6:00 a.m. and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight on one designated watering day per month (based on address number) and shall be by means of hand-held hoses, hand-held buckets, or drip irrigation only. The use of hose-end sprinklers or permanently installed automatic sprinkler systems are prohibited at all times.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle not occurring on the premises of a commercial car wash and commercial service stations and not in the immediate interest of public health, safety, and welfare is prohibited. Further, such vehicle washing at commercial car washes and commercial service stations shall occur only between the hours of 6:00 a.m. and 10:00 a.m. and between 6:00 p.m. and 10:00 p.m.

(c) No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved, and time limits for approval of such applications are hereby suspended for such time as this drought response stage or a higher-numbered stage shall be in effect.

Stage 5 Response — EMERGENCY Water Shortage Conditions

<u>Target</u>: Achieve a 90 percent reduction in daily water demand.

<u>Best Management Practices for Supply Management</u>:
Describe additional measures, if any, to be implemented directly by (name of water supplier) to manage limited water supplies and/or reduce water demand. Examples include:

- *Eliminate all unnecessary water uses in and around the system.*
- *Limit water use by fire department to firefighting only.*

Mandatory Water Use Restrictions for Reducing Demand:
All requirements of Stage 2, 3, and 4 shall remain in effect during Stage 5 with the following additional restrictions:

(a) Irrigation of landscaped areas is absolutely prohibited.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is absolutely prohibited.

Stage 6 Response — WATER ALLOCATION

Note: The drought contingency plan must include specific, quantified targets for water use reductions to be achieved during periods of water shortage and drought. The entity preparing the plan shall establish the targets. The goals established by the entity under this subparagraph for WATER ALLOCATION are not enforceable.

In the event that water shortage conditions threaten public health, safety, and welfare, the (designated official) is hereby authorized to allocate water according to the following water allocation plan:

Single-Family Residential Customers

The allocation to residential water customers residing in a single-family dwelling shall be as follows:

Persons per Household	Gallons per Month
1 or 2	6,000
3 or 4	7,000
5 or 6	8,000
7 or 8	9,000
9 or 10	10,000
11 or more	12,000

"Household" means the residential premises served by the customer's meter. "Persons per household" include only those persons currently physically residing at the premises and expected to reside there for the entire billing period. It shall be assumed that a particular customer's household is comprised of 2 persons unless the customer notifies the (name of water supplier) of a greater number of persons per household on a form prescribed by the (designated official). The (designated official) shall give his/her best effort to see that such forms are mailed, otherwise provided, or made available to every residential customer. If, however, a customer does not receive such a form, it shall be the customer's responsibility to go to the (name of water supplier) offices to complete and sign the form claiming more than 2 persons per household.

New customers may claim more persons per household at the time of applying for water service on the form prescribed by the (designated official). When the number of persons per household increases so as to place the customer in a different allocation category, the customer may notify the (name of water supplier) on such form and the change will be implemented in the next practicable billing period. If the number of persons in a household is reduced, the customer shall notify the (name of water supplier) in writing within 2 days.

In prescribing the method for claiming more than 2 persons per household, the (designated official) shall adopt methods to ensure the accuracy of the claim. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of persons in a household or fails to timely notify the (name of water supplier) of a reduction in the number of person in a household shall be fined not less than $25.00.

Residential water customers shall pay the following surcharges:

- $10.00 for the first 1,000 gallons over allocation.
- $25.00 for the second 1,000 gallons over allocation.
- $50.00 for the third 1,000 gallons over allocation.
- $75.00 for each additional 1,000 gallons over allocation.

Surcharges shall be cumulative.

Master-Metered Multi-Family Residential Customers

The allocation to a customer billed from a master meter that jointly measures water to multiple permanent residential dwelling units (e.g., apartments, mobile homes) shall be allocated 6,000 gallons per month for each dwelling unit. It shall be assumed that such a customer's meter serves two dwelling units unless the customer notifies the (name of water supplier) of a greater number on a form prescribed by the (designated official). The (designated official) shall give his/her best effort to see that such forms are mailed, otherwise provided, or made available to every such customer. If, however, a customer does not receive such a form, it shall be the customer's responsibility to go to the (name of water supplier) offices to complete and sign the form claiming more than 2 dwellings. A dwelling unit may be claimed under this provision whether it is occupied or not.

New customers may claim more dwelling units at the time of applying for water service on the form prescribed by the (designated official). If the number of dwelling units served by a master meter is reduced, the customer shall notify the (name of water supplier) in writing within 2 days.

In prescribing the method for claiming more than 2 dwelling units, the (designated official) shall adopt methods to ensure the accuracy of the claim. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of dwelling units served by a master meter or fails to timely notify the (name of water supplier) of a reduction in the number of person in a household shall be fined not less than $25.00.

Customers billed from a master meter under this provision shall pay the following monthly surcharges:

- $10.00 for the first 1,000 gallons over allocation.
- $25.00 for the second 1,000 gallons over allocation.
- $50.00 for the third 1,000 gallons over allocation.
- $75.00 for each additional 1,000 gallons over allocation.

Surcharges shall be cumulative.

Commercial Customers

A monthly water allocation shall be established by the (designated official), or his/her designee, for each non-residential commercial customer other than an industrial customer who uses water for processing purposes. A non-residential customer whose monthly usage is less than 5,000 gallons shall be allocated 5,000 gallons. For non-residential customers with higher monthly usage, the allocation shall be approximately 75 percent of the customer's usage for the corresponding month's billing period during the previous 12 months. If the customer's billing history is shorter than 12 months, the monthly average for the period for which there is a record shall be used for any monthly period for which no history exists. The (designated official) shall give his/her best effort to see that notice of each non-residential customer's allocation is mailed to such customer. If, however, a customer does not receive such notice, it shall be the customer's responsibility to contact the (name of water supplier) to determine the allocation.

Upon request of the customer or at the initiative of the (designated official), the allocation may be reduced or increased if (1) the designated period does not accurately reflect the customer's normal water usage, (2) one non-residential customer agrees to transfer part of its allocation to another non-residential customer, or (3) other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the (designated official, or alternatively, a special water allocation review committee).

Non-residential commercial customers shall pay the following surcharges:

- $10.00 for the first 1,000 gallons over allocation.
- $25.00 for the second 1,000 gallons over allocation.
- $75.00 for the third 1,000 gallons over allocation.

- $100.00 for each additional 1,000 gallons over allocation.

The surcharges shall be cumulative.

Industrial Customers

A monthly water allocation shall be established by the (designated official), or his/her designee, for each industrial customer that uses water for processing purposes. The industrial customer's allocation shall be approximately 90 percent of the customer's water usage baseline. Ninety (90) days after the initial imposition of the allocation for industrial customers, the industrial customer's allocation shall be further reduced to 85 percent of the customer's water usage baseline. The industrial customer's water use baseline will be computed on the average water use for the 12 month period ending prior to the date of implementation of Stage 2 of the Plan. If the industrial water customer's billing history is shorter than 12 months, the monthly average for the period for which there is a record shall be used for any monthly period for which no billing history exists. The (designated official) shall give his/her best effort to see that notice of each industrial customer's allocation is mailed to such customer. If, however, a customer does not receive such notice, it shall be the customer's responsibility to contact the (name of water supplier) to determine the allocation, and the allocation shall be fully effective notwithstanding the lack of receipt of written notice.

Upon request of the customer or at the initiative of the (designated official), the allocation may be reduced or increased if (1) the designated period does not accurately reflect the customer's normal water use because the customer had shut down a major processing unit for repair or overhaul during the period, (2) the customer has added or is in the process of adding significant additional processing capacity, (3) the customer has shut down or significantly reduced the production of a major processing unit, (4) the customer has previously implemented significant permanent water conservation measures such that the ability to further reduce water use is limited, (5) the customer agrees to transfer part of its allocation to another industrial customer, or (6) other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the (designated official, or alternatively, a special water allocation review committee). Industrial customers shall pay the following surcharges:

- $20.00 for the first 1,000 gallons over allocation.
- $50.00 for the second 1,000 gallons over allocation.
- $150.00 for the third 1,000 gallons over allocation.
- $200.00 for each additional 1,000 gallons over allocation.

The surcharges shall be cumulative.

Section X: Enforcement

(a) No person shall knowingly or intentionally allow the use of water from the (name of water supplier) for residential, commercial, industrial, agricultural, governmental, or any other purpose in a manner contrary to any provision of this Plan, or in an amount in excess of that permitted by the drought response stage in effect at the time pursuant to action taken by (designated official), or his/her designee, in accordance with provisions of this Plan.

(b) Any person who violates this Plan is guilty of a misdemeanor and upon conviction shall be punished by a fine of not less than $50.00 and not more than $500.00. Each day that one or more of the provisions in this Plan is violated shall constitute a separate offense. If a person is convicted of three or more distinct violations of this Plan, the (designated official) shall, upon due notice to the customer, be authorized to discontinue water service to the premises where such violations occur. Services discontinued under such circumstances shall be restored only upon payment of a reconnection charge, hereby established at $50.00, and any other costs incurred by the (name of water supplier) in discontinuing service. In addition, suitable assurance must be given to the (designated official) that the same action shall not be repeated while the Plan is in effect. Compliance with this plan may also be sought through injunctive relief in the district court.

(c) Any person, including a person classified as a water customer of the (name of water supplier), in apparent control of the property where a violation occurs or originates shall be presumed to be the violator, and proof that the violation occurred on the person's property shall constitute a rebuttable presumption that the person in apparent control of the property committed the violation; however, any such person shall have the right to show that he/she did not commit the violation. Parents shall be presumed to be responsible for violations of their minor children, and proof that a violation committed by a child occurred on property within the parents' control shall constitute a rebuttable presumption that the parent committed the violation; however, any such parent may be excused if he/she proves that he/she had previously directed the child not to use the water as it was used in violation of this Plan and that the parent could not have reasonably known of the violation.

(d) Any employee of the (name of water supplier), police officer, or other City employee designated by the (designated official) may issue a citation to a person he/she reasonably believes to be in violation of this Ordinance. The citation shall be prepared in duplicate and shall contain the name and address of the alleged violator, if known, and the offense charged, and shall direct him/her to appear in the municipal court or local equivalent on the date shown on the citation, which shall not be less than 3 days nor more than 5 days from the date the citation was issued. The alleged violator shall be served a copy of the citation. Service of the citation shall be complete upon delivery of the citation to the alleged violator, to an agent or employee of a violator, or to a person over 14 years of age who is a member of the violator's immediate family or is a resident of the violator's residence. The alleged violator shall appear in municipal court or local equivalent to enter a plea of guilty or not guilty for the violation of this Plan. If the alleged violator fails to appear in municipal court or local equivalent, a warrant for his/her arrest may be issued. A summons to appear may be issued in lieu of an arrest warrant. These cases shall be expedited and given preferential setting in municipal court or local equivalent before all other cases.

Section XI: Variances

The (designated official), or his/her designee, may, in writing, grant temporary variance for existing water uses otherwise prohibited under this Plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the health, sanitation, or fire protection for the public or the person requesting such variance and if one or more of the following conditions are met:

(a) Compliance with this Plan cannot be technically accomplished during the duration of the water supply shortage or other condition for which the Plan is in effect.

(b) Alternative methods can be implemented that will achieve the same level of reduction in water use.

Persons requesting an exemption from the provisions of this Ordinance shall file a petition for variance with the (name of water supplier) within 5 days after the Plan or a particular drought response stage has been invoked. All petitions for variances shall be reviewed by the (designated official), or his/her designee, and shall include the following:

(a) Name and address of the petitioner(s).
(b) Purpose of water use.
(c) Specific provision(s) of the Plan from which the petitioner is requesting relief.
(d) Detailed statement as to how the specific provision of the Plan adversely affects the petitioner or what damage or harm will occur to the petitioner or others if petitioner complies with this Ordinance.
(e) Description of the relief requested.
(f) Period of time for which the variance is sought.
(g) Alternative water use restrictions or other measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date.
(h) Other pertinent information.

Region O Model Drought Contingency Plan For a Midsize (population between 15,000 and 250,000) Retail Public Water Supplier Groundwater and Surface Water Sources

Disclaimer: The following form is a model drought contingency plan for a retail public water supplier with both groundwater and surface water sources that was developed by the Region O regional water planning group as a part of the 2016 regional water planning process. This model is supplied for your convenience as a template and includes more than the state requires. Not all items may apply to your utility's situation, but this template may be modified as needed to address your specific issues. At a minimum the red text portions of this model plan should be thoroughly reviewed and updated with appropriate information for your utility. Your utility will be responsible for making sure that your completed drought contingency plan is approved by the Texas Commission on Environmental Quality (TCEQ).

____

(Name of Utility)

____

(Address, City, Zip Code)

____

(CCN#)

____

(PWS #s)

____

(Date)

Section I: Declaration of Policy, Purpose, and Intent

In order to conserve the available water supply and protect the integrity of water supply facilities—with particular regard for domestic water use, sanitation, and fire protection—and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, the (name of water supplier) hereby adopts the following regulations and restrictions on the delivery and consumption of water through an ordinance and/or resolution (cite or attach ordinance/or resolution).

Water uses regulated or prohibited under this Drought Contingency Plan (the Plan) are considered to be non-essential, and continuation of such uses during times of water shortage or other emergency water supply condition are deemed to constitute a waste of water that subjects the offender(s) to penalties as defined in Section XI of this Plan.

Section II: Public Involvement

Opportunity for the public to provide input into the preparation of the Plan was provided by the (name of water supplier) by means of (describe methods used to inform the public about the preparation of the plan and provide opportunities for input; *for example, scheduling and providing public notice of a public meeting to accept input on the Plan*).

Section III: Public Education

The (name of water supplier) will periodically provide the public with information about the Plan as developed under their continuing public education program along with information regarding this drought contingency plan. The drought information will include the conditions under which each stage of the Plan is to be initiated or terminated and the drought response measures to be implemented in each stage. This information will be provided by means of (describe methods to be used to provide information to the public about the Plan; *for example, public events, press releases or utility bill inserts*).

Section IV: Coordination with Regional Water Planning Groups

The service area of the (name of water supplier) is located within the Llano Estacado Regional Water Planning Group (Region O), and (name of water supplier) has provided a copy of this Plan to the Llano Estacado Regional Water Planning Group.

Section V: Authorization

The (designated official*; for example, the mayor, city manager, utility director, general manager, etc.*) or his/her designee is hereby authorized and directed to implement the applicable provisions of this Plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The (designated official) or his/her designee shall have the authority to initiate or terminate drought or other water supply emergency response measures as described in this Plan.

Section VI: Application

The provisions of this Plan shall apply to all persons, customers, and property utilizing water provided by the (name of water supplier). The terms "person" and "customer" as used in the Plan include individuals, corporations, partnerships, associations, and all other legal entities.

Section VII: Definitions

For the purposes of this Plan, the following definitions shall apply:

<u>Aesthetic water use</u>: water use for ornamental or decorative purposes such as fountains, reflecting pools, and water gardens.

Commercial and institutional water use: water use that is integral to the operations of commercial and non-profit establishments and governmental entities such as retail establishments, hotels and motels, restaurants, and office buildings.

Conservation: those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water or increase the recycling and reuse of water so that a supply is conserved and made available for future or alternative uses.

Customer: any person, company, or organization using water supplied by (name of water supplier).

Domestic water use: water use for personal needs or for household or sanitary purposes such as drinking, bathing, heating, cooking, sanitation, or for cleaning a residence, business, industry, or institution.

Even-numbered address: street addresses, box numbers, or rural postal route numbers ending in 0, 2, 4, 6, or 8 and locations without addresses.

Firm system capacity: the system delivery capacity with the largest single water well or production unit out of service.

Industrial water use: the use of water in processes designed to convert materials of lower value into forms having greater usability and value.

Landscape irrigation use: water used for the irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns, gardens, golf courses, parks, and rights-of-way and medians.

Non-essential water use: water uses that are not essential nor required for the protection of public, health, safety, and welfare, including:

(a) irrigation of landscape areas, including parks, athletic fields, and golf courses, except as otherwise provided under this Plan;
(b) use of water to wash any motor vehicle, motorbike, boat, trailer, airplane, or other vehicle;
(c) use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
(d) use of water to wash down buildings or structures for purposes other than immediate fire protection;
(e) flushing of gutters or permitting water to run or accumulate in any gutter or street;
(f) use of water to fill, refill, or add to any indoor or outdoor swimming pools or Jacuzzi-type pools;
(g) use of water in a fountain or pond for aesthetic or scenic purposes except where necessary to support aquatic life;
(h) failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s); and

(i) use of water from hydrants for construction purposes or any other purposes other than fire fighting.

Odd-numbered address: street addresses, box numbers, or rural postal route numbers ending in 1, 3, 5, 7, or 9.

Total system peak capacity: the maximum system delivery capacity with all water wells and production units in service.

Section VIII: Criteria for Initiation and Termination of Drought Response Stages

The (designated official) or his/her designee shall monitor water supply and/or demand conditions on a daily basis and shall determine when conditions warrant initiation or termination of each stage of the Plan, that is, when the specified "triggers" are reached.

The triggering criteria described below are based on state and local regulation, pertaining to the water supplied by city wells, surface water reservoir levels, and the entire water system capacity, and analysis of the vulnerability of the available water sources under drought of record conditions.

Drought Response Triggers

Stage 1 Triggers — MILD Water Shortage Conditions

Requirements for initiation

Customers shall be requested to voluntarily conserve water and adhere to the prescribed restrictions on certain water uses, defined in Section VII-Definitions, when:

- *Weather conditions, time of year and system pressures indicate that a mild drought condition exists.*
- *Surface water reservoir storage capacity is between 70 and 80 percent.*
- *Surface water source is not able to supply entire demand and it is necessary to use groundwater supply.*
- *The daily water use exceeds 75 percent of the total system peak capacity for 10 consecutive days.*
- *The static water level in the (name of water supplier) well(s) is more than xxx feet below the measuring point.*
- *The total daily water demand equals or exceeds xxx million gallons for 10 consecutive days.*
- *Notification is received, pursuant to requirements specified in the (name of water supplier) wholesale water purchase contract with (name of wholesale water supplier), requesting initiation of Stage 1 of the Drought Contingency Plan.*
- *Treated water reservoir levels continue falling without refilling above xxx percent overnight (e.g., based on an evaluation of minimum treated water storage required to avoid system outage).*

The public water supplier may devise other triggering criteria that are tailored to its system.

Requirements for termination
Stage 1 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of 5 consecutive days.

Stage 2 Triggers — MODERATE Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses provided in Section IX of this Plan when:

- *The daily water use exceeds 85 percent of the total system peak capacity for 10 consecutive days.*
- *Surface water reservoir storage capacity is between 50 and 69 percent.*
- *Surface water source is not able to supply entire demand and it is necessary to use groundwater supply.*
- *The static water level in the (name of water supplier) well(s) is more than xxx feet below the measuring point.*
- *The total daily water demand equals or exceeds xxx million gallons for 10 consecutive days.*
- *Notification is received, pursuant to requirements specified in the (name of water supplier) wholesale water purchase contract with (name of wholesale water supplier), requesting initiation of Stage 2 of the Drought Contingency Plan.*
- *Treated water reservoir levels continue falling without refilling above xxx percent overnight (e.g., based on an evaluation of minimum treated water storage required to avoid system outage).*

The public water supplier may devise other triggering criteria that are tailored to its system.

Requirements for termination
Stage 2 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of 5 consecutive days. Upon termination of Stage 2, Stage 1 restrictions will apply.

Stage 3 Triggers — SEVERE Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 3 of this Plan when:

- *The daily water use exceeds 95 percent of the total system peak capacity for 5 consecutive days.*
- *Surface water reservoir storage capacity is between 30 and 49 percent.*

- *Surface water source is not able to supply entire demand and it is necessary to use groundwater supply.*
- *The static water level in the (name of water supplier) well(s) is more than xxx feet below the measuring point.*
- *The total daily water demand equals or exceeds xxx million gallons for 5 consecutive days.*
- *Notification is received, pursuant to requirements specified in the (name of water supplier) wholesale water purchase contract with (name of wholesale water supplier), requesting initiation of Stage 3 of the Drought Contingency Plan.*
- *Treated water reservoir levels continue falling without refilling above xxx percent overnight (e.g., based on an evaluation of minimum treated water storage required to avoid system outage).*

The public water supplier may devise other triggering criteria that are tailored to its system.

Requirements for termination
Stage 3 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of 3 consecutive days. Upon termination of Stage 3, Stage 2 restrictions will apply.

Stage 4 Triggers — CRITICAL Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 4 of this Plan when:

- *Surface water reservoir storage capacity is between 20 and 29 percent. Termination of surface water reservoir water supply source will be initiated when the reservoir capacity drops below 15 percent.*
- *Water demand exceeds the firm system capacity for 5 consecutive days. As a result, supply cannot keep up with demand and primary wells or storage facilities do not recover sufficiently to allow for continued pumping into the system.*

The public water supplier may devise other triggering criteria that are tailored to its system.

Requirements for termination
Stage 4 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of 3 consecutive days. Upon termination of Stage 4, Stage 3 restrictions will apply.

Stage 5 Triggers — EMERGENCY Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions for Stage 5 of this Plan when (designated official) or his/her designee determines that a water supply emergency exists based on:

- Major water line breaks or pump or system failures that cause unprecedented loss of capability to provide water service; ***or***

- Natural or man-made contamination of the water supply source(s).

Requirements for termination
Stage 5 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of 3 consecutive days. Upon termination of Stage 5, Stage 4 restrictions will apply.

Stage 6 Triggers — WATER ALLOCATION

Note: The inclusion of WATER ALLOCATION as part of a drought contingency plan may not be required in all cases. For example, for a given water supplier, an analysis of water supply availability under drought of record conditions may indicate that there is essentially no risk of water supply shortage. Hence, a drought contingency plan for such a water supplier might only address facility capacity limitations and emergency conditions (e.g., supply source contamination and system capacity limitations).

Requirements for initiation
Customers shall be required to comply with the water allocation plan prescribed in Section IX of this Plan and comply with the requirements and restrictions for Stage 6 of this Plan when:

- *Water demand exceeds the firm system capacity for more than 10 consecutive days despite the restrictions in place under Stage 5. As a result, supply cannot keep up with demand, and primary wells or storage facilities do not recover sufficiently to allow for continued pumping into the system.*

Requirements for termination
The water allocation plan prescribed in Section IX may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of 3 consecutive days. Upon termination of Stage 6, Stage 5 restrictions will apply.

Section IX: Drought Response Stages
The (designated official) or his/her designee, shall monitor water supply and/or demand conditions on a daily basis and, in accordance with the triggering criteria set forth in Section VIII of this Plan, shall determine that a mild, moderate, severe, critical, emergency, or water allocation condition exists and shall implement the following notification procedures:

Drought Response Notification

Notification of the Public
The (designated official) or his/ her designee shall notify the public by means of:

- *publication in a newspaper of general circulation;*
- *direct mail to each customer;*
- *public service announcements;*
- *signs posted in public places; and/or*
- *take-home fliers at schools.*

Additional Notification
The (designated official) or his/ her designee shall notify directly, or cause to be notified directly, the following individuals and entities:

- *Mayor / Chairman and members of the City Council / Utility Board*
- *Fire Chief(s)*
- *City and/or County Emergency Management Coordinator(s)*
- *County Judge and Commissioner(s)*
- *State Disaster District / Department of Public Safety*
- *TCEQ (required when mandatory restrictions are imposed or when going to a less restrictive stage)*
- *Major water users*
- *Critical water users (e.g., hospitals)*
- *Parks / street superintendents and public facilities managers*

Note: The plan should specify direct notice only as appropriate to respective drought stages.

Drought Responses

Stage 1 Response — MILD Water Shortage Conditions

Target: Achieve a voluntary 10 percent reduction in daily water demand.

Best Management Practices for Supply Management:
Describe measures, if any, to be implemented directly by (name of water supplier) to manage limited water supplies and/or reduce water demand. Examples include:
- *Reduction of flushing of water mains (if more than required monthly frequency).*
- *Reduction of watering in public landscaped areas (e.g., parks).*
- *Reduction of water usage during fire training exercises.*
- *Activation and use of an alternative supply source(s).*

Voluntary Water Use Restrictions for Reducing Demand:

(a) Water customers are requested to voluntarily limit the irrigation of landscaped areas to Sundays and Thursdays for water customers with an even-numbered address and Saturdays and Wednesdays for water customers with an odd-numbered address, and to irrigate landscapes only between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight on designated watering days.

(b) All operations of the (name of water supplier) shall adhere to water use restrictions prescribed for Stage 2 of the Plan.

(c) Water customers are requested to practice water conservation and to minimize or discontinue water use for non-essential purposes.

Stage 2 Response — MODERATE Water Shortage Conditions

Target: Achieve a 25 percent reduction in daily water demand.

Best Management Practices for Supply Management:
Describe additional measures, if any, to be implemented directly by (name of water supplier) to manage limited water supplies and/or reduce water demand. Examples include:

- *Temporary discontinuation of flushing of water mains except for monthly flushing.*
- *Temporary discontinuation of watering in public landscaped areas (e.g., parks).*
- *Use of an alternative supply source(s).*
- *Use of reclaimed water for non-potable purposes.*

Mandatory Water Use Restrictions for Demand Reduction:
Under threat of penalty for violation, the following water use restrictions shall apply to all persons:

(a) Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to Sundays or Thursdays for customers with an even-numbered address and Saturdays or Wednesdays for water customers with an odd-numbered address, and irrigation of landscaped areas is further limited to the hours from 12:00 midnight until 10:00 a.m. and from 8:00 p.m. to 12:00 midnight on designated watering days. However, irrigation of landscaped areas is permitted at any time if it is by means of a hand-held hose, a faucet filled bucket or watering can of 5 gallons or less, or a drip irrigation system.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane, or other vehicle is prohibited except between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight on designated watering days. Such washing, when allowed, shall be done with a hand-held bucket or a hand-held hose equipped with a positive shutoff nozzle for quick rinses. Vehicle washing may be done at any time on the immediate premises of a commercial car wash or commercial service station. Further, such washing may be exempted from these regulations if the health, safety, and welfare of the public is contingent upon frequent vehicle cleansing, such as garbage trucks and vehicles used to transport food and perishables.

(c) Use of water to fill, refill, or add to any indoor or outdoor swimming pools, wading pools, or Jacuzzi-type pools is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight.

(d) Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system.

(e) Use of water from hydrants shall be limited to firefighting-related activities or other activities necessary to maintain public health, safety, and welfare, except that use of water from designated fire hydrants for construction purposes may be allowed under special permit from the (name of water supplier).

(f) Use of water for the irrigation of golf course greens, tees, and fairways is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight. If the golf course utilizes a water source other than that provided by the (name of water supplier), the facility shall not be subject to these regulations.

(g) All restaurants are prohibited from serving water to patrons except upon request of the patron.

(h) The following uses of water are defined as non-essential and are prohibited:

1. Wash down of any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
2. Use of water to wash down buildings or structures for purposes other than immediate fire protection;
3. Use of water for dust control (with the exception of non-potable water);
4. Flushing of gutters or permitting water to run or accumulate in any gutter or street; and
5. Failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s).

Stage 3 Response — SEVERE Water Shortage Conditions

<u>Target</u>: Achieve a 50 percent reduction in daily water demand.

<u>Best Management Practices for Supply Management</u>:
Describe additional measures, if any, to be implemented directly by (name of water supplier) to manage limited water supplies and/or reduce water demand. Examples include:

- *Reduce flushing of water mains to when required only.*
- *Cease watering in public landscaped areas (e.g., city parks).*
- *Cease use of water for fire training.*

<u>Mandatory Water Use Restrictions for Demand Reduction</u>:
All requirements of Stage 2 shall remain in effect during Stage 3 with the following additional restrictions:

(a) Irrigation of landscaped areas shall be limited to one designated watering day per two week period (based on address number) between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight and shall be by means of hand-held hoses, hand-held buckets, drip irrigation, or permanently installed automatic sprinkler system only. The use of hose-end sprinklers is prohibited at all times.

(b) The watering of golf course tees is prohibited unless the golf course utilizes a water source other than that provided by the (name of water supplier).

(c) The use of water for construction purposes from designated fire hydrants under special permit is prohibited.

(d) The filling, refilling, or adding of water to swimming pools, wading pools, and Jacuzzi-type pools is prohibited.

Stage 4 Response — CRITICAL Water Shortage Conditions

<u>Target</u>: Achieve a 75 percent reduction in daily water demand.

<u>Best Management Practices for Supply Management</u>:
Describe additional measures, if any, to be implemented directly by (name of water supplier) to manage limited water supplies and/or reduce water demand. Examples include:

- *Minimize unnecessary water uses in and around the system.*
- *Monitor progress of actions.*
- *Prohibit outside water use.*

Mandatory Water Use Restrictions for Reducing Demand:
All requirements of Stage 2 and 3 shall remain in effect during Stage 4 with the following additional restrictions:

(a) Irrigation of landscaped areas shall be limited to the hours between 6:00 a.m. and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight on one designated watering day per month (based on address number) and shall be by means of hand-held hoses, hand-held buckets, or drip irrigation only. The use of hose-end sprinklers or permanently installed automatic sprinkler systems are prohibited at all times.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle not occurring on the premises of a commercial car wash and commercial service stations and not in the immediate interest of public health, safety, and welfare is prohibited. Further, such vehicle washing at commercial car washes and commercial service stations shall occur only between the hours of 6:00 a.m. and 10:00 a.m. and between 6:00 p.m. and 10:00 p.m.

(c) No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved, and time limits for approval of such applications are hereby suspended for such time as this drought response stage or a higher-numbered stage shall be in effect.

Stage 5 Response — EMERGENCY Water Shortage Conditions

Target: Achieve a 90 percent reduction in daily water demand.

Best Management Practices for Supply Management:
Describe additional measures, if any, to be implemented directly by (name of water supplier) to manage limited water supplies and/or reduce water demand. Examples include:

- *Eliminate all unnecessary water uses in and around the system.*
- *Limit water use by fire department to firefighting only.*

Mandatory Water Use Restrictions for Reducing Demand: All requirements of Stage 2, 3, and 4 shall remain in effect during Stage 5 with the following additional restrictions:

(a) Irrigation of landscaped areas is absolutely prohibited.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is absolutely prohibited.

Stage 6 Response -- WATER ALLOCATION

Note: The drought contingency plan must include specific, quantified targets for water use reductions to be achieved during periods of water shortage and drought. The entity preparing the plan shall establish the targets. The goals established by the entity under this subparagraph for WATER ALLOCATION are not enforceable.

In the event that water shortage conditions threaten public health, safety, and welfare, the (designated official) is hereby authorized to allocate water according to the following water allocation plan:

Single-Family Residential Customers

The allocation to residential water customers residing in a single-family dwelling shall be as follows:

Persons per Household	Gallons per Month
1 or 2	6,000
3 or 4	7,000
5 or 6	8,000
7 or 8	9,000
9 or 10	10,000
11 or more	12,000

"Household" means the residential premises served by the customer's meter. "Persons per household" include only those persons currently physically residing at the premises and expected to reside there for the entire billing period. It shall be assumed that a particular customer's household is comprised of 2 persons unless the customer notifies the (name of water supplier) of a greater number of persons per household on a form prescribed by the (designated official). The (designated official) shall give his/her best effort to see that such forms are mailed, otherwise provided, or made available to every residential customer. If, however, a customer does not receive such a form, it shall be the customer's responsibility to go to the (name of water supplier) offices to complete and sign the form claiming more than 2 persons per household.

New customers may claim more persons per household at the time of applying for water service on the form prescribed by the (designated official). When the number of persons per household increases so as to place the customer in a different allocation category, the customer may notify the (name of water supplier) on such form and the change will be implemented in the next practicable billing period. If the number of persons in a household is reduced, the customer shall notify the (name of water supplier) in writing within 2 days.

In prescribing the method for claiming more than 2 persons per household, the (designated official) shall adopt methods to ensure the accuracy of the claim. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of persons in a household or fails to timely notify the (name of water supplier) of a reduction in the number of person in a household shall be fined not less than $25.00.

Residential water customers shall pay the following surcharges:

- $10.00 for the first 1,000 gallons over allocation.
- $25.00 for the second 1,000 gallons over allocation.
- $50.00 for the third 1,000 gallons over allocation.
- $75.00 for each additional 1,000 gallons over allocation.

Surcharges shall be cumulative.

Master-Metered Multi-Family Residential Customers

The allocation to a customer billed from a master meter that jointly measures water to multiple permanent residential dwelling units (e.g., apartments, mobile homes) shall be allocated 6,000 gallons per month for each dwelling unit. It shall be assumed that such a customer's meter serves two dwelling units unless the customer notifies the (name of water supplier) of a greater number on a form prescribed by the (designated official). The (designated official) shall give his/her best effort to see that such forms are mailed, otherwise provided, or made available to every such customer. If, however, a customer does not receive such a form, it shall be the customer's responsibility to go to the (name of water supplier) offices to complete and sign the form claiming more than 2 dwellings. A dwelling unit may be claimed under this provision whether it is occupied or not.

New customers may claim more dwelling units at the time of applying for water service on the form prescribed by the (designated official). If the number of dwelling units served by a master meter is reduced, the customer shall notify the (name of water supplier) in writing within 2 days.

In prescribing the method for claiming more than 2 dwelling units, the (designated official) shall adopt methods to ensure the accuracy of the claim. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of dwelling units served by a master meter or fails to timely notify the (name of water supplier) of a reduction in the number of person in a household shall be fined not less than $25.00. Customers billed from a master meter under this provision shall pay the following monthly surcharges:

- $10.00 for the first 1,000 gallons over allocation.
- $25.00 for the second 1,000 gallons over allocation.
- $50.00 for the third 1,000 gallons over allocation.
- $75.00 for each additional 1,000 gallons over allocation.

Surcharges shall be cumulative.

Commercial Customers

A monthly water allocation shall be established by the (designated official), or his/her designee, for each non-residential commercial customer other than an industrial customer who uses water for processing purposes. A non-residential customer whose monthly usage is less than 5,000 gallons shall be allocated 5,000 gallons. For non-residential customers with higher monthly usage, the allocation shall be approximately 75 percent of the customer's usage for the corresponding month's billing period during the previous 12 months. If the customer's billing history is shorter than 12 months, the monthly average for the period for which there is a record shall be used for any monthly period for which no history exists. The (designated official) shall give his/her best effort to see that notice of each non-residential customer's allocation is mailed to such customer. If, however, a customer does not receive such notice, it shall be the customer's responsibility to contact the (name of water supplier) to determine the allocation.

Upon request of the customer or at the initiative of the (designated official), the allocation may be reduced or increased if (1) the designated period does not accurately reflect the customer's normal water usage, (2) one non-residential customer agrees to transfer part of its allocation to another nonresidential customer, or (3) other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the (designated official or alternatively, a special water allocation review committee).

Nonresidential commercial customers shall pay the following surcharges:

- Customers whose allocation is 1,000 gallons through 25,000 gallons per month:
  - $10.00 for the first 1,000 gallons over allocation.
  - $25.00 for the second 1,000 gallons over allocation.
  - $75.00 for the third 1,000 gallons over allocation.
  - $100.00 for each additional 1,000 gallons over allocation.

- Customers whose allocation is 25,000 gallons per month or more:
  - 1.50 times the block rate for each 1,000 gallons in excess of the allocation up through 5 percent above allocation.
  - 2.00 times the block rate for each 1,000 gallons from 5 percent through 10 percent above allocation.
  - 2.50 times the block rate for each 1,000 gallons from 10 percent through 15 percent above allocation.
  - 3.00 times the block rate for each 1,000 gallons more than 15 percent above allocation.

The surcharges shall be cumulative. As used herein, "block rate" means the charge to the customer per 1,000 gallons at the regular water rate schedule at the level of the customer's allocation.

Industrial Customers

A monthly water allocation shall be established by the (designated official), or his/her designee, for each industrial customer that uses water for processing purposes. The industrial customer's allocation shall be approximately 90 percent of the customer's water usage baseline. Ninety (90) days after the initial imposition of the allocation for industrial customers, the industrial customer's allocation shall be further reduced to 85 percent of the customer's water usage baseline. The industrial customer's water use baseline will be computed on the average water use for the 12 month period ending prior to the date of implementation of Stage 2 of the Plan. If the industrial water customer's billing history is shorter than 12 months, the monthly average for the period for which there is a record shall be used for any monthly period for which no billing history exists. The (designated official) shall give his/her best effort to see that notice of each industrial customer's allocation is mailed to such customer. If, however, a customer does not receive such notice, it shall be the customer's responsibility to contact the (name of water supplier) to determine the allocation, and the allocation shall be fully effective notwithstanding the lack of receipt of written notice.

Upon request of the customer or at the initiative of the (designated official), the allocation may be reduced or increased if (1) the designated period does not accurately reflect the customer's normal water use because the customer had shut down a major processing unit for repair or overhaul during the period, (2) the customer has added or is in the process of adding significant additional processing capacity, (3) the customer has shut down or significantly reduced the production of a major processing unit, (4) the customer has previously implemented significant permanent water conservation measures such that the ability to further reduce water use is limited, (5) the customer agrees to transfer part of its allocation to another industrial customer, or (6) other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the (designated official, or alternatively, a special water allocation review committee). Industrial customers shall pay the following surcharges:

- Customers whose allocation is 1,000 gallons through 25,000 gallons per month:
  - $20.00 for the first 1,000 gallons over allocation.
  - $50.00 for the second 1,000 gallons over allocation.
  - $150.00 or the third 1,000 gallons over allocation.
  - $200.00 for each additional 1,000 gallons over allocation.

- Customers whose allocation is 25,000 gallons per month or more:
  - 1.50 times the block rate for each 1,000 gallons in excess of the allocation up through 5 percent above allocation.

- 2.00 times the block rate for each 1,000 gallons from 5 percent through 10 percent above allocation.
- 2.50 times the block rate for each 1,000 gallons from 10 percent through 15 percent above allocation.
- 3.00 times the block rate for each 1,000 gallons more than 15 percent above allocation.

The surcharges shall be cumulative. As used herein, "block rate" means the charge to the customer per 1,000 gallons at the regular water rate schedule at the level of the customer's allocation.

Section X: Enforcement

(a) No person shall knowingly or intentionally allow the use of water from the (name of water supplier) for residential, commercial, industrial, agricultural, governmental, or any other purpose in a manner contrary to any provision of this Plan, or in an amount in excess of that permitted by the drought response stage in effect at the time pursuant to action taken by (designated official), or his/her designee, in accordance with provisions of this Plan.

(b) Any person who violates this Plan is guilty of a misdemeanor and, upon conviction shall be punished by a fine of not less than $50.00 and not more than $500.00. Each day that one or more of the provisions in this Plan is violated shall constitute a separate offense. If a person is convicted of three or more distinct violations of this Plan, the (designated official) shall, upon due notice to the customer, be authorized to discontinue water service to the premises where such violations occur. Services discontinued under such circumstances shall be restored only upon payment of a reconnection charge, hereby established at $50.00, and any other costs incurred by the (name of water supplier) in discontinuing service. In addition, suitable assurance must be given to the (designated official) that the same action shall not be repeated while the Plan is in effect. Compliance with this plan may also be sought through injunctive relief in the district court.

(c) Any person, including a person classified as a water customer of the (name of water supplier), in apparent control of the property where a violation occurs or originates shall be presumed to be the violator, and proof that the violation occurred on the person's property shall constitute a rebuttable presumption that the person in apparent control of the property committed the violation; however, any such person shall have the right to show that he/she did not commit the violation. Parents shall be presumed to be responsible for violations of their minor children, and proof that a violation committed by a child occurred on property within the parents' control shall constitute a rebuttable presumption that the parent committed the violation; however, any such parent may be excused if he/she proves that he/she had previously directed the child not to use the water as it was used in violation of this Plan and that the parent could not have reasonably known of the violation.

(d) Any employee of the (name of water supplier), police officer, or other City employee designated by the (designated official), may issue a citation to a person he/she reasonably believes to be in violation of this Ordinance. The citation shall be prepared in duplicate and shall contain the name and address of the alleged violator, if known, and the offense charged, and shall direct him/her to appear in the municipal court or local equivalent on the date shown on the citation, which shall not be less than 3 days nor more than 5 days from the date the citation was issued. The alleged violator shall be served a copy of the citation. Service of the citation shall be complete upon delivery of the citation to the alleged violator, to an agent or employee of a violator, or to a person over 14 years of age who is a member of the violator's immediate family or is a resident of the violator's residence. The alleged violator shall appear in municipal court or local equivalent to enter a plea of guilty or not guilty for the violation of this Plan. If the alleged violator fails to appear in municipal court or local equivalent, a warrant for his/her arrest may be issued. A summons to appear may be issued in lieu of an arrest warrant. These cases shall be expedited and given preferential setting in municipal court or local equivalent before all other cases.

Section XI: Variances

The (designated official), or his/her designee, may, in writing, grant temporary variance for existing water uses otherwise prohibited under this Plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the health, sanitation, or fire protection for the public or the person requesting such variance and if one or more of the following conditions are met:

(a) Compliance with this Plan cannot be technically accomplished during the duration of the water supply shortage or other condition for which the Plan is in effect.

(b) Alternative methods can be implemented that will achieve the same level of reduction in water use.

Persons requesting an exemption from the provisions of this Ordinance shall file a petition for variance with the (name of water supplier) within 5 days after the Plan or a particular drought response stage has been invoked. All petitions for variances shall be reviewed by the (designated official), or his/her designee, and shall include the following:

(a) Name and address of the petitioner(s).
(b) Purpose of water use.
(c) Specific provision(s) of the Plan from which the petitioner is requesting relief.
(d) Detailed statement as to how the specific provision of the Plan adversely affects the petitioner or what damage or harm will occur to the petitioner or others if petitioner complies with this Ordinance.
(e) Description of the relief requested.
(f) Period of time for which the variance is sought.
(g) Alternative water use restrictions or other measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date.
(h) Other pertinent information.

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Protection of Springs and Seeps

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Appendix I: Protection of Springs and Seeps

The Llano Estacado Regional Water Planning Group (LERWPG) supports the voluntary protection of **springs and seeps** as they exist within the region and encourages landowners to use best management practices (BMPs) to protect and maintain these important water resources for not only their practical value for livestock and wildlife, but as aesthetic resources as well**.** As addressed in past Llano Estacado Region water plans, there are some remnant springs and seeps across the region that can experience renewed flow in instances of strong rainfall such as in the spring and early summer of 2019 and in 2023.

A key to the continued life of springs and seeps in the Southern Plains region—and to the continued useful life of the Ogallala Aquifer itself—is maintaining soil health on both farmlands and rangelands across the breadth of the Llano Estacado Region. This is a voluntary measure on the part of landowners, but where soil health is sufficient for the maintenance of improved organic matter in the soil, the ability of the soil to absorb water is greatly enhanced. For example, on a *No-Till On the Plains* tour during the summer of 2019, a demonstration near Milo Center, north of Hereford, revealed that soil that had been under no-till farming for 12 years had rainfall infiltration of 20 inches plus per hour. In comparison, conventionally tilled cotton land nearby had infiltration of only 0.5 inch per hour.

Some would argue that a high rate of rainfall infiltration is not possible to store in soils common in the Llano Estacado Region. Gregory F. Scott of Tryon, Oklahoma, Soil Scientist, Geomorphologist and Oklahoma Certified Soil Profiler #SP081, performed the infiltration test on the Carlson farm at Milo Center. He was surprised at how soils in the Great Plains respond to no-till. Scott explains that there are so many variables that each farm and each field must be considered individually. Clay soils often have more potential to recover than loamy soils. If the clay minerals are the 2:1 swelling type, they will open up with wetting and drying cycles through the years. As long as the soil structure is not destroyed with tillage, there can be many permanent cracks at the surface that create high infiltration rates.

Scott confirmed his test findings at Milo Center and that clayey soils in some areas of the Llano Estacado Region are capable of high rates of rainfall infiltration. He says soil cannot hold more than some maximum value, but that maximum value can also change over time, as organic matter increases, bulk density decreases, and deep macro-pores develop. The variability will be high across the area.

Scott cites that clay soil that has built up structure and receives a large rain event is capable of high infiltration rates. If the soil has numerous cracks, "we can fill that jug from the bottom up." Infiltration might be more than the soil can hold against gravity with surface tension, and some of the water would be expected to escape below the root zone to eventually recharge the water table.

Scott explains, "I have *already* decided how to use my water before it rains. If I have a healthy soil with good infiltration, I will use my water for plant growth (soil storage), base flow (water that gets to creeks or ultimately to springs in a short time, weeks to months), and aquifer recharge. Yes, there is a maximum the soil will hold, but if I get more than the maximum into the soil, I can use it in other beneficial ways. On the High Plains, a huge rainfall event will have runoff on any soil, but clean runoff going to a playa will create recharge."

Conversely, Scott said “If I have an unhealthy soil, my water will be used minimally for plant growth, and 50 to 80 percent will be flood runoff, not beneficial, with sediment loss, nutrient loss, pesticide movement, and loss of plant growth. Much of that silt may flow to playas or springs and is not going to properly recharge.”

With improved soil structure, more water goes in the soil, and the way the soil holds water changes. Greatly enhanced infiltration due to high soil organic matter can mean that large quantities of water could be safely stored within the soil profile for later use by plants, as a source of recharge to the aquifer, and as an enhancement to spring flow.

A rancher from the area west of the Muleshoe National Wildlife Refuge in Bailey County reported that flow returned to seven springs on that property given good soil management of native grass grazing lands and the control of water-robbing salt cedar on the property. This has occurred in relatively recent times in country that would seem unlikely for such renewal of spring flow.

Lacy Cotter Vardeman, manager of ranchland west of the Muleshoe National Wildlife Refuge in Bailey County, reports “We have had 13 springs come back around Monument Lake. They are not huge, but they are enough that you see them in the setting sun and the spring flow keeps it boggy enough that you cannot drive across the area.” She attributes these springs coming back to control of salt cedar and judicious grazing management.

Saline wetlands associated with the Ogallala Aquifer came into focus for participants in a Stewarding Our Aquifer Field Day, staged May 18, 2023, in Pep, Texas, that included a field trip to Silver Lake (Laguna Quemado) in Hockley County on land managed by Stan Aycock. A flowing spring was viewed at the site.

Jude Smith, Refuge Complex Manager of the Muleshoe, Buffalo Lake, and Grulla wildlife refuges explained that vigilant salt cedar control and good grassland management are vital factors in restored spring flow.

“We have a return of springs on the Muleshoe Refuge after a strong effort at controlling salt cedar. Springs are also returning on the Buffalo Lake Refuge, at Umbarger, and in fact, are producing enough water to hold waterfowl on the southern end of the refuge. We have had an ongoing effort of salt cedar control that is showing results in return of spring flow,” he said.

Salt cedar is a pervasive thief of water, with individual plants grabbing up to 200 gallons per day. Small wonder its control gives withered springs a new chance.

Smith reports that in recent years, inflow from major rains that cause runoff in Tierra Blanca Creek has gone underground on the southern end of the Buffalo Lake Refuge and resurfaces with seep or spring flow to feed a waterfowl habitat area that can range in size from roughly 30 acres to well over 100 acres, dependent on rainfall abundance.

During the field tour to Silver Lake, in the edge of Hockley County, Stan Aycock, who owns the Silver Lake location, explained that he also controls salt cedar.

The field tour setting at Silver Lake included a heavy cover of native grasses on slopes above the spring site, effectively protecting the spring from siltation.

According to Mike and Janice Brumley, a seep is evident west of Bootleg Corner about 0.75 mile from the Texas/New Mexico state line . The same heavy rainfall of 2023 that swelled Tierra Blanca Creek from Clovis, New Mexico, through Hereford and eastward to Buffalo Lake National Wildlife Refuge and the Frio Draw flowing from Castro County into Deaf Smith County and a confluence with Tierra Blanca Creek to massive flood stage provided recharge to the seep site mentioned by the Brumleys. That seep remains evident in wet years.

Grassland Interconnectivity

Grassland recharge zones play a crucial role to protecting springs and seeps. Grasslands have long had a natural and vital association with playas, springs, and seeps on the Southern Great Plains.

Grasslands provides invaluable environmental impact by "holding the world together," slowing the flow of runoff, cleansing silt and assorted contaminants from water flowing into playas and watersheds for springs, and serving as a buffer against erosion, in addition to enhancing aquifer recharge through deep root systems and enhancement of soil organic matter. Playas in grassland are more likely to retain their natural function, and remnant functioning springs are often found in association with rangeland.

Grasslands are one of the most threatened ecosystems in North America, and grassland birds are experiencing some of the most significant population declines.

Playa and spring conservation is a logical companion to native grassland conservation and restoration efforts, as the two natural features work effectively to recharge the Ogallala Aquifer, an essential role in the Llano Estacado Region.

Expanses of grassland serve as a recharge zone for playas, springs, and for municipal water supplies. For the best chance of retaining groundwater for municipal water needs, cities may need as much as 10 acres of watershed per house, and the best sort of watershed is grassland.

Grassland recharge zones can contribute from 1.8 to 2 inches of aquifer recharge annually.

Grasses help clean surface water and reduce soil erosion into nearby wetlands. The roots help maintain the structure of wetlands, rivers, and streams — which is especially important during rainstorms — by keeping runoff from eroding soils and creating channels in the grasslands.

Swisher County is an area of diminishing Ogallala Aquifer reserves. Brenda May, now serving with the Lamb County Soil and Water Conservation District and the Littlefield Natural Resources Conservation Service (NRCS) office, who formerly served in Tulia and championed the cause, and many landowners there took measures to return farmland to grassland. As a result, aquifer recharge has improved and depth to water levels in some irrigation wells has stabilized. It is a story also applicable to other counties in the region.

While the drawdown of groundwater from the Ogallala Aquifer is a chief factor in the decline and disappearance of springs across the Southern High Plains, the loss of native grasslands also plays a role. In his 1981 work, "*Springs of Texas*," Gunnar Brune maintains that siltation that began when the native grass cover was removed from the land was also a reason. Topsoil that washed into creeks and draws choked many springs. With the loss of native grassland, landscape lost its sponge-like capacity to absorb recharge water. That capacity is urgently needed to ensure the water future of the Llano Estacado Region.

Playa Conservation

Playas are naturally occurring, shallow, wind-dished ephemeral wetlands in the Southern Plains that drain internally, flood periodically, and accumulate sediment. They can be as numerous as one per square mile in their greatest concentration on the Southern High Plains of Texas in the heart of the Llano Estacado Water Planning Region.

The area of high playa density near the middle part of the Southern High Plains correlates to irrigation-intense zones and includes Castro, Deaf Smith, Parmer, Floyd, Hale, Lamb, Lubbock and Swisher counties in Texas and Curry County in New Mexico. This region, in fact, holds the highest density of playas anywhere in the world. The Texas county with the highest concentration of playas is Floyd County.

Wind deflation and land subsidence are given widespread credence in how playas were formed. One theory is that when water collected in depressions, it percolated downward, carrying organic matter. This organic material oxidized, forming carbonic acid that dissolved the underlying caliche layer. Dissolution increased the ability of surface waters to permeate the soil, allowing increased transportation of dissolved substances, organic matter and particulate rock. Dissolution of caliche, surrounding land subsidence deepened and expanded basins in a circular pattern. As basins increased in size, clay-sized matter entering the basins increased. Some of it could not be removed by downward transport resulting in development of a nearly impermeable basin floor, primarily Randall clay, formed in surrounding settlements and transported into playas.

Shallow playas are rain-fed wetlands throughout the Great Plains. When containing surface water, playas provide crucial habitat for wildlife that depend on water to survive. When dry, playas also support several other Great Plains wildlife species because they are often the only natural lands in a region dominated by agricultural production. Playas also are also a source of recharge water to the underlying aquifer, filter nutrients and chemicals from the surrounding watershed, and add recreational value to the region.

All told, some 23,000 playas are found in the Texas portion of the playa region that stretches across Plains states that also include Oklahoma, New Mexico, Kansas, Colorado, and Nebraska.

Functioning playas have wet and dry cycles, both crucial to their well-being, and an undisturbed floor of Randall clay that cracks deeply during dry periods. That clay soil is a storehouse for the seeds of native plants—some 300 plants all-told across the entirety of their Texas expanse—which cause them to teem with flora in unheard-of variety. Also contained in playa soil are the eggs of micro invertebrates.

Add water, and playas become a vibrant ecosystem, a keystone with playas harboring or providing food or habitat to virtually all wildlife species across the Southern High Plains.

Those cracks in the Randall clay of playas and root channels in the clay and the adjoining uplands are crucial channels for recharge to the Ogallala Aquifer, as is the adjoining upland soil when playas overflow their basins.

Playas have gone through a full historical circle as far as how they are regarded. Early man on the Plains, historic explorers, settlers and cattlemen saw them as vital water sources. During settlement of the Plains, bankers were at one time more inclined to lend money to those with playas on their property, as they playas could be a source of water, grazing, and hay. The ability of playa soils to retain moisture made them an important source of forage for early-day farmers and ranchers, with tons of playa hay sold to cattlemen, who considered it some of the best feed to be had. Some considered playas even more valuable for their forage production than as a source of livestock water.

As farmers followed ranchers onto the Llano Estacado Region, something of a love-hate relationship developed between those tilling the land and playas. Farmers came to regard playas as little more than a “weed bed.”

Once intense irrigation agriculture exploded onto the Plains, playas sometimes came to be regarded as “waste acres,” unproductive of crops, and an alleged source of weed problems. Playas were held in so little regard that they dumped old concrete, trash, and metal in them. Farmers plowed the clay basins into oblivion or filled and leveled them for cropping, and when it rained and flooded the crop, pronounced playas lost acres, weed and insect havens.

During the heyday of row crop irrigation on the Plains, with tailwater collecting in low-lying playas, many producers pitted or otherwise altered playas to permit concentration of water in playas for collecting irrigation tailwater and pumping of that water back onto cropland.

Up to 85 percent of the larger playas in the intensively irrigated zone in the Southern High Plains of Texas were modified for irrigation. Estimates in 1980 were that nearly 11,000 playas had been modified for agricultural uses compared to just 150 in 1965. The primary area of playa modification on the Llano during the 1960s and 1970s was in the south-central portion of the region in the intensively irrigated cropland zone including Castro, Parmer, Floyd, Hale, Lamb, and Swisher counties.

The regard—or lack thereof—for playas, has been shifting in recent years as the Ogallala Aquifer beneath the Southern High Plains steadily declines. Some rural communities are already facing water availability issues. The capacity of playas to facilitate aquifer recharge has returned them to a favorable light, as has their potential for altering the water future of the Plains in a favorable direction.

At one time, popular thinking was that the Ogallala Aquifer received no recharge. Time, study, and technology have showed that playa basins on the Llano Estacado provide a pathway for recharge to the aquifer, albeit slowly in most cases. The importance of aquifer recharge from playas was unheralded for years, but at last, awareness is growing.

In a 1990 interview, the late A. Wayne Wyatt, former manager of the High Plains Underground Water Conservation District No. 1, credited playas as the most important recharge point to the Ogallala Aquifer on the High Plains and theorized that they once helped to prevent the aquifer underlying the High Plains from being drained.

Functioning playa wetland ecosystems, in addition to providing habitat and sanctuaries for biodiversity, serve to improve water quality. Playas and groundwater are interconnected; maintaining the integrity of the playas is essential to protecting the underlying aquifers.

Playas, it would seem, are a primary source of water recharge to the Ogallala Aquifer, a role that is only now becoming fully appreciated.

The Bureau of Economic Geology determined that recharge to the Ogallala Aquifer is focused through playas and occurs at a high rate. The rapid recharge rates suggest recharge through desiccation fractures and the annulus. Large areas of preferential flow are facies controlled and include delta deposits in the playa sediments. Intermediate and small size flow paths are soil fractures, animal burrows, and root tubules. Open root tubules have been found preserved in core to a depth of 374 feet.—*Smith, Doris. 1993. Stage right does not protect us. The Nuclear Examiner, November, page 2.*

Randall clay soils lining playa basins "become thin and eventually are replaced by highly permeable silty sand or silty loam soils on the surrounding upslopes. When precipitation raises the water level of the playa above the liner of Randall clay, considerable infiltration occurs through the permeable soils.—*Wood, W.W. and W.R. Osterkamp. 1984. Recharge to the Ogallala aquifer from playa lake basins on the Llano Estacado (an outrageous proposal?) Pp 337-349 in G.A. Whetstone (ed.) Proceedings of the Ogallala Aquifer Symposium II. Water Resources Center, Texas Tech University.*

Sadly, there are only roughly 4,000 remnant functioning pristine playas in the Southern High Plains of Texas. While recharge is dependent on the soil profile below them, and time frames are slow, from 10 to 50 years, the rate of recharge from playas is from 10 to 1,000 times greater than through other areas.

- Texas has 23,037 playas, with 4,080 categorized as pristine/functional.
- Texas also has 5,631 playas listed as functional but at risk, and 13,326 not functional.

Current average pristine/functional playas encompass 69,360 acres. A single 3-inch recharge event through an average 17-acre playa could potentially recharge 1,385,500 gallons. At a recharge rate of 81,500 gallons per acre from a single 3-inch rainfall event, water recharged from all of the average-size pristine and functional playas would amount to 5,652,840,000 gallons. A 3-inch recharge across pristine and functional playas would sustain 154,800 people for a year at 100 gallons per day.

Dr. Chris Grotegut, agriculture representative to the LERWPG, and groundwater expert, says that if per person per day water use was reduced and 70 percent of playas restored to functional condition, recharge would possibly be sufficient to sustain 1.5 million people indefinitely.

Mike Carter, former executive director of the Playa Lakes Joint Venture, reminds that playas are a haven for waterfowl and shorebirds as well as all Plains wildlife, and a seedbed of native plants, "but by definition are recharge wetlands and 95 percent of recharge in this area is through playas. That is vital to this nation's water future."

With only 2 percent of the Texas plains made up of playas, sustainable playas become important. Playas account for nearly 90 percent of recharge occurring in the Ogallala Aquifer.

"Playas in Texas average 17 acres. Most are recharging an acre-foot a year. A 3-inch recharge across a considerable number of functional playas can provide a water supply for the High Plains.

In the coming decades, the Llano Estacado Region will face increasing demand for groundwater. Healthy playas are crucial in meeting that need. Rehabilitating playas and filling their pits could potentially gain 15,661 acre-feet of aquifer recharge—enough to meet the increased municipal demand in the region, except for Lubbock, or to come close to meeting future livestock demand of 18,715 acre-feet. With converting farmed playas to native grass and filling their pits, some 22,778 acre-feet—enough to meet increased livestock demand—could be gained.

County Anecdotal and Historical Knowledge of Springs and Seeps

Springs have a sacredness to them, water coming mysteriously out of the ground to play a significant ecological, historical, cultural, and even spiritual role in the High Plains and across Texas. The LERWPG is keenly aware that springs and seeps historically existed in the region, and a few precious remnant ones persist. The plow, resultant silt, and high-volume centrifugal pumps sounded the death knell for many springs in the Panhandle-Plains.

Most of the region's springs and seeps disappeared as native grassland was cultivated and irrigated agriculture evolved. Pumping of the Ogallala Aquifer that drew down the water table is usually blamed for the demise of springs but is not the singular factor.

In "*Springs of Texas*," Gunnar Brune notes invasive brush species, including salt cedar and juniper came to grow adjacent to many now-defunct spring sites. Interception of large volumes of recharge flow by brush species cannot be discounted as a factor in the loss of spring flow.

Springs and seeps still occur in the Llano Estacado Region. Their flow is minimal in comparison to historic times, and typically dependent on rainfall, which can occasionally prove intense. While some springs pour water from the Ogallala Aquifer, others flow only after prolonged, substantial rainfall. Water that soaks into surrounding lands still gradually feeds the springs. Many springs and seeps are located on private land and their presence can only be confirmed through frequent and close observation, a challenge in modern times when access is limited. Landowners may be reluctant to allow public access to these sites due to concern over liability, the wish to avoid damage to the landscape, or other factors.

The flow from most of these springs is local and does not contribute to river flow. Spring water may travel a short distance and generally evaporates or runs back into the ground. Seeps are generally little more than small pools sustained by minimal flow from underground. Where springs and seeps still exist, they are highly dependent on favorable rainfall at the site and upstream and can be important to local wildlife and may be a source of livestock or recreational water.

The Llano Estacado Region experienced unusually heavy rainfall during 2004, and again in 2023 that renewed spring and seep flows in some locations. Where normal annual rainfall is roughly 18 inches, 42 inches of more of precipitation fell on parts of the region in 2004. Localized flooding occurred with intense rainfall in May of 2023, so intense, in fact, that it drowned cattle in feed yards in Castro and Deaf Smith counties and caused the Frio Draw south of Hereford and Tierra Blanca Creek to flood at intense levels across Deaf Smith and into Randall counties. Renewed spring flows noted in 2004-2005 are out-of-the-ordinary, localized, and a direct result of abundant rainfall.

According to "Major and Historical Springs of Texas" published by the Texas Water Development Board, and from information garnered by area residents, several active springs and seeps are located within the Llano Estacado Planning Region. Their flows can fluctuate substantially. Included here is a list of historic springs in the Llano Estacado Region, as well as information on any spring and seep sites still active. Material in this report is taken primary from “Springs of Texas” Volume 1 by Gunnar Brune and is supplemented here with anecdotal information. **Type in boldface indicates current anecdotal information on springs and seeps.**

BAILEY COUNTY: At the time of his 1978 documentation, Brune found that the springs of Bailey County had nearly all ceased flowing. Through history, several springs issued from Tertiary Ogallala sand and more recent sand and caliche, and from Cretaceous limestone. Springs were located primarily along Blackwater Draw and its larger tributaries, and adjacent to the larger lakes. Cultivation of grassland diminished the soil’s ability to absorb recharge water and the springs along Blackwater Draw were largely gone by the 1930s. Among historic springs mentioned by Brune, and their location are Alkali Springs, 1.5 miles south of Baileyboro; Hamett Springs, 6.8 miles southeast of Coyote Lake and just over a half-mile northeast of Baileyboro; Blackwater Lake and Springs, 6.2 miles west of Muleshoe; Jumbo and Turnbo Springs, 1.8 miles northeast of Muleshoe; Butler Springs, in the northeast corner of the county on the Parmer County line and just over a half-mile west of Lamb County line; and White Springs, in the Muleshoe National Wildlife Refuge 6.2 miles south of Needmore. In a telephone interview on March 24, 2005, Mr. Jim Young of Muleshoe reported that springs consistently maintained seeps on property south of Baileyboro. These were not large flows, but they did maintain standing water. Mr. Harold Beierman, manager of the Muleshoe National Wildlife Refuge near Needmore at that time said that abundant rainfall during 2004 caused seeps to moisten the ground at several sites *on* the refuge. Beierman said that spring flow also occurred at Paul’s Lake on private property north of the refuge, and that water was present in the lake throughout the fall and winter of 2004-2005.

Jude Smith, Refuge Complex Manager of the Muleshoe, Buffalo Lake, and Grulla wildlife refuges explained late in 2023 that vigilant salt cedar control and good grassland management are vital factors in evident restored spring flow in 2023 and 2024. “We have a return of springs on the Muleshoe Refuge after a strong effort at controlling salt cedar. We have had an ongoing effort of salt cedar control that is showing results in return of spring flow,” he said in a November 2024 interview. Salt cedar is a pervasive thief of water, with individual plants grabbing up to 200 gallons per day. Small wonder its control gives withered springs a new chance.

BRISCOE COUNTY: Most of the historic springs in Briscoe County issued from Tertiary Ogallala sand and Quaternary sands and gravels such as the Tule, in the western part of the county. From 15,000 years ago, when Clovis man frequented the springs, until over a century ago, nearly all of the springs ran continuously. Remains of mammoths hunted by the Clovis people have been found in Briscoe County. Hearths, projectile points, knives and scrapers and paintings on rock cliffs indicated that from Clovis to historic times, man and animal have associated with spring sites here. Irrigation caused a severe decline in the water table, a major cause of the failure of most springs, but extensive erosion also resulted in creeks being choked with sand and silt, and many springs were buried. Evidence indicates that Coronado followed the waters of Tule Creek in 1541 and stopped at HULSEY SPRINGS, located just below the caprock in Palo Duro Canyon, approximately 9 miles north of Vigo Park. This name evidently represented several small springs at that location. Brune documented springs still running on Deer, Turkey, and Cedar springs with flow rates of 20.5, .39.6 and 15.8 gallons per minute, respectively, on September 4, 1978. According to NRCS records, Dick Cogdell was the current landowner of the site. A telephone interview with Mrs. Dick Cogdell on

February 2, 2005, revealed that Turkey Springs at that time remained the primary active spring at that location. The spring did not flow during hot dry summers. Any spring flow is dependent on abundant rainfall soaking into the surrounding landscape and feeding the spring, and water does not flow a large distance from the site when the spring is running.

Brune also documented a number of other spring sites in Briscoe County. Some of these go by other local names. In favorable seasons such as 2004, when abundant rainfall provided a recharge source, some of these springs revive, but run only a small distance before going back underground or evaporating. Mr. Rank Cogdell of the Vigo Park area reported in a phone interview on February 2, 2005, that he observed many active springs along Tule Canyon during a helicopter flight over the area in January of 2005. He reported that the Tule had numerous springs along its length, and that in the winter, Tule Creek and Deer Creek are the only locations with spring flow sufficient to provide dependable livestock water, with flow from Deer Creek estimated at roughly 20 gallons per minute. The best of the small, localized springs on the Tule was located within 2 miles of Highway 207 that runs between Claude and Silverton. Mr. Cogdell commented that a favorable fall and winter of rainfall had created spring flows in Briscoe County that likely would not be maintained once dryer weather set in. Water from these did not travel large distances or contribute to river flows.

Among other historic springs mentioned by Brune are Marting Springs, roughly 5 miles southwest of Brice; Burson Springs, 9.3 miles northwest of Turkey; Hell Springs, 6.2 miles northwest of Turkey; Gyp Springs, 5.5 miles northwest of Quitaque; Haynes Springs, 2.4 miles upstream from Gyp Springs on the South Prong of the Little Red River; Cottonwood and Red Rock Springs, 4.3 miles west-northwest of Quitaque on Little Cottonwood Creek; Las Lenguas Springs, 8.6 miles west-southwest of Quitaque; Rock Springs, 7.4 miles west-northwest of Silverton; and Mayfield Spring, 1.8 miles north-northeast of Rock Springs.

In a January 13, 2025, telephone interview, Jimmy Burson, who resides east of Silverton, said several springs remain in Briscoe County. He said two exist on his property below the Caprock, with one north of his home. He said Vince Terry Springs is on the Upper Barrell Ranch and that Rock Creek some 7 miles northwest of Silverton still flows. "Irrigation has mostly diminished natural springs. Tule Creek, which once ran a bunch, is reduced to little seeps," said Burson.

Jimmy Burson, who lives 6 miles northeast of Silverton, in Briscoe County, related in a telephone interview on February 2, 2025, fittingly on World Wetlands Day, that he has knowledge of several remnant springs in Briscoe County. He said that Terry Springs 12 miles west-southwest of Silverton and 12.3 miles south-southeast of Quitaque remains somewhat active in the breaks. He related that three springs are located adjacent to the edge of the Caprock Escarpment about 0.25 mile from the edge of the Caprock. "There are two springs on one place I own northeast of Silverton. One is active west of Silverton and one southeast of Silverton. I can locate eight to ten small springs. They do not run a lot of water, but there is still some flow."

He said a "good one" is still situated on Rock Creek, west-northwest of Silverton on the edge of the breaks, and Las Lenguas Springs, 8.6 miles west-southwest of Quitaque and southeast of Silverton continues with some flow. The rates of flow are highly dependent on rainfall and its infiltration into the landscape. Spring flow is also impacted by irrigation above the Caprock.

CASTRO COUNTY: As late as 1978, Brune indicated that no springs flow in Castro County, although in historic times many issued from Ogallala sand, gravel, silt and caliche. Springs once maintained a flowing stream in Running Water Draw, but this has not been the case in modern times. Decline of the water table due to pumping from the Ogallala and siltation contributed to the failure of springs. Among historic spring sites and their locations was Flagg Springs, 3.1 miles south of the Flagg community and 6.8 miles upstream from Sunnyside on Running Water Draw. Jumbo Lake, 6.2 miles northeast of Easter, was once kept full by seeps from Ogallala silt and sand. Middle Tule Draw northeast of Nazareth held some pools of live water, as did the North Fork of the Running Water Draw. Running Water Draw was fed by springs near Sunnyside.

COCHRAN COUNTY: Brune documented in1978 that hardly any springs still flowed in Cochran County, although they issued in abundance from the Ogallala when the water table was at or near the surface. Springs were especially numerous around Silver Lake and along the major draws. Historic spring sites include Morton Springs, 3.1 miles west of Morton, which dried up in 1907, and Silver Springs, on the northwest side of Silver Lake. Discharge of springs around the lake was impacted by irrigation pumping, and the presence of salt cedars could also account for some water loss. South-southeast of Lehman about 6.2 miles springs or seeps may have flowed in former times. In the southeast corner of the county, just over 0.5 mile from north of the Yoakum County line, and 8.6 miles west of the Hockley County line, springs formerly kept a draw running with water year-round.

CROSBY COUNTY: Historically, Crosby County was abundantly endowed with springs, mostly in the canyon breaks below the caprock, with water flowing from Ogallala and Triassic Dockum sands. Over the past 75 years, the springs declined markedly as the Ogallala water table dropped. Brune noted in 1978 that Crawfish Creek was dry except in times of heavy rainstorms. Among historic creeks and their location, as listed by Brune were Rock Housse Springs, near the junction of Highway 651 and 193 in northern Crosby County; Ericson Springs, 1.2 miles west-southwest of Mount Blanco, issuing in a ravine with vertical caliche cliffs, the site offered only a seep in 1978; Dewey Springs, a group of springs on the north side of Dewey Lake located 4.3 miles east-northeast of Crosbyton, now dry; Silver Falls, below the Highway 82 crossing of the White River, was once a source of water for White River Reservoir, but the spring flow diminished; Couch, or English Springs, 8 miles east of Crosbyton in Blanco Canyon, dry now; Davidson Springs, 4.9 miles southeast of Crosbyton; Cold Springs, 8 miles southeast of Crosbyton; L7 Springs,9.3 miles south-southeast of Crosbyton; Wilson Springs, 2.4 miles east-southeast of Cap Rock; Cottonwood Springs, 9.9 miles east- northeast of Slaton on Plum Creek; C Bar Springs, 8.6 miles east-southeast of Slaton; and Gholson Springs, 6.2 miles east-northeast of Slaton.

DAWSON COUNTY: The larger springs of Dawson County were in the breaks and canyons below the caprock such as TJF Draw, Tobacco Creek and Gold Creek Canyons. Small springs on the plains such as those along Sulphur Springs Draw were the first to fail as the water table began declining. Many creeks also were filled with drifting sand during dust storms. Brune's field studies during 1975 showed the springs issuing from Pleistocene sand, Tertiary Ogallala sand, and lower Cretaceous limestone. Among spring sites documented by Brune and their location are Sulphur Springs Draw, 3.1 miles south of Welch, where several small springs or seeps are speculated to have flowed during historic times; Rock Crusher or turner Springs, 6.8 miles south of O'Donnell, where Brune metered a flow rate of 30.1 gallons per minute in October of 1978, with the water flow increasing greatly over that metered in June of 1938; Earl Springs, 1.2 miles north of Rock Crusher

Springs; Tobacco Springs, at the head of Tobacco Creek, 5.6 miles south-southeast of O'Donnell; Indian Springs, 5.5 miles east-northeast of Tobacco Springs, where an historic people lived in caves and left pictographs on the walls; West Tobacco Springs, 4.9 miles south-southwest of Tobacco Springs; and Mullins Springs, 14.2 miles east of Lamesa and .3.7 miles northeast of the Midway community in a canyon. Mullins Springs flowed until 1969.

DEAF SMITH COUNTY: Springs flowed along Tierra Blanca and Palo Duro creeks below the caprock in the northwest corner, and at Garcia Lake and other large lakes or deep depressions. In nearly all cases historic springs flowed from Ogallala sand and caliche, with a few issuing from Dockum sandstone. Tierra Blanca Creek once flowed constantly and large blue holes of spring water flowed to the surface at the community of Blue Water, later named Hereford. While irrigation's drawdown of the Ogallala aquifer was a factor in the decline of spring flow, Brune's studies indicated the plowing of native grasslands loosened fragile topsoil that washed into Tierra Blanca Creek and smothered many springs. Ability of the soil to recharge water to the aquifer was also damaged. During studies in May of 1977, Brune documented historic spring sites and their locations. Based on his studies at that time, Brune concluded that Big Springs on the Gault Ranch along Tierra Blanca Creek, about 4.3 miles west of the Randall County line, was the only flowing spring in Deaf Smith County, with a flow of about 5 gallons per minute. Southeast of the Big Springs site about 3.1 miles, Parker Springs flowed from the base of caliche caprock Most of the springs at this location had disappeared by April of 2002, but one small spring continued to seep, maintaining a small pool of water. Heavy rains in the area revitalized Devil's Canyon, south of Parker Springs. Seepage continued to maintain water in a cattle watering tank at that site. Sulphur Springs in Sulphur Park on the old L.R. Bradly farm, just upstream from the junction of Tierra Blanca Creek and Frio Draw was once the site of a lake popular for recreation. The Sulphur Springs area is today part of the City of Hereford's farm, some 4.9 miles northeast of Hereford, and two or three springs ran intermittently here. Brune believed that Sulphur Springs failed by the 1940s**.** Recharge from rainfall or some other factor served to rejuvenate at least light flow, and several seeps could be found along Tierra Blanca Creek on the City of Hereford property. Spring flow in this area, if it exists travels only a small distance before evaporating or going below ground. Just east of the Sulphur Springs area, several live springs were present on ranch property along the Tierra Blanca Creek. From 1972 through 1994 the flow of some 20 springs on the site did not stop although it was often minimal. Most springs at this location flowed intermittently, declining during the heavy irrigation season. In former years during the fall and winter months water flowed for a mile or more in the channel of Tierra Blanca Creek. One spring at the site once flowed at a rate as high as 30 gallons per minute, but the flow fell off to approximately 15 gallons per minute during irrigation season. There is some question as to whether this water originated from the Ogallala, or a local perched aquifer. **Some rejuvenation of springs during large rainfall events could account for occasionally minimal flow.**

John Josserand, the current lease holder on the City of Hereford farm, east of Hereford reported in a January 14, 2025, telephone interview, that there are still some small seeps along Tierra Blanca Creek on the City Farm that pool water in the creek occasionally. Josserand has tracked small flows of water coming down the creek through Hereford Feedyard to a bridge west of that location but has not been able to identify the source. "There are times when the flow down the creek increases and decreases and could possibly be outflow from White Energy on the eastern edge of Hereford," he theorizes.

Torrential rainfall of up to 11 inches May 26/27 of 2023, southwest of Hereford and in the Summerfield area in Castro County, resulted in massive flooding of Tierra Blanca Creek and Frio Draw in Castro County, which makes a confluence with Tierra Blanca Creek. Pouring as fast as 7 inches an hour, the downpour mostly sealed over the soil surface, then ran off farmland to creeks and draws in roiling brown shades of sheet erosion of the soil. Debris-laden water from Tierra Blanca Creek and the Frio Draw meandered eastward to the Buffalo Lake Refuge south of Umbarger. Varying landowners and a lack of access made assessing the impact of the flooding difficult, but where siltation did not bury spring and seep sites, they could still persist in the bed of Tierra Blanca Creek.

Bridwell Springs, on the Bridwell Ranch in the northwestern corner of the county went dry. Fowler Springs was found 1.8 miles west of the Randall County line on Palo Duro Creek, and Hodges Spring, 2.4 miles west of the Randall County line, are among springs that formerly flowed along Palo Duro Creek. Ojo Frio or Cold Spring was located in the Frio Draw upstream from its junction with Tierra Blanca Creek. Punta De Agua or Source of Water was 5.5 miles west of Hereford in Tierra Blanca Creek. Below this point Tierra Blanca Creek flowed constantly, but began to falter in 1925, well before massive development of irrigation, and after about 1940 there was no flow except from surface runoff. In western Deaf Smith County, 2.4 miles east of the New Mexico state line, the XIT Ranch used Escarbada Springs in historic times, but they are now dry. **At least one small seep is still active in this area of western Deaf Smith County, adjacent to the New Mexico border. Ojo de Garcia or Little Garcia Springs formerly flowed from Dockum sandstone 1.2 miles west-northwest of Garcia Lake in western Deaf Smith County. Spring flow eventually declined to seeps, and water is only present in Garcia Lake now when large, localized rainstorms cause runoff to flow to the lake.**

In years of strong rainfall, seeps can still be found in the far western edge of Deaf Smith County near the eastern New Mexico border. Mike and Janice Brumley, who own rangeland near Bootleg Corner and beyond reported in a November 2024 interview that a seep is still present about 0.75 mile from the eastern New Mexico border when rainfall feeds the grassland recharge zone in that vicinity. Mr. Brumley credited the May 2023 heavy rainfall with reviving the seep on their property, with water still evident into 2024.

On the east side of Deaf Smith County, heavy rainfall such as that in May of 2023 impacted seeps and possibly springs. Spring flow has returned on the Buffalo Lake National Wildlife Refuge, at Umbarger, in Randall County, downstream from the flow of Tierra Blanca Creek in Deaf Smith County and in fact, can produce enough water to hold waterfowl on the southern end of the refuge, related Refuge Manager Jude Smith in a November 2024 telephone interview. "We have had an ongoing effort of salt cedar control that is showing results in return of spring flow," he said. According to Smith, flow from Tierra Blanca Creek apparently flows into a shallow perched aquifer at the refuge. "In years of good rainfall, this spring on the refuge flows sufficiently to create a 300-acre wet area for waterfowl. In moderate or low rainfall years the moist area for waterfowl may only be 30-40 acres," Smith said.

In a telephone interview on January 11, 2025, Steve Parker reported that one seep remains on the family ranch south of Dawn, east of Hereford. That seep is located about 0.25 mile south of Tierra Blanca Creek, and has minimal water, except in instances of major rainfall. According to Parker, his family's ranch land once had three live springs, all on the south side

of Tierra Blanca Creek. Parker also reported that to the east of his family's ranch, a spring was once located on the south end of the Buffalo Lake National Wildlife Refuge that flowed at a rate of 1,000 gallons a minute in a time before siltation and large-scale irrigation deprived it of flow.

Native grass rangeland remains crucial to filtering the inflow to Tierra Blanca Creek and preventing the few remnant seeps and springs from being smothered by silt.

DICKENS COUNTY: The northwest comer of Dickens County lies on the High Plains, underlain by Tertiary Ogallala sand, gravel and caliche. Abundant springs once flowed from this formation all along the caprock escarpment, but most have disappeared due to heavy pumping for the Ogallala aquifer. The remainder of the county lies in the Rolling Plains, where springs trickle from Permian gypsum and sandstone. Some historic springs were choked by erosion and buried as early as 1914. Most springs declined permanently by 1979. Historic springs and their locations include Browning Springs, 3.1 miles northwest of Dickens, and springs was 4.9 miles northwest of Dickens in Hobble Scobble Canyon. Pecan Grove Spring was 5.5 miles southeast of McAdoo. On Grapevine Creek were White House Springs, 4.3 miles northeast of McAdoo. Cottonwood Springs were just over a half mile west of Afton, which can still flow in the event of heavy local rainfall. Erosion choked the creek bed in this area. A half-mile north of Afton are Patton Springs, which was eventually covered by a lake; Jackson Springs, 6.2 miles north of Dickens went dry and the creek channel filled with sand; Sanders Springs, east-northeast of Afton, is also subject to rainfall recharge, with Brune documenting a flow of 158.4 gallons per minute in August, 1979 after a heavy local rainstorm, Shinnery Springs 6.2 miles southwest of Dumont on the Pitchfork Ranch still ran year-around according to Wyman Meinzer of Benjamin, Texas. Brune documented a flow of less than 5 gallons per minute in August 1979. Meinzer reported that prior to 2006 the flow was not large but consistent. The water did not flow a long distance. Dripping Springs are 5.5 miles southwest of Dumont and were termed similar to Shinnery Springs. Law Springs were also 2.4 miles northeast of Dickens. Dickens or Crow Springs are less than a mile northeast of Dickens. Brune noted a flow of 38 gallons per minute in August 1979 following heavy rain. Mitchell Springs are 1.8 miles east- southeast of Dickens. **Meinzer also reported on January 10, 2025, a seep "south of my old trapping post on the Pitchfork Ranch, named, I believe, Bird Pour Off, but I don't recall it being anything more than a seep."**

FLOYD COUNTY: Brune pronounced the story of springs in Floyd County as largely one of water sources that were once important but are no more due to decline of the water table. Springs formerly issued from sands and gravels of the Ogallala formation. Blue Hole Springs was on Quitaque Creek 6.2 miles east of South Plains. It had no water flow in July of 1978 and had been partially filled with cobbles and gravel. Likewise, Rain Springs 5.6 miles southwest of Flomot, just below the caprock, was dry. Montgomery Springs, in Blanco Canyon, just north of the Crosby County line, ceased flowing in 1948. Massie Springs, 6.2 miles southwest of Floydada, ceased flowing about 1945.

GAINES COUNTY: Most of the springs here flowed from Ogallala and more recent sands. Decline of the Ogallala Aquifer is cited as a cause for most springs drying up. Boar's Nest Springs in northwest Gaines County were dry by 1955. Cedar Lake or Laguna Sabinas in northeastern Gaines County was once surrounded and fed by numerous fresh and saline springs. Buffalo Springs on the north side of the lake and Johnson Springs on the south side of the lake had only small flows by 1963, but none of the Cedar Lake springs were flowing by 1977, although a few seeps were still evident. Balch

Springs on McKenzie Draw south of Cedar Lake was still yielding 39.6 gallons of water a minute when Brune measured in March 1977, but Bobby Tabor, soil conservationist with the Seminole Field office of NRCS, in a telephone interview on February 3, 2005, reported no flow in that area. A number of seeps were cited by Brune as existing along McKenzie Draw. Mr. Tabor related that a local landowner reported to him early in 2005 that at McKenzie Lake 19.2 miles east of Seminole and south of Cedar Lake two springs located on private property still ran into McKenzie Lake. The flow was likely not large. South of Seminole 5.5 miles, Indian Wells was the site of as many as 20 seeps issuing from Ogallala sand. Downstream on Seminole Draw, six springs formerly flowed. Brune projects there were probably also seeps along Monument Draw in the southwestern comer of the county. Ward's Well at Hackberry Grove 2.4 miles south of Seminole was a former area of shallow water that could be hand-dipped, but the water table declined at this site.

GARZA COUNTY: The western edge of the county lies on the High Plains and on the edge of these plains are springs flowing from Tertiary sand, gravel and caliche. Much of the county lies on the Red Bed or Gypsum Plains where some springs issued from Quaternary sand, gravel and caliche and from Triassic Dockum sandstone. Many springs weakened or failed as groundwater declined and severe erosion filled many stream channels and buried springs. Glen Killough, district conservationist with the Post field office of the NRCS, reported in 2006 that many seeps still existed off the caprock. They were local and their waters did not contribute to in-stream flows. Seeps and any small spring flows remaining are highly dependent on rainfall. In the way of historic references: Post Springs, 3.1 miles west of Post, once a source of part of the water for that city, are now dry. Golf Course Springs 3.1 miles northwest of Post once discharged water over a mile downstream and were strong in the 1930s, declined to only a seep in 1975. Tipton Springs, 4.3 miles northwest of Post, have been dry since about 1945. Barnum Springs were 7.4 miles north-northwest of Post. Live water existed in holes until about 1975. Double U Springs were noted 3.7 miles southeast of Eastland. Brune measured a flow of 3.1 gallons per minute in June 1979. Whiskey Springs, 3.1 miles northeast of Southland were a tiny trickle of 0.79 gallons per minute in June of 1979 and a similar spring in Red Creek 1.2 miles south-southwest flowed even less. Llano Springs 8 miles north of Post on the northeast side of the Brazos River flowed until the 1940s, and seeps could still occur in the event of wet weather. Lane Springs 6.2 miles southwest of Kalgary had declined to seep status by the time of Brune's survey and Indian Springs 5.5 miles south- southeast of Kalgary trickled at 1.9 gallons per minute when Brune measured in August of 1979, and might be subject to some seepage in the event of favorable rainfall. Chimney Springs were noted less than a half-mile upstream. K Springs were located 3.7 miles east-southeast of Indian Springs. Southeast of Lane Springs some seeps were noted and 2.4 miles farther south Slick Nasty Springs were once an important watering site on the Spur Ranch but reduced to seeps. OS Springs was cited 9.3 miles east of Post, south of the North Fork of the Double Mountain Fork of the Brazos River, characterized even in 1979 as only wet weather seeps. Reed Springs, 4.9 miles east of Justiceburg was a seep from Dockum sandstone. Rocky Springs, 5.5 miles east-southeast of Justiceburg fed Rocky Creek with slightly saline water from Dockum sandstone bluffs. Spring Creek Springs were 4.3 miles southeast of Grassland and were about seven groups of springs that flowed 34.8 gallons per minute in the winter, but less in summer. Spring water flowed as much as two miles. Cooper Springs in Cooper's Canyon 4.3 miles south of Post were once strong but flowed only about 11 gallons per minute in 1979. Boy Scout Springs, 2.4 miles southwest of Post stopped flowing about 1946 but there were still wet weather seeps in 1979. Box Canyon Springs, 2.4 miles west-southwest of Post flowed at 13.1 gallons per minute in June of 1979.

Garza and Crosby County rancher and Llano Estacado Region Water Planning Group Agriculture Representative Mark Kirkpatrick of Post related in a January 14, 2025, telephone interview that some of the long-time springs and seeps in Garza County below the Caprock are still in existence, though their flow is highly subject to abundant rainfall, and irrigation drawdown above the Caprock. He related that Cooper Canyon Springs 4.3 miles south of Post still flows a little, and that his family has "a couple of springs on ranchland that don't run to a creek or riverbed, but flow enough during the dormant time of the year for water cattle near their mouth. We had good rains in 2024 that amounted to 25 to 27 inches and that helped springs and seeps in Garza County. The best prior year was in 2010, so there are long gaps between good moisture years. Salt cedar is an invasive species impacting springs and seeps, and our country is covered up with invasive red and blue junipers, which also hog a lot of water. We're hoping that a chemical will be developed that will control them, and possibly free up more water for growth of native grasses and recharge to springs and seeps."

HALE COUNTY: Brune noted no flowing springs in Hale County, although historically, springs and spring-fed creeks were abundant. Decline of the water table is a factor in the demise of the springs. Norfleet Springs were in the northwest corner of the county 1.2 miles from the Lamb County line on Running Water Draw and bubbled up in 12 or 13 springs in the 1930s but failed by 1945. Downstream on Running Water Draw, 6.2 miles west of Edmonson, was Ojo de Agua Springs. These and other springs maintained a running stream in Running Water Draw. These springs dried up in the 1950s with some seepage until the 1960s. Jones Springs were 3.1 miles west of Edmonson. Running Water Springs were roughly 2.4 miles south of Edmonson, on the north side of the draw. Up to 12 feet of silt from erosion had filled the draw by the late 1970s. On Crawfish Draw were once Crawfish Springs 7.4 miles south of Hale Center. They dried up by 1920. Eagle Springs were 7.4 miles west-northwest of Abernathy on Blackwater Draw. It dried up in the 1930s and seeped intermittently until the 1940s.

HOCKLEY COUNTY: The springs of Hockley County issued from Tertiary Ogallala sand and gravel. Decline of the water table impacted local springs. Silver Springs was located at Silver Lake or Laguna Plata, in the northwest corner of the county, where springs issued at various points around the lake. The flow was less than a gallon per minute in October of 1978. The Devil's Ink Well was a pool of water in Sucker Rod Draw 3.7 miles east-southeast of Pep. Yellow House Springs were two small springs 4.3 miles east of Pep. Small springs once flowed 4.3 miles northeast of Pettit. Some seeps existed in Yellow House Draw until about 1920. **Some revival of spring flow has been noted around Silver Lake. Saline wetlands associated with the Ogallala Aquifer came into focus for participants in a Stewarding Our Aquifer Field Day staged May 18, 2023, at Pep, Texas, that included a field trip to Silver Lake (Laguna Quemado) in Hockley County on land managed by Stan Aycock. In grassland at the site, a light flowing spring slightly more than a seep was viewed at the site. Its output was flowing toward a saline lake on the property.**

LAMB COUNTY: The channel from Water Draw, 6.2 miles east-southeast of Sunnyside, has been choked with sand washed in by erosion. King Springs was 6.8 miles north of Olton. It fed into Running Water Draw, but failed in the 1950s; however, there was some seepage into the 1960s. Many springs once flowed on Blackwater Draw. Alamosa Springs was 4.3 miles east of the Bailey County line on Blackwater Draw. Soda Lake and Springs were 2 miles farther south. Spring Lake was located on Blackwater Draw 4.9 miles west of Earth. Springs here lasted until 1942, with seeps persisting until the early 1960s. In the sandhills, many lakes were once fed by springs and seeps.

Sod House Spring 6.2 miles north of Amherst on Blackwater Draw flowed until the 1950s. Rocky Ford Springs were just upstream from the Highway. Brune noted only a few springs still flowing here in the late 1970s. Springs formerly ran on County Road 385 crossing of Blackwater Draw 6.8 miles northeast of Amherst but faltered in the 1940s and were gone in the 1950s. Fieldton Springs south of Fieldton were gone around 1949. Hart Springs were a little over 0.5 mile southeast of Hart Camp, but the springs, draw and lake dried up in the 1930s. Bull Springs, at Bull Lake 8 miles west of Littlefield, were already only a seep by 1978. Rains could cause some seepage. Roland Springs formed a chain of pools in Bull Draw, and they were only seeps in October of 1978, although the springs ran a bit in the winter. Glumpler Springs were 3.1 miles northeast of Pep and flowed about 8 gallons per minute in October 1978. Just south of Glumpler Creek on Goat Creek Green Springs flowed 11.8 gallons per minute of slightly saline water in October 1978. Illusion Springs on the north end of Illusion Lake flowed 25.3 gallons per minute of moderately saline water in October 1978. At the end of Yellow Lake Yellow Springs was part of a series of freshwater springs once present along the eastern shore of Yellow Lake and flowed an intermittent 2.2 gallons per minute in October 1978. Some saline springs were 1.8 miles west of Yellow Lake, near the Hockley County line, with one flowing 11.2 gallons per minute in 1978 and several others dry.

LUBBOCK COUNTY: Springs once flowed abundantly along Yellowhouse and Blackwater Draws, emerging chiefly from Ogallala sand and gravel. Lubbock Springs were at the Lubbock Lake archaeological site near the intersection of Highway 84 and Loop 289. These springs had failed to flow by the early 1950s. Buffalo Springs, in Yellow House Canyon 9.9 miles southeast of Lubbock, were immersed by a lake at the site. Brune reported that measurement of the flow of Buffalo Springs could be made only by comparing discharge above and below Buffalo Lake and allowing for evaporation. Discharge, including all springs in the Buffalo Lake area, was 1,246.9 gallons per minute as measured by Brune in 1976, and the historic high discharge was 1,521.2 gallons in 1969, when all spring flow combined was measured. Currently, effluent from Lubbock of 1 to 2 million gallons per day flows into Buffalo Lake. Johnson Springs are at Lake Ransom Canyon just downstream from Buffalo Lake and may receive some recharge from Buffalo Lake. Brune measured 15.8 gallons per minute in December 1975, but the flow had declined to less than a gallon per minute by August 1978. Tinsley Springs, 3.7 miles downstream in Yellow House Canyon, flowed 11.5 gallons per minute in August 1978.

LYNN COUNTY: In Lynn County, spring water flowed mainly from Ogallala sand and gravel, with some from Triassic Dockum sandstone, but spring output has been reduced due to the decline of the aquifer. Double Lakes Springs, 8.6 miles northwest of Tahoka on the north side of Double Lakes, issued 15.8 gallons per minute in December 1975. Spring sites were partially buried by sediment. Tahoka Springs on the west side of Tahoka Lake 6.21 miles north of Tahoka included a large spring near the north end of the lake that flowed 53.8 gallons per minute in December 1974, and several other springs farther south combined for a flow of 95 gallons per minute at that time. Moore Springs, 2.4 miles southeast of Grassland in Moore's Draw produced 25.3 gallons per minute in 1975.

Springs were in Chimney Draw northwest of Guthrie Lake, 3.7 miles southwest of Tahoka, but no longer flow. Saleh Lake and Seeps were noted 3.7 miles southeast of New Moore. Gooch Springs about 1.2 miles farther west at Gooch Lake, and the largest spring flowed 12.3 gallons per minute in October 1978. Frost Lake, 4.3 miles south-southwest of New Moore was fed by water from Frost Springs, which discharge 66.5 gallons per minute in October 1978. New Moore Springs, 1.8 miles west-northwest of New Moore, were reported by Brune as being suddenly rejuvenated in 1968 by a combination of high rainfall and potential injection of water brought in from Rich Lake at the upstream Ozark-Mahoning mine. Brune measured a flow of 90.3 gallons per minute of moderately saline water in October of 1978. Historically, the flow at this location has been greater in the winter months. The late Pat Childress of O'Donnell reported in a telephone interview on February 6, 2005, that a lake had formed at the New Moore Springs site as the spring flow had been greatly enhanced by the heavy rainfall of 2004. The springs were at that time covered by the lake water and Mr. Childress estimated that the flow was probably comparable to past measurements, although spring flow had declined severely, and the springs had about dried up prior to the high rainfall year of 2004. The lake at the location was filled with what Mr. Childress called "gyppy" water, not suitable for human consumption, but used by wildlife. Mr. Childress also reported Frost Springs regained strength thanks to the high rainfall. Brune noted in 1975 that water flowed into the swampy area at New Moore Springs from Ogallala sand and that salt cedars were numerous around the site, with flow increasing in the winter when salt cedars and other vegetation were dormant**.** Spring and seep-fed lakes and pools in this area have historically been important to large numbers of sandhill cranes as well as to wintering ducks.

In a telephone interview on January 13, 2025, Mr. Childress's son, Clay Childress, who lives west of O'Donnell related that the timeless cycle of drought and moist years continues 20 years after his late father's comments in 2005. He related that spring and seep flow has been much-diminished the last few years and New Moore Springs that was well-watered after heavy rains in 2004 has been adversely impacted since about 2022. "The draw that New Moore Springs flows through held water all of my life. Salt cedars take a lot of the water. New Moore Springs dried up a few years ago and you could drive a vehicle across an area that previously pooled water six feet deep." He said two places about 10 miles northeast of O'Donnell still hold seep water. He is hopeful that good rains and recharge through the crucial rangeland soil profile will revive the flow of New Moore Springs.

MOTLEY COUNTY: Nearly all springs in the county flow or flowed from Ogallala sand and Triassic Dockum sandstone. Pumping from the Ogallala Aquifer drew down the aquifer and drastically lessened spring flow. Quitaque Creek, estimated in the 1940s to be capable of furnishing 3 million gallons per day, had greatly reduced flows by the mid l970s. Roaring Springs, 3.1 miles south of the town of that name, was once a crown jewel of spring flow in the Llano Estacado Region, although its flow is greatly diminished from historic levels. The area around the springs has been developed with a golf course, campground and RV parking. Spring waters fall with namesake sound over a sandstone ledge. The recharge area for Roaring Springs is 12 miles or more to the west, where rainfall runoff slowly seeps into Ogallala sands. **Today, irrigation of pastureland just upstream from the spring site can greatly diminish the flow when wells begin operating in the summer. Development of a solar project is also expected to impact water to the historic spring site.** Brune noted, when measuring spring flow in 1978 at 633 gallons per minute, that very little decline in spring flow had occurred in the previous 40 years,(i.e., the flow was 664 gallons per minute in 1962, and the all-time high flow since records began in 1937 was 1,125 gallons per minute in 1946). However, heavy irrigation pumping was not occurring adjacent to the springs at that time. While anecdotal information was obtained via phone calls in February 2005, current flow measurements were not available at that time**.** Anecdotes from local residents indicated that spring flow had declined appreciably over the decades. One local resident related that filling a recreational swimming pool with flow from the springs could once be accomplished overnight, but the process came to take days. Water from Roaring Springs feeds into a swimming pool and runs only a short distance before entering the South Pease or Tongue River, where it quickly goes underground. The South Pease merges with the Middle and North Pease to form the Pease River that eventually flows into the Red River. Scab Springs, 1.3.6 miles east of Matador on Highway 70, have been dry since 1945. Wolf Spring, 7.4 miles southwest of Roaring Springs were the source of Wolf Creek, where the combined flow of several springs at the site amounted to 112.5 gallons per minute when Brune noted them in June of 1975. Anecdotal information taken in February 2005 indicated they do not flow now.

Springs on Dutchman Creek 6.21 miles west-northwest of Roaring Springs was measured by Brune at 36.4 gallons per minute in July 1979. Anecdotal information gathered in February 2005 indicated that some seasonal seepage still occurred at the site, though little more than a trickle. The presence of several earthen dams along the headwaters of the spring drainage may be one of the reasons for the decline of this spring. Ballard Springs, 6.2.1 miles south of Matador, were measured at 13.4 gallons per minute in July 1975, and fed an earthen stock tank. Priest Springs, 2.4 miles southwest of Matador, measured 20.5 gallons per minute in August 1978. Willow Springs, 3.7 miles southwest of Matador, flowed 15 gallons per minute in August 1978. Dripping Springs, now dry, were 6.21 miles west-southwest of Matador. Lost Canyon springs were 5.5 miles west of Matador in Lost Canyon. Mott Camp Springs were 10.5 miles west of Matador. Chimney Springs were 1.2 miles northwest of Mott Camp Springs and were only wet weather seeps in 1978. Burleson Springs, 8.6 miles west-southwest of Whiteflat, had ceased flowing by 1978. Chimney Springs, 1.2 miles northwest of Mott Camp Springs were cited as wet weather seeps in 1978. Miller Springs, 7.4 miles west of Whiteflat flowed only 1.5 gallons per minute in 1979.

In a January 13, 2025, telephone interview, James Gillespie of Matador, an NRCS consultant, reported that Motley County still has a number of springs, with small springs basically amounting to seeps in Western Motley County. Gillespie related that the most recent flow measurement of Roaring Springs that he was familiar with indicated a discharge rate of 125 gallons per minute. He said numerous center pivot sprinkler systems were located immediately above the Roaring Springs site, and a solar development project is also underway upstream and is anticipated to further impact spring flow.

PARMER COUNTY: Springs were once numerous along the county's major draws, but they began to disappear by 1900. On Frio Draw, about 0.5 mile east of the Texas-New Mexico state line, on the north side, a spring flowed intermittently from a cave in 1927. At Mustang Lake, 2.4 miles north-northwest of Bovina, springs flowed until the 1930s. A spring also once flowed intermittently .3.7 miles east of Bovina on Running Water Draw.

SWISHER COUNTY: In Swisher County, springs once flowed along Tule Creek, and historically, spring water flowed in North, Middle, and South Tule Creeks. As the aquifer level declined, spring flow diminished. Some springs were also buried by silt from severe erosion. Rogers Springs in western Mackenzie Lake Park offered only seeps from Triassic sandstone when measured by Brune in September 1978. Prairie Dog Springs were at the Highway 2301 crossing of Tule Creek but declined to only a seep. About 0.5 mile northwest of the bridge Anderson Springs once flowed, but they were dry when Brune noted them. Hackberry Springs were some 1,600 feet farther upstream. They dried up in 1974. Dawson Springs were 3.1 miles downstream from the Highway 1318 crossing of Tule Creek. They ran until the 1930s when some were buried by silt. Just over a half-mile downstream from the Highway 1318 crossing were Elkins Springs, now, long dry. Edwards Springs were 1.2 miles upstream from the Highway 1318 crossing. They flowed in winter until drying up in 1956. Poff Springs were 0.62 miles downstream from the Highway 146 crossing and 3.1 miles north-northeast of Tulia. They ceased flowing about 1940. Faulkner Springs were in Mackenzie Park in southeast Tulia, and flowed until the 1930s. Maupin Springs, 1.8 miles upstream from Highway 87 flowed until the 1920s. Hardy Springs, 3.1 miles past the Highway 87 crossing, are dry.

TERRY COUNTY: Springs in Terry County issue primarily from Ogallala sand and caliche, and in modem times, are highly wet-weather dependent. In February 2005 abundant summer, fall, and early winter rainfall in 2004 contributed to a renewal of some springs and seeps that generally flow from Ogallala sands. Some on the perimeter of saline lakes are not Ogallala, but flow from a Cretaceous outcrop exposed at the surface. Many observations are of pools only, without measurable flow, probably supported by slow seeps. Several seeps were noted on dryland farmland on the Terry-Lynn County line. Several springs and seeps were also noted along Sulphur Springs Draw. Water had not been seen to stand in the draw for nearly 60 years prior to the 2004 wet-weather-related events. A draw running from southeast Terry County into Lynn County contained a small lake lying in Terry County, probably spring or seep-fed. Decline of the groundwater level has been a factor in the demise of most springs and seeps in this county. At Rich Springs at Rich Lake, 4.3 miles south-southeast of Meadow, water issued from Tahoka Sand on Duck Creek shale. Brune measured flow from springs at the north end of the lake totaling 19 gallons per minute in October 1978 and noted the presence of many other very small springs flowing around the lake. Rich Lake has historically been important to sandhill cranes as a roost site. Local anecdotal information indicated that in previous times, the lake rose before rains, indicating that springs and the lake were impacted by barometric pressure. Mound Springs at Mound Lake, 10.5 miles east- northeast of Brownfield was documented by Brune as flowing 63.3 gallons per minute of highly saline water in December of 1975. This water fed into Mound Lake. On South Lost Draw, 10.5 miles southeast of Brownfield, Seven Lakes was fed by numerous springs and seeps, with the springs increasing flow before a rain when barometric pressure changed. Brune documented the historic presence of many small springs along Sulphur Springs Draw 6.21 miles east-southeast of Wellman. Many of these seep-fed lakes and pools have historically been important to wildlife including sandhill cranes and waterfowl.

YOAKUM COUNTY: Brune noted following studies in March 1977 that springs and seeps formerly existed along the major draws in Yoakum County, flowing mainly from Ogallala and more recent sands, but decline of the water table resulted in all of the springs of the county drying up. Oho Springs were in New Mexico, .3.1 miles west of Bronco, Texas. Ulou was downstream on Sulphur Springs Draw, about halfway between Bronco and Plains, where springs once likely existed. Other springs also likely existed farther downstream on Sulphur Springs Draw. Southwest of Plains 9.9 miles, Ink Basin was once a seep-fed freshwater basin but has remained dry since 1949. Evidence of springs was also found present in Lost Draw in the northeast part of the county.

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Implementation Status of Projects Identified in 2021 Plan

REGIONAL WATER PLAN WMS/PROJECT DATA						ANTICIPATED/ESTIMATED (OR ACTUAL[1]) IMPLEMENTATION ACTIVITIES AND DATES																	
Water Management Strategy/Project Name	Project Sponsor	WMS Project Sponsor Region	Online Decade	Capital Cost	Anticipated Footprint Acreage (acres)	SPONSOR AUTHORIZATION	PERMITTING STATUS (as applicable)									PLANNING, DESIGN, AND CONSTRUCTION STATUS						TOTAL FUNDS EXPENDED TO DATE	Other significant activities completed (summary)
							STATE WATER RIGHT STATUS				FEDERAL 404 PERMIT STATUS (if applicable)		DESALINATION PERMIT STATUS		OTHER KEY PERMITS	GEOTECH/DESIGN	LAND ACQUISITION		CONSTRUCTION				
						Date(s) that the sponsor took an affirmative vote or other action to make expenditures necessary to construct or file applications for state or federal permits (date(s))	Anticipated (or actual) TCEQ application filed (date)	Anticipated (or actual) State Water Right Permit Administratively Complete (date)	Anticipated (or actual) Draft State Water Right Permit Issued (date)	Anticipated (or actual) Date Final State Water Right Permit Issued (date)	Anticipated (or actual) application for permit filed (date)	Anticipated (or actual) permit issuance (date)	Anticipated (or actual) diversion permit issued (date)	Anticipated (or actual) Discharge/Disposal Permit Issued (date)	Summary of other permits and status (summary)	Generally describe the types and amount (as %s) of geotechnical/ reconnaissance/ engineering feasibility or other technical, testing, and/or design work etc. performed to date (summary)	Percent Land Acquisition Completed (%)	Anticiptated land acquisition completion (date)	Anticipated start of construction (Date)	Percent construction completed (%)	Anticipated construction completion (date)	Rough approximation of the total expenditures, to date, on ALL activities related to project implementation to date (millions of $s)	
Lake 7 Reuse	City of Lubbock	Region O	2030	526580000	858.4	4/17/2006	10/17/2005	4/17/2006	11/15/2021	3/14/2024	1/31/2026	1/1/2030	N/A	N/A	Potential TPDES permit amendments for changes in discharges	Conceptual design completed, which includes updated flood hydrology (PMF) routing and conceptual spillway design, and preliminary geotechnical investigation (4 borings) and conceptual geotechnical design.	85	12/31/2025	1/1/2031	0	1/1/2032	18	An initial Environmental Information Document was prepared in support of TCEQ water rights permit application. This included initial environmental field work to delineate wetlands and waters of the U.S., and identify the presence of state or federally listed species. Other water right permit amendments have been completed to support the Lake 7 water right (indirect reuse, etc.). Initial evaluations of other water supply strategies have been completed, such as ASR, DPR, and brackish groundwater. Costs for those evaluations are not included in the total funds expended to date.

FOOTNOTE 1 : ANY DATE ENTERED THAT IS PRIOR TO ADOPTION OF THE REGIONAL WATER PLAN IS ASSUMED TO BE AN 'ACTUAL' DATE

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Comments Received on Initially Prepared Plan and Response to Comments

Comments Received on Initially Prepared Plan and Response to Comments

This appendix will contain comments received on the Initially Prepared Plan and response to these comments in the Final Regional Water Plan submitted to the TWDB in October 2025.