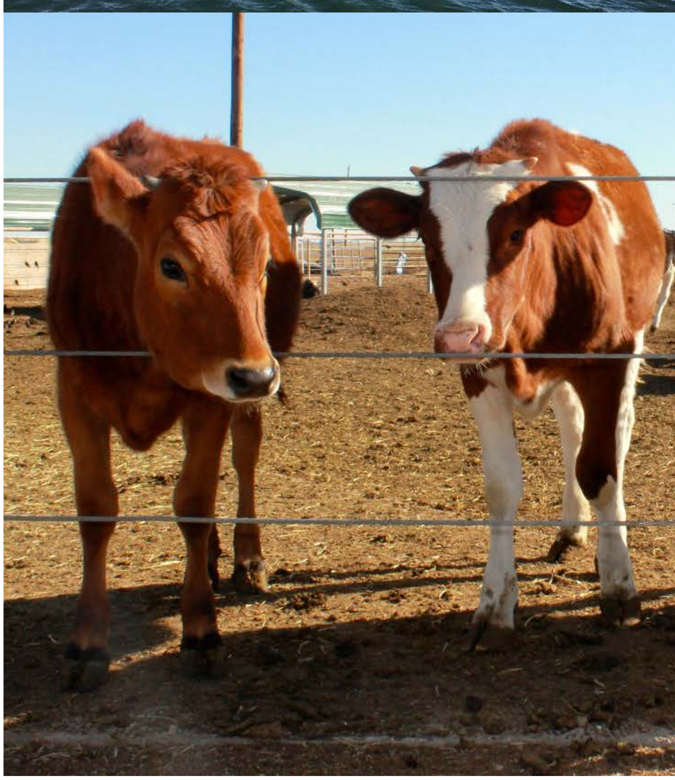

2021 Llano Estacado Regional Water Plan

November 2020

South Plains Association Of Governments

HDR

INTERA GEOSCIENCE & ENGINEERING SOLUTIONS

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2021 Llano Estacado Regional Water Plan

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

This regional water plan is released for planning purposes on October 28, 2020, by HDR Engineering, Inc., 1917 S 67th Street, Omaha, NE 68106-2973, Texas Board of Professional Engineers and Land Surveyors Registered Firm F-754, Texas Board of Professional Geoscientists Firm No. 50226 and the following individuals presented below.

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2021 Llano Estacado Regional Water Plan

November 2020

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

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Jason Coleman, PE *Water Districts*	Charles (Charlie) Morris *Counties*
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Joey Hardin *Industries*	Jeffrey Snyder *Municipalities (Medium) 10-30,000*
Ronnie Hopper *GMA 2*	Aubrey A. Spear, PE *Municipalities (Large) 30,000 or more (Chairman)*
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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
DB22	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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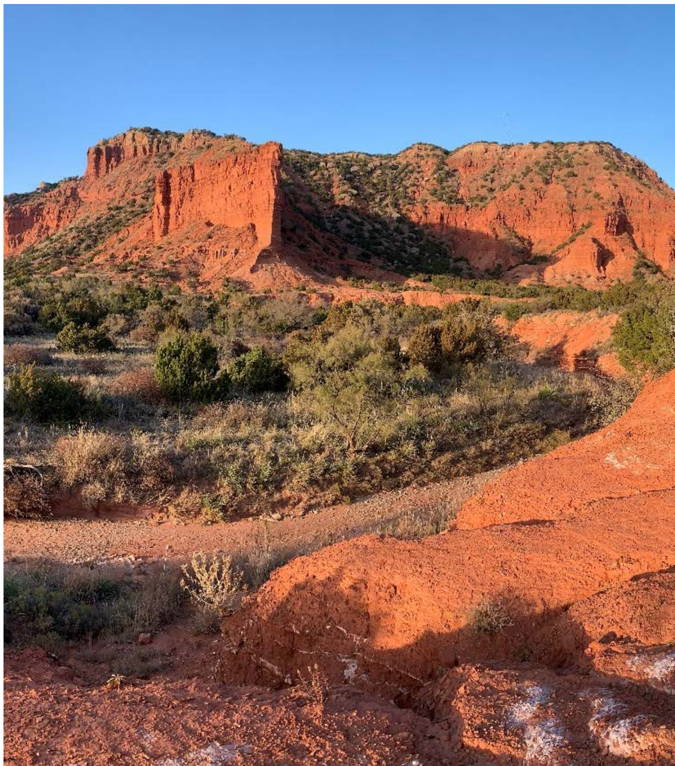

Executive Summary

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Executive Summary

[31 TAC §357.50]

ES.1 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 2017 State Water Plan* (2017 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 goal of the regional water planning process is to ensure that Texas has adequate water supplies in times of drought.

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.

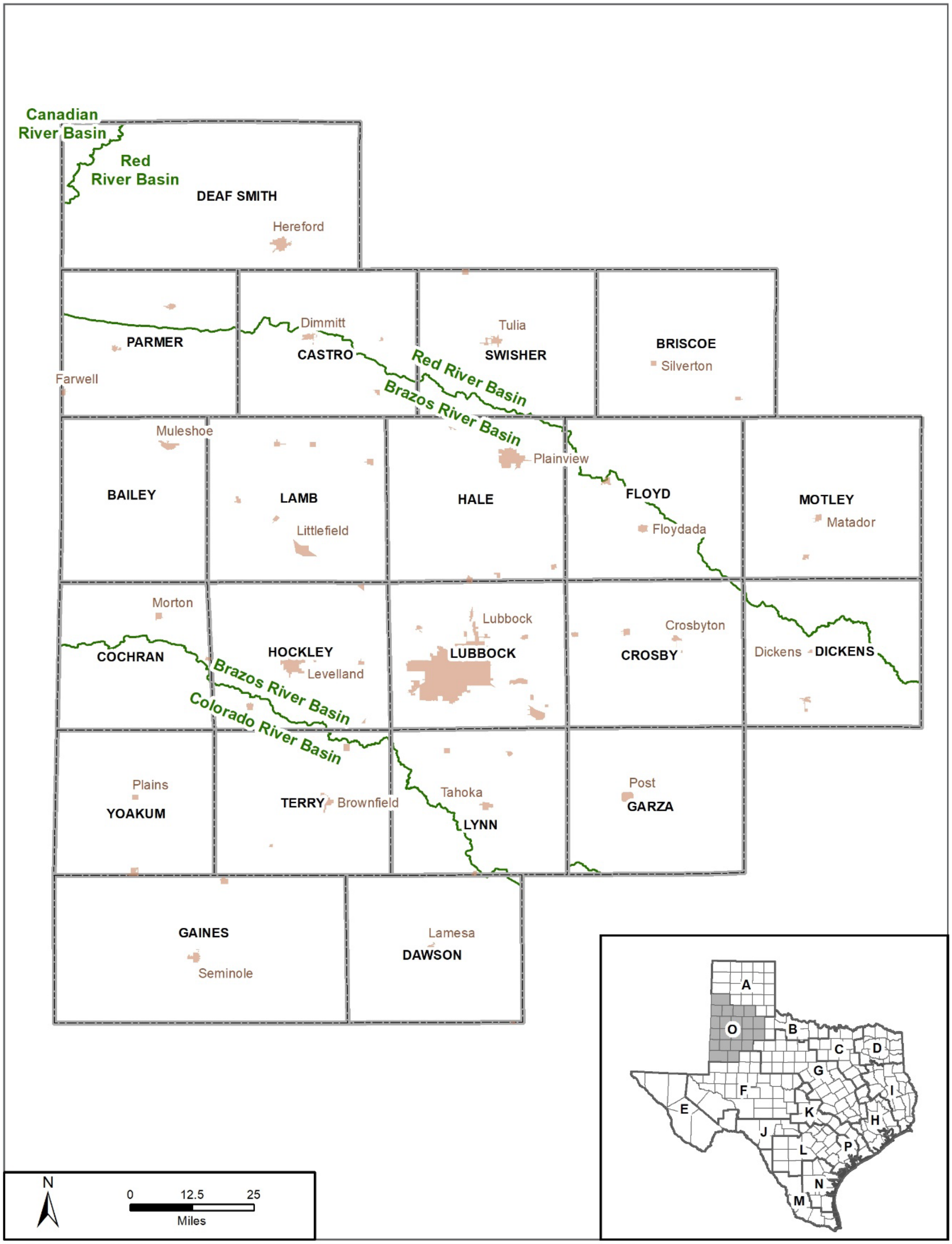

Figure ES-1. Llano Estacado Regional Water Planning Area

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 2021 Llano Estacado Regional Water Plan (LERWP), members of the LERWPG Executive Committee included Chairman Aubrey A. Spear, PE, Vice-Chairman Mark Kirkpatrick, and Secretary-Treasurer Doug Hutcheson from 2016 through mid-2019, followed by Dr. Ken Rainwater, PE.

The South Plains Association of Governments (SPAG) serves as the political subdivision and administrator for developing the LERWP. Kelly Davila, SPAG's Director of Regional Services, currently serves as the LERWP administrator for SPAG, assisted by Belinda Solis, Gynova Samples, 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, 20 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 2021 LERWP (both current and recently resigned).[1]

[1] LERWPG. 2019. Llano Estacado Regional Water Planning Group SPAG http://www.llanoplan.org/

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.

Table ES-1. Current and Recently Resigned Llano Estacado Regional Water Planning Group Membership, as of November 2020

Interest Group	Name	Affiliation
Voting Members		
Agricultural	Mark Kirkpatrick	Agricultural Producer, Garza County
Agricultural	Chris Grotegut, DVM	Veterinarian / Agricultural Producer, Deaf Smith County
Agricultural	Delmon Ellison, Jr. (former)	Agricultural Producer, Gaines County
Agricultural	Harry DeWit	Blue Sky Farms
Agricultural	Jimmy Wedel (former)	Wedel Farms
Agricultural	Benjamin (Ben) Weinheimer, Sr. PE	Texas Cattle Feeders Association
Counties	Charles (Charlie) Morris	Dickens County Commissioner #3
Electric Generating Utilities	Bret Yeary, PE	Golden Spread Electric Cooperative
Electric Generating Utilities	Shane McMinn, PE (former)	Golden Spread Electric Cooperative
Environmental	Jim Steiert	West Texas Rural Telephone Cooperative
Groundwater Management Areas #2	Ronnie Hopper	Agricultural Producer, Hale County
Groundwater Management Areas #6	Carrie Dodson	Gateway Groundwater Conservation District
Groundwater Management Areas #6	Jack Campsey (former)	Gateway Groundwater Conservation District
Industries	Joey Hardin	RAW Oil & Gas
Water Utilities	Kent Satterwhite, PE	Canadian River Municipal Water Authority
Water Utilities	Harvey Everheart (former)	Mesa Underground Water Conservation District
Water Utilities	Nathaniel (Shane) Jones	White River Municipal Water District
Municipalities (Small) Less than 10,000	Alan Monroe	City of Friona

Table ES-1. Current and Recently Resigned Llano Estacado Regional Water Planning Group Membership, as of November 2020

Interest Group	Name	Affiliation
Municipalities (Small) Less than 10,000	John Taylor (former)	City of Friona
Municipalities (Small) Less than 10,000	Doug Hutcheson (former)	City of Wolfforth
Municipalities (Medium) 10-30,000	Jeffrey Snyder	City of Plainview
Municipalities (Medium) 10-30,000	Tom Simons (former)	City of Hereford
Municipalities (Large) 30,000 or more	Aubrey A. Spear PE	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	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	Jean Devlin	n/a
Texas Department of Agriculture (TDA)	Carol Faulkenberry	n/a
Texas Commission on Environmental Quality (TCEQ)	Jason Lindeman	n/a
Texas Parks and Wildlife Department (TPWD)	John Clayton	n/a
Texas State Soil and Water Conservation Board	Rusty Ray	n/a
Designated liaison from adjacent regional water planning group (Brazos G)	Tommy O'Brien, PE	City of Abilene

The regional water plans are developed on a 5-year cycle, with previous plans developed in 2001, 2006, 2011, and 2016. 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 2021 regional water plans are due November 5, 2020[2]. The TWDB will then compile the 16 regional water plans into the 2022 State Water Plan.

The TWDB requires a planning horizon of 50 years from 2020 to 2070. 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

[2] A letter from TWDB (dated 8/11/2020) was provided to RWPG technical consultants extending the regional water plan deadline from October 14, 2020 to November 5, 2020.

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 2022 State Water Plan.

The *2021 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	Infrastructure Financing
Chapter 10	Public Participation and Adoption of Plan
Chapter 11	Implementation and Comparison to Previous Regional Water Plans

ES.2 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 fifth 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.

ES.3 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 2020, the Llano Estacado Region accounted for 1.8 percent of the state's total population and about 19 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 2020 to 2070 (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 2020 and 2070, respectively.

According to TWDB projections, the population of the Llano Estacado Region is projected to increase from 540,495 in 2020 to 801,719 by 2070 (an increase of 48.3 percent). Annual total water demands for the region are projected to decrease from 3,367,953 acre-feet (ac-ft) in 2020 to 2,452,931 ac-ft in 2070 (Table ES-2; Figure ES-3). Castro County projections indicate the highest water demand in the region of 388,413 ac-ft/yr in 2020 decreasing to 235,381 ac-ft/yr in 2070. Dickens County has the lowest projected water demand of 9,774 ac-ft/yr in 2020 increasing to 9,845 ac-ft/yr in 2070. Only Dickens County has 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 DB22.Table ES-2. Projected Population and Water Demands in the Llano Estacado Region

	2020	2030	2040	2050	2060	2070
Population	**540,495**	**594,391**	**645,980**	**697,869**	**750,858**	**801,719**
Water User Groups	**Water Demand (acre-feet per year)**					
IRRIGATION	3,182,630	3,182,630	2,719,937	2,446,236	2,299,692	2,215,638
LIVESTOCK	41,589	46,096	49,276	52,721	56,453	60,304
MANUFACTURING	10,881	12,341	12,341	12,341	12,341	12,341
MINING	16,869	18,021	16,518	14,345	12,375	10,890
MUNICIPAL	94,899	101,787	108,839	116,359	124,644	132,673
STEAM ELECTRIC POWER	21,085	21,085	21,085	21,085	21,085	21,085
Llano Estacado Region Total	**3,367,953**	**3,381,960**	**2,927,996**	**2,663,087**	**2,526,590**	**2,452,931**

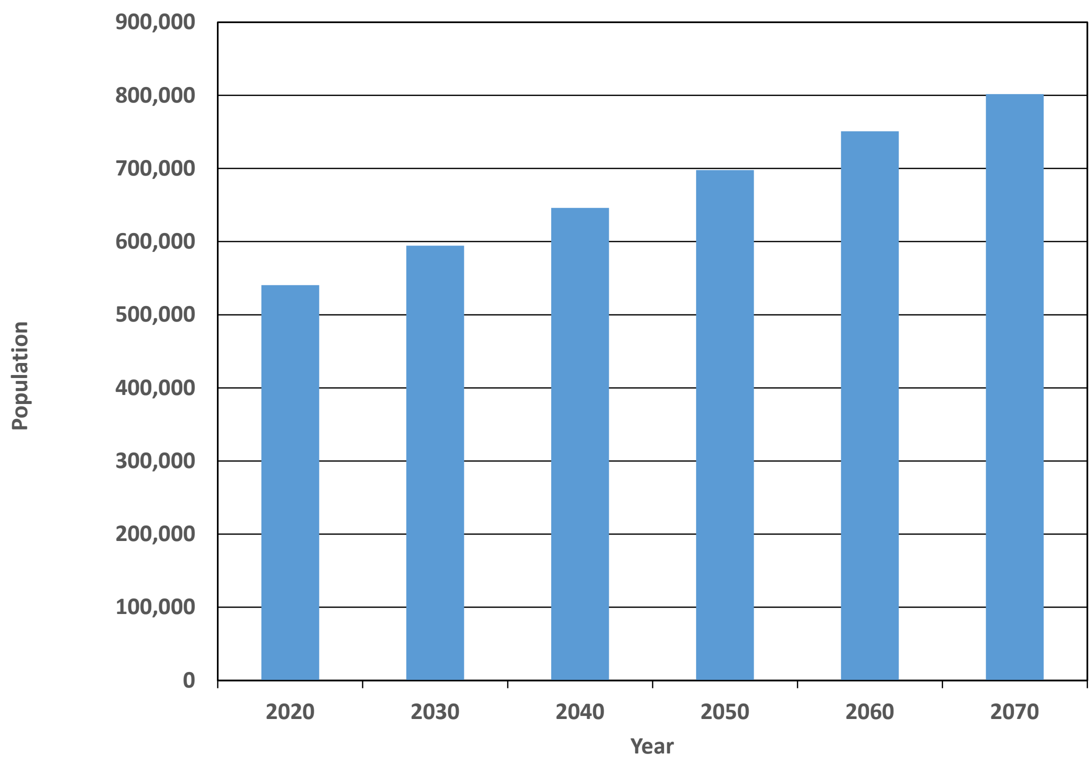

Figure ES-2. Llano Estacado Region Projected Population

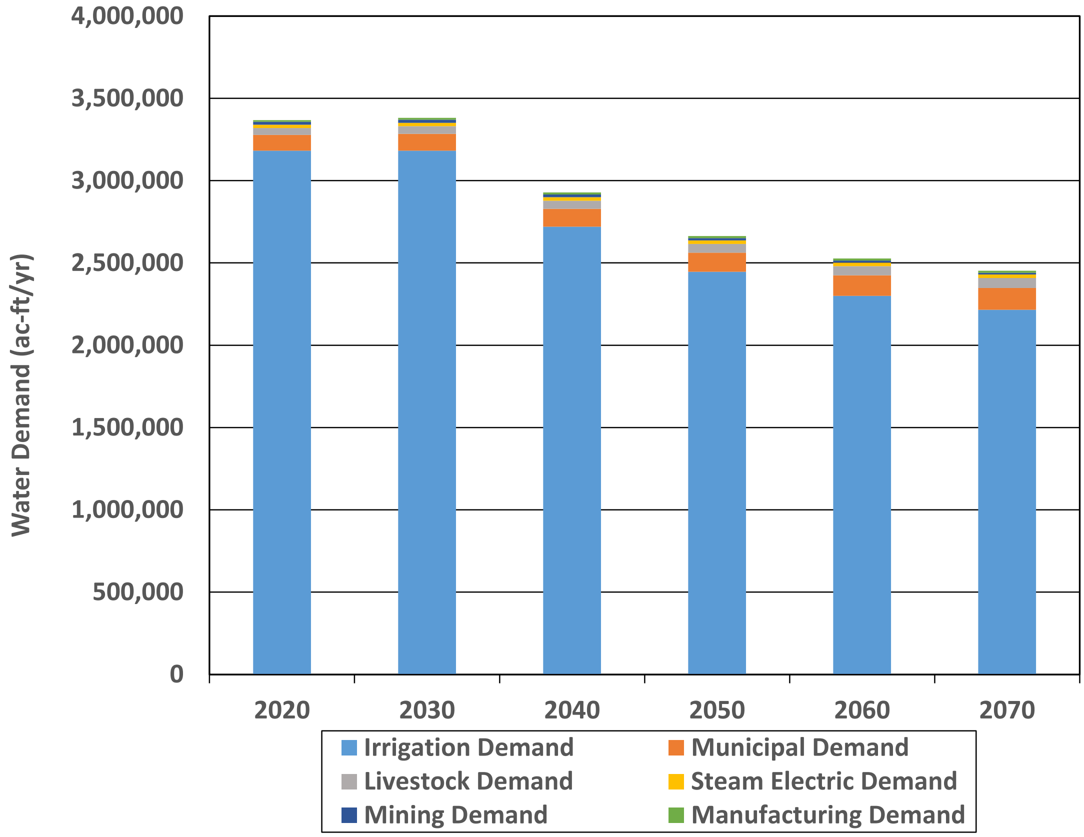

Figure ES-3. Llano Estacado Region Projected Total Water Demand

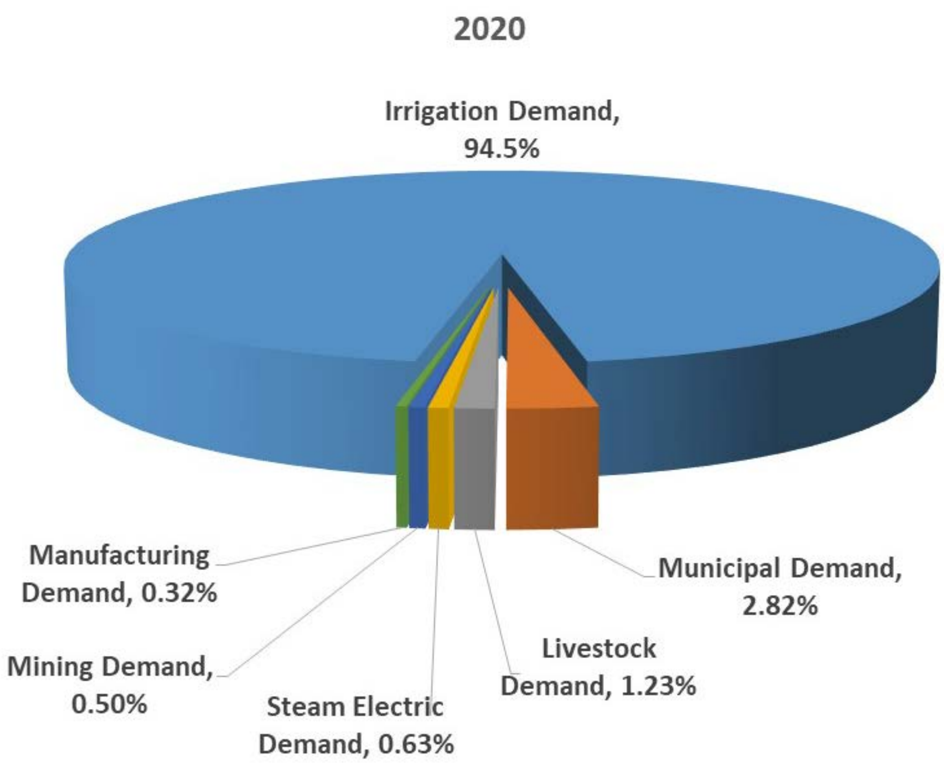

Figure ES-4. Total Water Demand in 2020

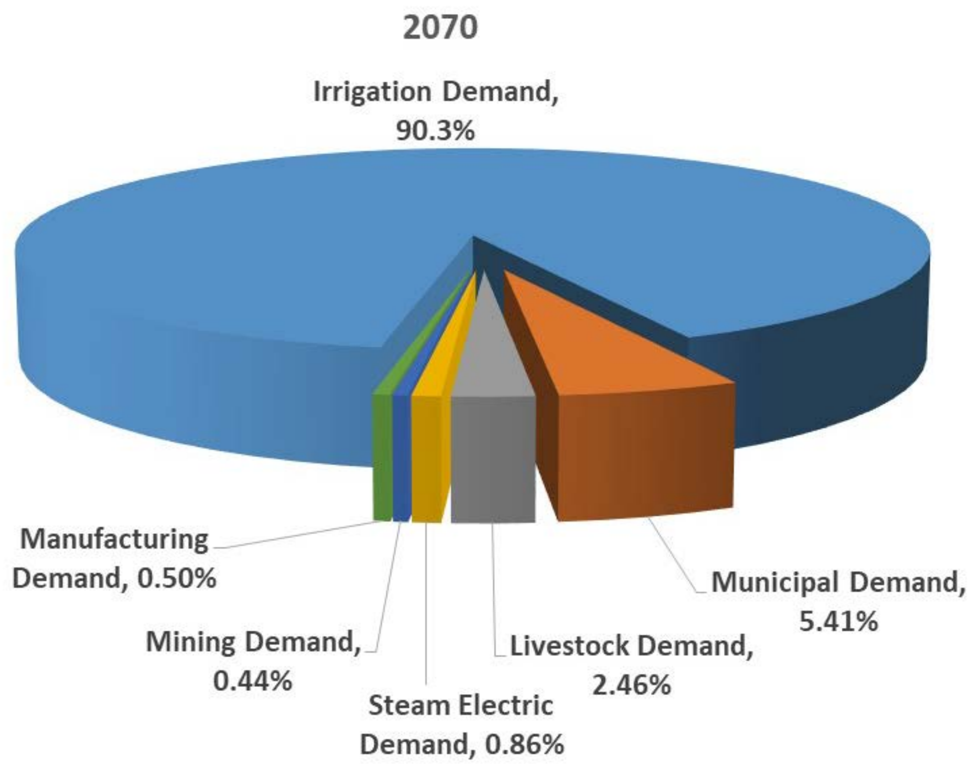

Figure ES-5. Total Water Demand in 2070

ES.4 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 19 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*[3], 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

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

(Region A) assessed Lake Meredith to have a firm yield of 28,221 ac-ft/yr in 2020. LAH's firm yield was calculated at 21,400 ac-ft/yr in 2020.

Table ES-3. Surface Water Supplies

Source	Annual Quantity Available (acre-feet)					
	2020	2030	2040	2050	2060	2070
Lake Alan Henry	21,400	20,940	20,480	20,020	19,560	19,100
Lake Mackenzie	4,530	4,530	4,530	4,530	4,530	4,530
White River Reservoir	0	0	0	0	0	0
Lake Meredith*	21,400	21,400	21,400	21,400	21,400	21,400
Reservoir Total	**25,930**	**25,470**	**25,010**	**24,550**	**24,090**	**23,630**
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	**26,048**	**25,588**	**25,128**	**24,668**	**24,208**	**23,748**

* Lake Meredith is located in the Panhandle Region (Region A).

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 October 2016, GMA 2 officials adopted a DFC for the ETHP Aquifer to be an average drawdown between 23 and 27 feet. The drawdown is calculated from the end of 2012 conditions to the year 2070.

In 2020, nearly 3.1 million ac-ft of groundwater are available in the Llano Estacado Region, with the ETHP Aquifer accounting for 98 percent of the supply. By 2070, this volume is reduced to 1 million 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 10,889 ac-ft in 2020, increasing to 15,852 ac-ft in 2070. 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.

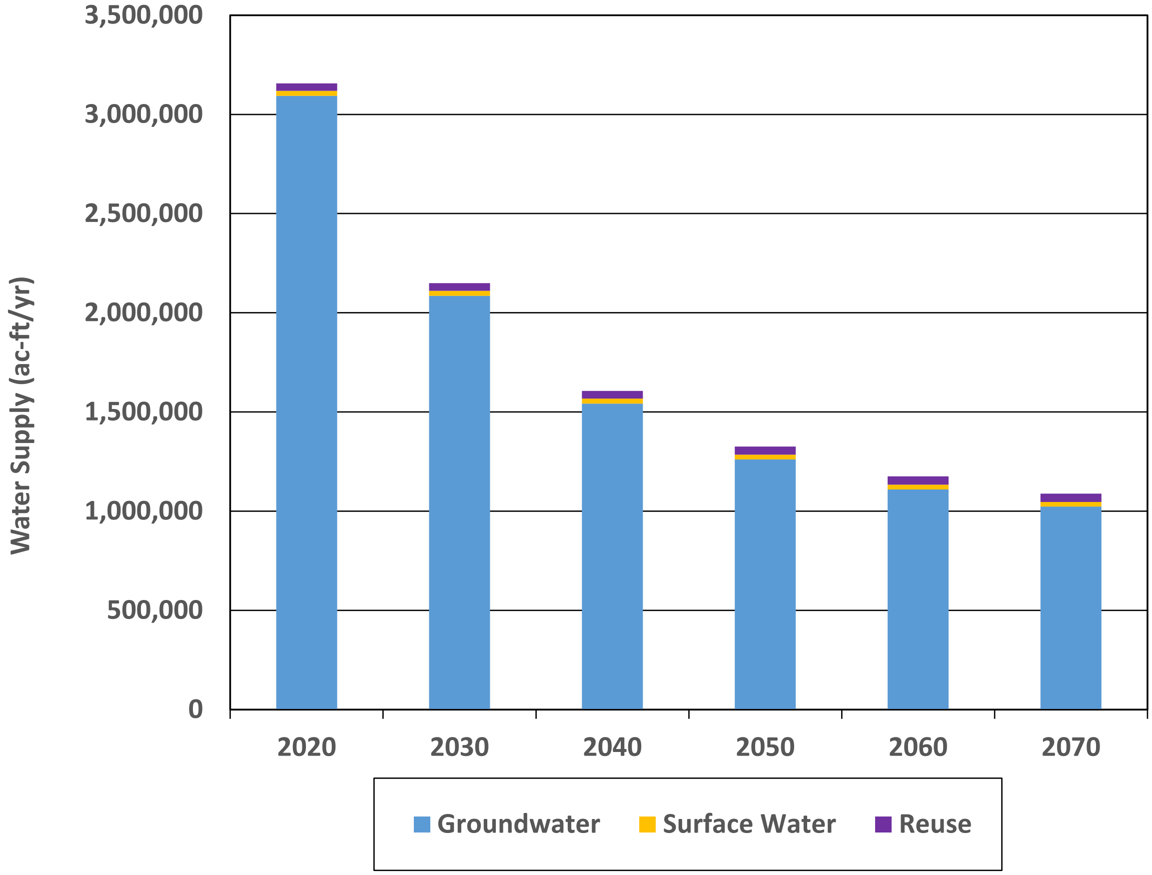

Figure ES-6. Total Available Supplies in the Llano Estacado Region

ES.5 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 2020 are approximately 726,000 ac-ft/yr, increasing to nearly 1.5 million ac-ft/yr by 2070 (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 (Crosby, Gaines, Lubbock, and Terry) are projected to have at least one WUG with a municipal need during the planning period. Eighteen counties (all counties, except Dickens, Garza, and Motley) are projected to have an irrigation need, and three counties (Bailey, Deaf Smith, and Lamb) are projected to have a livestock water need during the planning period.

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

	Annual Water Need (acre-feet)					
Water User Group	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	4,345	9,345	15,418	21,861	30,062	36,931
Irrigation	705,992	1,440,091	1,450,917	1,446,461	1,445,719	1,445,026
Livestock	112	122	844	2,041	3,689	5,442
Manufacturing	5,454	6,482	6,482	6,482	6,482	6,482
Mining	10,118	10,503	9,517	8,145	6,908	6,016
Steam Electric	0	0	0	0	0	0
Total	**726,021**	**1,466,543**	**1,483,178**	**1,484,990**	**1,492,860**	**1,499,897**

The LERWPG identified water management strategies (WMSs) to meet specific water user needs. Conservation for all water users with needs was evaluated as a way 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; and
- 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-5. Strategy evaluations show that conservation is projected to provide 115,256 ac-ft/yr of water savings by 2070. New groundwater development is projected to provide 32,000 ac-ft/yr by 2070. Alternate WMSs include those shown in Table ES-6.

Table ES-5. Summary of Strategies Recommended for WUGs and/or WWPs

Recommended Strategies	Entity using Strategy	County	First Decade Average Annual Unit Cost ($/ac-ft)	Supply Developed (ac-ft/yr)						Total Project Cost ($)
				2020	2030	2040	2050	2060	2070	
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
Jim Bertram Lake 7	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)	Mining	Crosby, Dawson, Hale, Lamb, Lubbock, Lynn, Terry, Yoakum	Varies	11,165	11,165	11,165	11,165	11,165	11,165	$28,168,000

Table ES-5. Summary of Strategies Recommended for WUGs and/or WWPs

Recommended Strategies	Entity using Strategy	County	First Decade Average Annual Unit Cost ($/ac-ft)	Supply Developed (ac-ft/yr)						Total Project Cost ($)
				2020	2030	2040	2050	2060	2070	
Additional Groundwater Development (Ogallala)	Manufacturing	Deaf Smith, Gaines, Hale, Lubbock	Varies	7,250	7,250	7,250	7,250	7,250	7,250	$17,962,000
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	$2,021	-	-	800	800	800	800	$9,968,000
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)	County-Other	Gaines	$208	-	1,930	1,930	1,930	1,930	1,930	$4,159,000
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-6. Summary of Alternate Water Management Strategies

Recommended Strategies	Entity using Strategy	County	First Decade Average Annual Unit Cost ($/ac-ft)	Supply Developed (ac-ft/yr)						Total Project Cost ($)
				2020	2030	2040	2050	2060	2070	
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

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 2017 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 2021 LERWP, unmet needs again exist for irrigation and livestock water users (Table ES-7).

Table ES-7. Unmet Needs in the Llano Estacado Region

Water User Group	Annual Water Need (acre-feet per year)					
	2020	2030	2040	2050	2060	2070
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

ES.6 Implementation

Implementation of the 2021 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 2021 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.

ES.7 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 2021 LERWP, including CRMWA strategies developed by the Panhandle Region that are recommended strategies to meet needs in the Llano Estacado Region.

- Eighteen counties (all counties, except Dickens, Garza, and Motley) are projected to have an irrigation need, and three counties (Bailey, Deaf Smith, and Lamb) are projected to have a livestock water need during the planning period. 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.

ES.8 Other Aspects of the 2021 Llano Estacado Regional Water Plan

In addition to providing a roadmap for developing supplies to meet future water needs in the region, the 2021 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.

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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

[4] Texas Water Development Board (TWDB). 2019. http://www.twdb.texas.gov/waterplanning/rwp/regions/o/index.asp

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 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 metropolitan area of greater than 300,000 people[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] USCB. 2019. Quick Facts Lubbock County Texas. Population estimate July 1, 2018. https://www.census.gov/quickfacts/lubbockcountytexas

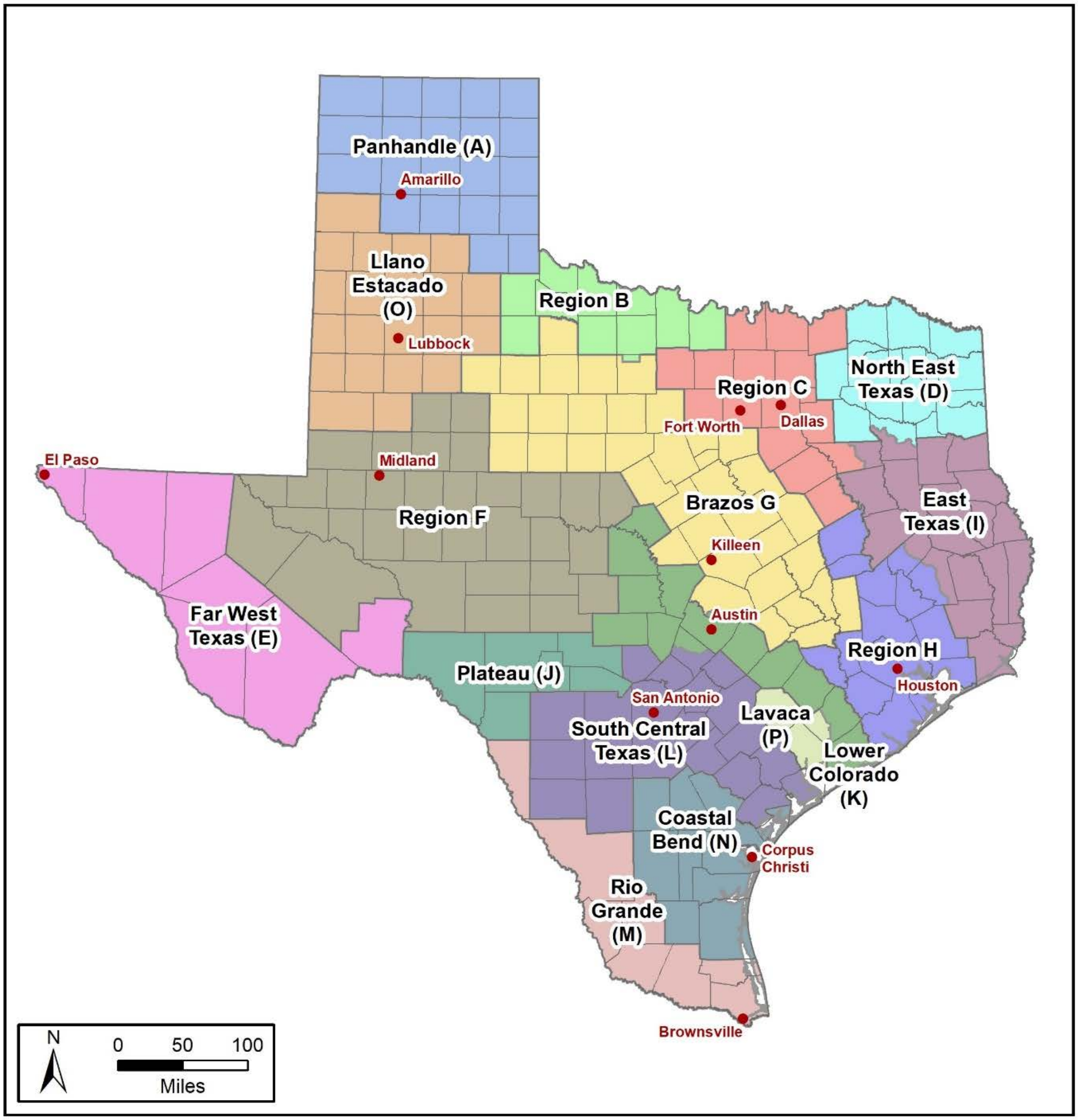

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Figure 1.1. Water Planning Regions of Texas

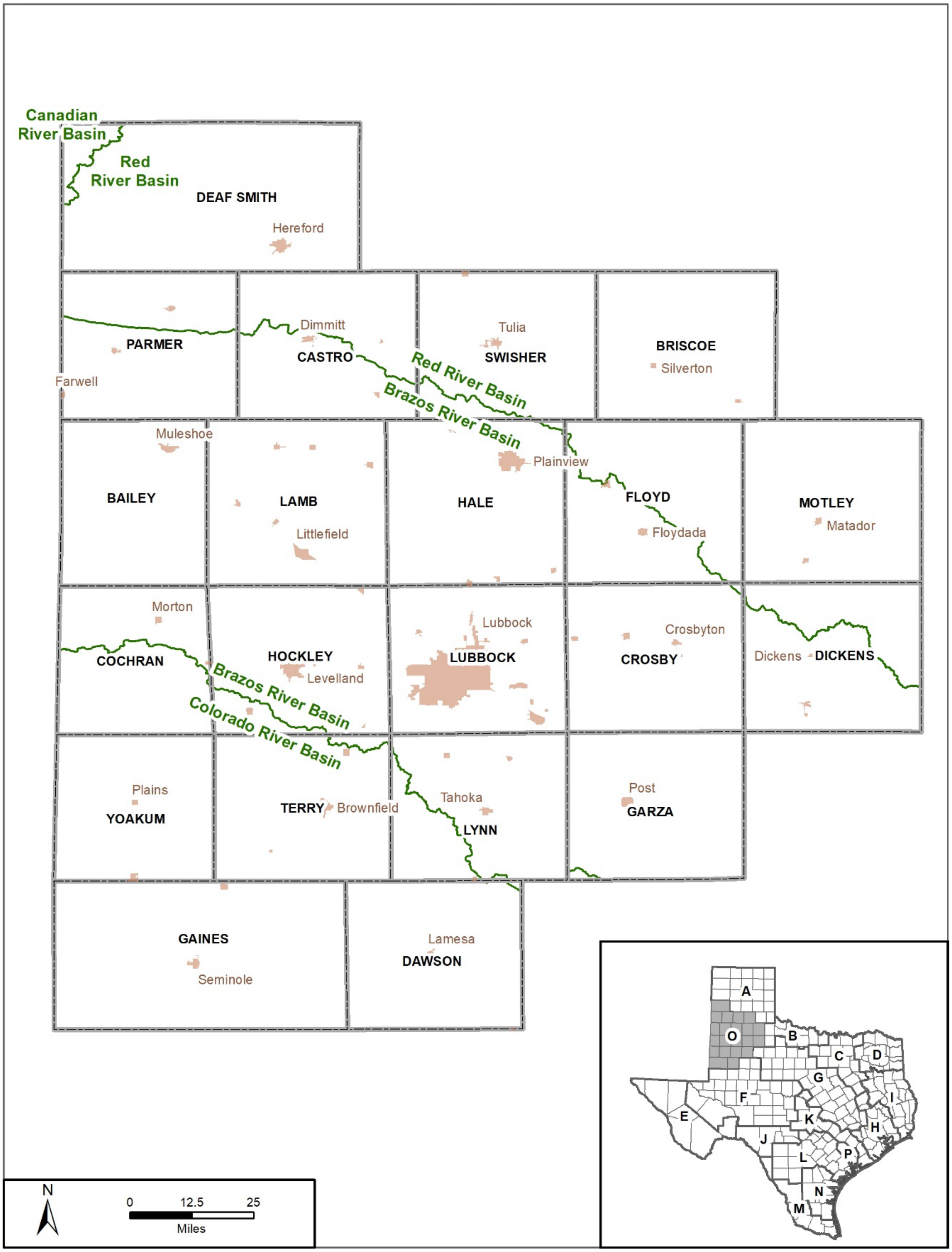

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Figure 1.2. Llano Estacado Region

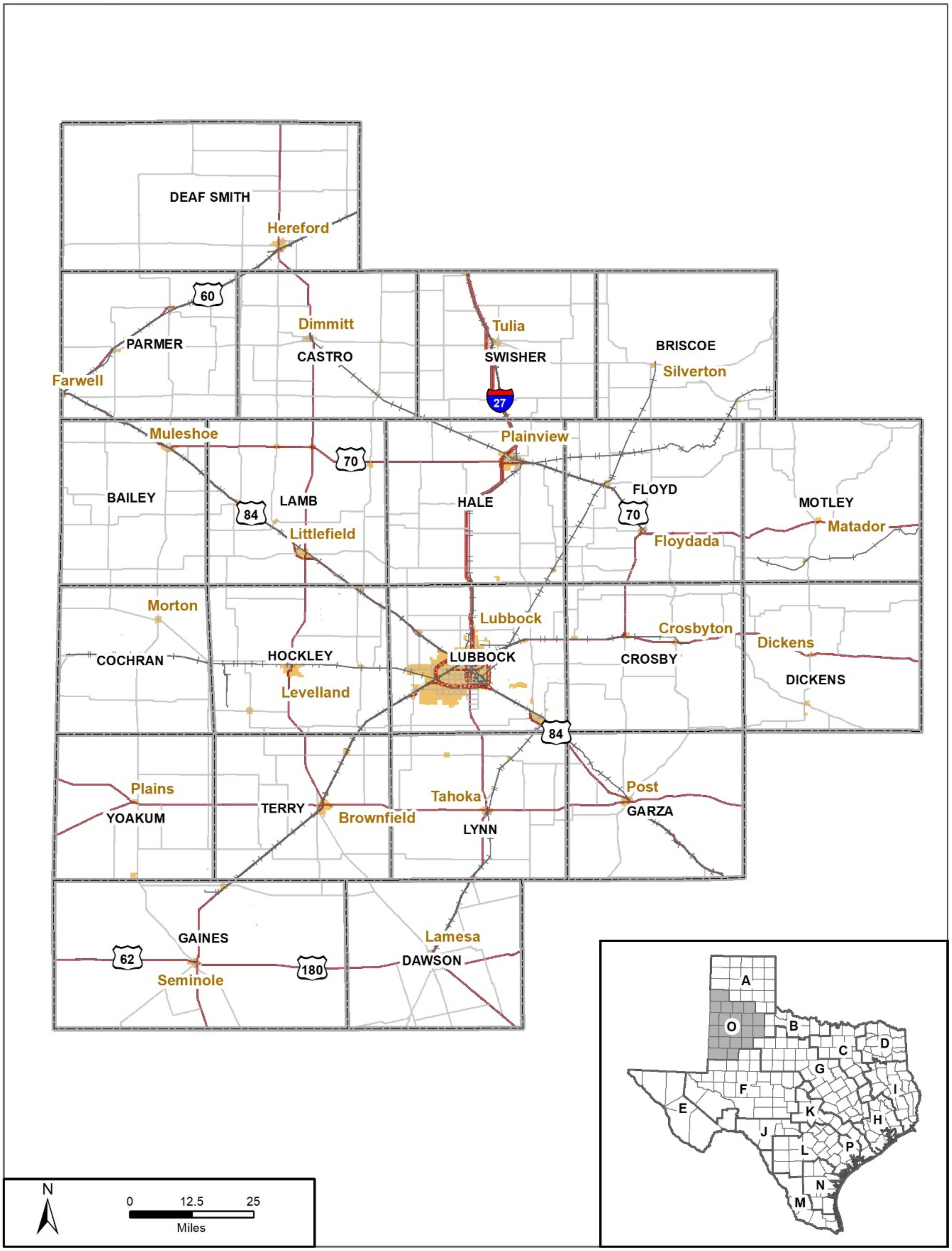

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Figure 1.3. Cities of the Llano Estacado Region

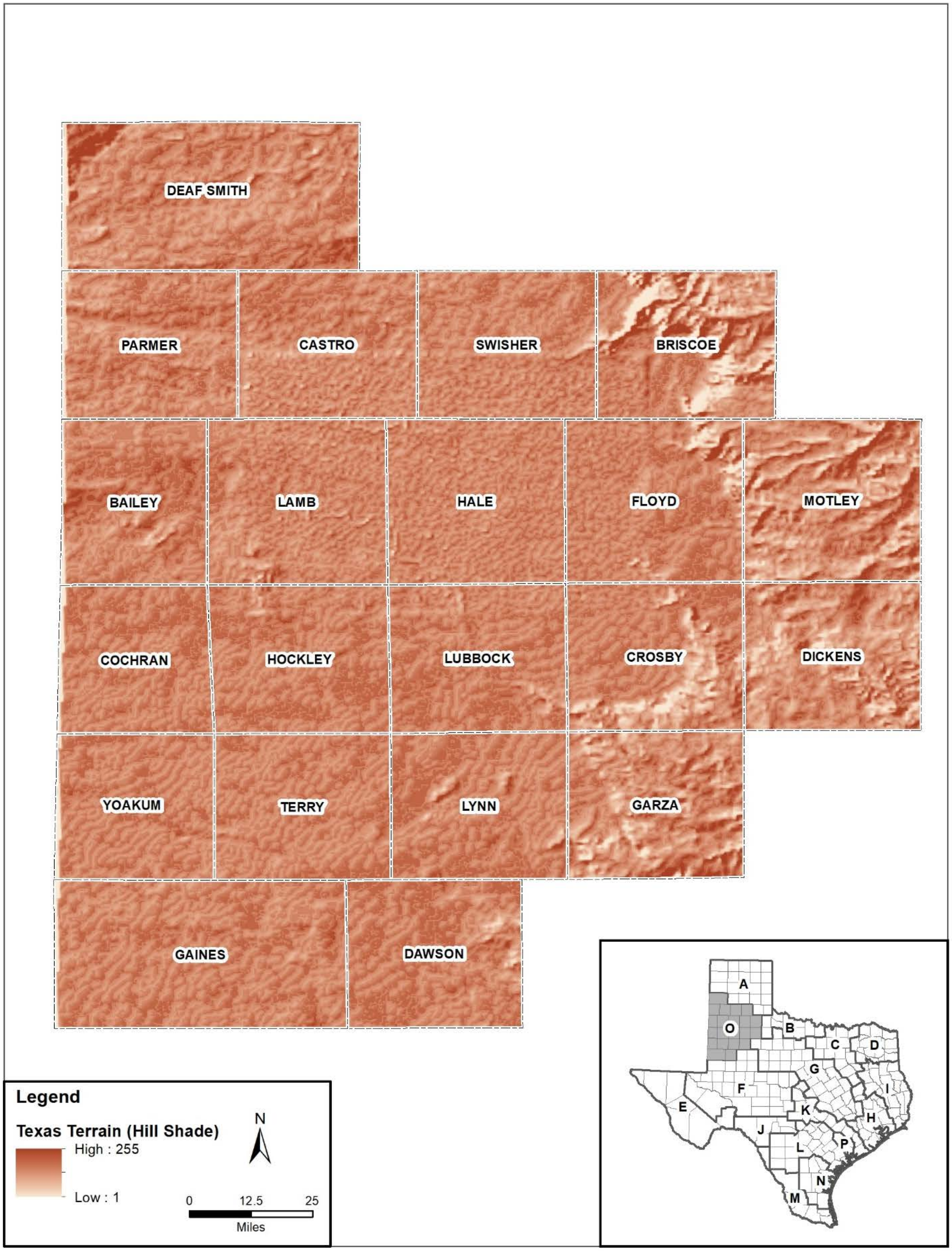

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Figure 1.4. Topography Shaded Relief Map of the Llano Estacado Region

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 members is presented in Table 1-1, which includes TWDB appointees and members appointed from nominations by local citizens[6]Table 1-1. 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 Membership

Member	Term	Interest Category
Melanie Barnes, PhD	2019	Public
Chris Grotegut, DVM	2021	Agricultural
Carrie Dodson	2022	Groundwater Management Areas #6
Jason Coleman, PE	2024	Water Districts
Jeffrey Snyder	2021	Municipalities (Medium) 10-30,000
Joey Hardin	2022	Industries
Bret Yeary, PE	2019	Electric Generating Utilities
Ronnie Hopper	2022	Groundwater Management Areas #2
Mark Kirkpatrick	2022	Agricultural
Jeffrey (Jeff) Sammon	2022	River Authorities
Don McElroy	2022	Small Business
Charles (Charlie) Morris	2022	Counties
Ken Rainwater, PhD, PE	2022	Public
Kent Satterwhite, PE	2022	Municipal Water Supply Districts
Aubrey A. Spear, PE	2019	Municipalities (Large) 30,000 or more
Jim Steiert	2022	Environmental
Alan Monroe	2019	Municipalities (Small) Less than 10,000
Benjamin (Ben) Weinheimer, Sr. PE	2022	Agricultural
Shane Jones	2021	Municipal Water Supply Districts
Harry DeWit	2021	Agricultural

[6] LERWPG. 2019. Llano Estacado Regional Water Planning Group SPAG http://www.llanoplan.org/

Member	Term	Interest Category
Non-Voting Member	**Term**	**Representing**
Jean Devlin	n/a	TWDB Project Manager
Carol Faulkenberry	n/a	Texas Department of Agriculture
Jason Lindeman	n/a	Texas Commission on Environmental Quality
John Clayton	n/a	Texas Parks and Wildlife Department
Rusty Ray	n/a	Texas State Soil and Water Conservation Board
Tommy O'Brien, PE	n/a	Designated Liaison from adjacent regional water planning group (Region G)

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 Texas Administrative Code (TAC) §358.6 (relating to water loss audits).

[7] TWDB. 2018. Regional Water Planning In Texas. http://www.twdb.texas.gov/publications/shells/RegionalWaterPlanning.pdf?d=25882.86127198195

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 (ºF) in January to an average high of 93ºF 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*.

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 489,926 represents approximately 1.7 percent of the state total population of approximately 28.70 million persons in 2018[8]. Ten major cities with a population greater than 5,000 persons are located in the region, with these population centers relatively equality 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 and Slaton). Twelve counties in the region (Bailey, Briscoe, Castro, Cochran, Crosby, Dickens, Floyd, Garza, Lynn, Motely, Parmer, and Yoakum) have no cities with more than 5,000 persons.

Historical and Recent Trends in Population

The area's population has grown from 11,418 in 1900 to 489,926 in 2010[9] (Table 1-2). 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,

[8] U.S. Census Bureau (USCB). 2019. Quick Facts Texas. Population estimate July 1, 2018. https://www.census.gov/quickfacts/TX

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

including the use of agricultural inputs from the non-farm manufacturing, trades, and service sectors, including marketing and processing agricultural commodities.

Table 1-2. Population Growth (1900 to 2010) Llano Estacado Region[10 11 12]

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

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[13]. In 2007, there were 12,287 farms in the region. By 2017, there were 9,821 farms in the region[14 15].

Ten cities in the region have a population greater than 5,000 (Table 1-3). These larger urban areas constituted 66.2 percent of the region's 2010 population of 489,926, with

[10] USCB. 1196. Population of States and Counties of the United States: 1790-1990. March 1996. https://www.census.gov/population/www/censusdata/PopulationofStatesandCountiesoftheUnitedStates1790-1990.pdf

[11] Texas Health and Human Services. 2019. Texas Population, 2000. https://www.dshs.texas.gov/chs/popdat/ST2000.shtm

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

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

[14] U.S. Department of Agriculture (USDA). 2017. Census of Agriculture, Volume 1 Geographic Area Series. Table 1. County Summary Highlights: 2017.

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

most of this urban population located in the City of Lubbock, which had a 2010 population of 229,573 persons[16].

Table 1-3. Major Cities and U.S. Census Population (1990 to 2010) Llano Estacado Region[17] [18] [19]

City	County	1990		2000		2010	
		Population	Percent of Region	Population	Percent of Region	Population	Percent of Region
Brownfield	Terry	9,560	2.2	9,488	2.1	9,657	2.0
Hereford	Deaf Smith	14,745	3.4	14,597	3.2	15,370	3.1
Lamesa	Dawson	10,809	2.5	9,952	2.2	9,422	1.9
Levelland	Hockley	13,986	3.2	12,866	2.8	13,542	2.8
Littlefield	Lamb	6,489	1.5	6,507	1.4	6,732	1.4
Lubbock	Lubbock	186,206	42.5	199,564	44.0	229,573	46.9
Muleshoe	Bailey	4,571	1.0	4,530	1.0	5,158	1.1
Plainview	Hale	21,700	4.9	22,336	4.9	22,194	4.5
Seminole	Gaines	6,342	1.4	5,910	1.3	6,430	1.3
Slaton	Lubbock	6,078	1.4	6,109	1.3	6,121	1.2
Tulia	Swisher	4,699	1.1	5,117	1.1	4,967	1.0
Total		285,185	65.0	296,976	65.4	324,199	67.2

Demographic and Socioeconomic Characteristics

In terms of population density, Motley County is the least populated, with 1,201 residents or 1.2 persons per square mile (Table 1-4). Lubbock County had the highest population density in the region, with 278,831 residents or 311.3 persons per square mile. The regional average population density is 38.5 persons per square mile.

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

[17] 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

[18] 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

[19] 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

Table 1-4. County U.S. Census Population and Area for Llano Estacado Region[20]

County	Population (2010)	Area (sq. mi.)	Density (persons/sq. mi.)
Bailey	7,165	827	8.7
Briscoe	1,637	900	1.8
Castro	8,062	894	9
Cochran	3,127	775	4
Crosby	6,059	900	6.7
Dawson	13,833	900	15.4
Deaf Smith	19,372	1,497	12.9
Dickens	2,444	902	2.7
Floyd	6,446	992	6.5
Gaines	17,526	1,502	11.7
Garza	6,461	893	7.2
Hale	36,273	1,005	36.1
Hockley	22,935	908	25.2
Lamb	13,977	1,016	13.8
Lubbock	278,831	896	311.3
Lynn	5,915	982	6.6
Motley	1,210	990	1.2
Parmer	10,269	881	11.7
Swisher	7,854	890	8.8
Terry	12,651	889	14.2
Yoakum	7,879	800	9.9
Total	489,926	20,239	38.5

In 2010, the age distribution across the region was relatively uniform from county to county[21] (Table 1-5). 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).

With respect to the level of education, of those residents in the Llano Estacado Region who are 25 years of age or older, 79.9 percent have at least a high school diploma (State

[20] USCB. 2019. County Population by Characteristics: 2010-2018. https://www.census.gov/data/tables/time-series/demo/popest/2010s-counties-detail.html#par_textimage
[21] USCB. 2012. 2010 U.S. Census of Population and Housing, U.S. Department of Commerce, Washington, D.C.

of Texas average is 82.8 percent), while 22.5 percent have a college degree (State of Texas average is 28.7 percent) (Table 1-6)[22]. The region's unemployment rate was 3.6 percent in 2019[23]. Per capita income in 2017 was $48,431 for the region.

Table 1-5. Age Distribution of the U.S. Census Population in 2010 for Llano Estacado Region[24]

County	Population (2010)	Age Distribution (values are percent population)								
		0-4	5-14	15-19	20-24	25-34	35-44	45-54	55-59	60+
Bailey	7,165	10	17	7	6	13	11	12	6	18
Briscoe	1,637	6	12	6	4	10	11	15	7	30
Castro	8,062	9	18	8	6	12	11	13	7	18
Cochran	3,127	8	16	9	6	11	10	14	6	20
Crosby	6,059	8	15	8	5	11	11	13	6	23
Dawson	13,833	8	13	6	8	17	12	12	5	18
Deaf Smith	19,372	10	18	8	6	13	12	12	6	16
Dickens	2,444	5	11	6	5	14	12	15	6	26
Floyd	6,446	8	16	8	5	10	11	13	7	23
Gaines	17,526	10	19	9	7	14	12	13	5	13
Garza	6,461	6	10	8	10	18	12	15	7	15
Hale	36,273	8	16	8	8	13	12	13	5	17
Hockley	22,935	8	15	9	8	12	11	14	6	18
Lamb	13,977	8	16	8	5	11	11	14	6	21
Lubbock	278,831	7	13	8	12	15	11	12	5	15
Lynn	5,915	7	16	7	4	11	11	15	7	21
Motley	1,210	5	13	6	4	9	8	13	8	34
Parmer	10,269	9	17	9	6	13	12	13	5	16
Swisher	7,854	8	14	7	7	13	11	13	6	22
Terry	12,651	8	14	7	8	13	11	14	6	19
Yoakum	7,879	9	17	8	6	13	12	14	6	16
Total	489,926	10	17	7	6	13	11	12	6	18

[22] USCB. 2012. U.S. Census Educational Attainment 2013-2017 American Community Survey 5-Year Estimates. U.S. Department of Commerce, Washington, D.C.

[23] Texas Workforce Commission. Texas Labor Market Information, Austin, TX.

[24] USCB. 2019. County Population by Characteristics: 2010-2018. https://www.census.gov/data/tables/time-series/demo/popest/2010s-counties-detail.html#par_textimage

Table 1-6. Summary of Selected Socioeconomic Indicators (2017 and 2019) for Llano Estacado Region[21, 22, 23]

County	High School Graduates (% of Population) (2017)	College Graduates (% of Population) (2017)	Civilian Labor Force (2019)	Unemployment Rate (2019)	Median Household Income (2017)
Bailey	70.3	14.4	2,543	4.2	$43,523
Briscoe	80.6	21.9	536	4.7	$42,500
Castro	72.3	13.4	3,413	3.4	$44,643
Cochran	66.4	10.5	1,051	4.2	$37,500
Crosby	75.0	13.0	2,472	4.4	$38,674
Dawson	72.6	12.7	4,552	4.5	$43,201
Deaf Smith	73.0	14.2	8,350	3.2	$51,543
Dickens	80.3	15.2	645	5.1	$43,088
Floyd	73.9	17.4	2,589	5.3	$48,767
Gaines	61.7	11.2	9,516	2.8	$58,167
Garza	58.0	10.2	2,106	3.2	$53,832
Hale	75.4	16.1	12,328	5.0	$46,012
Hockley	77.3	13.6	11,574	3.3	$49,184
Lamb	73.7	16.4	5,119	4.9	$43,712
Lubbock	85.5	28.7	156,821	3.2	$49,078
Lynn	76.9	17.0	2,689	3.3	$44,922
Motley	89.9	15.6	424	4.5	$40,598
Parmer	71.3	16.1	4,740	2.7	$50,410
Swisher	77.1	13.0	2,648	4.6	$37,883
Terry	69.0	12.8	5,122	4.5	$42,441
Yoakum	70.2	15.1	3,646	3.2	$62,500
Region Totals	79.9	22.5	242,884	3.6	$48,431
State Totals	82.8	28.7	13,986,073	4.2	$57,051

1.3.2 Economics

The economy of the region in intertwined with the 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.

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 1-7)[25]. Reported production of these major crops is shown for each county of the region for 2017 (most recent census of agriculture).

All commodity farm sales in the Llano Estacado Region had a combined market value of over $7.0 billion in 2017. The major crops accounted for a combined market value of over $1.7 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 48 percent of cotton) and market value (28 percent) for the state.

Table 1-7. Crop Production in 2017 for Llano Estacado Region[26]

County	Selected Crops Harvested						
	Cotton (bales)	Wheat (bushels)	Corn (bushels)	Grain Sorghum (bushels)	Peanuts (lbs.)	Soybeans (bushels)	Hay and Haylage (tons)
Bailey	118,408	378,473	1,325,653	830,428	10,147,734	38,566	50,064
Briscoe	53,897	692,899	(D)	199,021	11,527,000	n/a	15,374
Castro	93,083	1,155,742	7,956,880	742,081	n/a	(D)	66,951
Cochran	189,612	376,748	1,515,038	1,229,473	65,649,055	n/a	1,974
Crosby	270,513	159,134	322,957	486,283	(D)	n/a	1,532
Dawson	314,844	128,806	n/a	168,405	59,008,273	(D)	14,643
Deaf Smith	68,084	3,437,887	6,310,519	2,268,866	n/a	14,776	115,135
Dickens	40,752	58,510	(D)	47,074	n/a	n/a	5,976
Floyd	323,467	1,392,148	2,068,204	450,448	n/a	(D)	7,809
Gaines	312,727	384,564	1,061,760	492,112	195,445,095	(D)	84,345
Garza	55,443	(D)	(D)	n/a	n/a	(D)	1,257

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

Table 1-7. Crop Production in 2017 for Llano Estacado Region[26]

County	Selected Crops Harvested						
	Cotton (bales)	Wheat (bushels)	Corn (bushels)	Grain Sorghum (bushels)	Peanuts (lbs.)	Soybeans (bushels)	Hay and Haylage (tons)
Hale	365,894	550,557	4,393,547	683,637	n/a	10,882	15,683
Hockley	233,521	32,817	1,497,554	2,842,016	2,891,690	8,148	5,208
Lamb	273,568	458,807	4,782,767	1,751,795	2,448,000	8,100	38,241
Lubbock	415,871	63,310	1,331,353	1,067,423	8,877,904	(D)	12,313
Lynn	359,853	158,761	848,220	885,753	(D)	n/a	4,358
Motley	6,495	(D)	(D)	(D)	n/a	n/a	5,859
Parmer	101,477	1,389,140	4,187,293	1,371,676	n/a	n/a	79,369
Swisher	189,255	1,759,092	1,126,467	924,189	n/a	n/a	24,562
Terry	290,740	292,218	648,351	391,875	67,788,441	(D)	5,928
Yoakum	169,701	94,246	790,586	748,379	102,145,273	n/a	4,162
Region Total	4,246,935	12,963,859	40,167,149	17,580,934	525,928,564	80,472	560,743
State Total	8,923,912	71,215,552	286,762,080	95,396,048	670,674,188	6,781,615	9,126,789
Region % State	47.6%	18.2%	14.0%	18.4%	78.4%	1.2%	6.1%

(D) = Withheld to avoid disclosing data for individual farms; n/a = not applicable; lbs = pounds

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[26] indicates that irrigated lands were approximately 2.012 million acres (26 percent) of the cropland in the region.

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 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

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

and equipment, and in some cases, individual farmers have built prototypes of equipment that specialized manufactures 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.

Dryland Crops

Dryland 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.

Livestock Production

Total livestock water use in 2017 accounted for 1 to 2 percent of the water demand in the Llano Estacado Region over the planning period from 2020 to 2070. 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[27]. U.S. Department of Agriculture (USDA) information indicates that the one-time feedlot capacity in 2017 was 1.53 million head in 2017 (Table 1-8).

Table 1-8. Livestock Numbers in 2017 for Llano Estacado Region[28]

County	2017 Livestock and Poultry						
	Feedlot Capacity (number)	Cattle & Calves (number)	Beef Cows (numbers)	Milk Cows (number)	Swine (Hogs & Pigs) (number)	Sheep & Lambs (number)	Poultry Layers (number)
Bailey	46,750	130,261	6,475	27,097	54	654	370

[27] Weinheimer, B. 2017. Personal communication, Texas Cattle Feeders Association, September 25, 2017.
[28] USDA. 2017. Agriculture Census. https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Texas/

Table 1-8. Livestock Numbers in 2017 for Llano Estacado Region[28]

County	2017 Livestock and Poultry						
	Feedlot Capacity (number)	Cattle & Calves (number)	Beef Cows (numbers)	Milk Cows (number)	Swine (Hogs & Pigs) (number)	Sheep & Lambs (number)	Poultry Layers (number)
Briscoe	-	21,864	11,423	-	-	-	50[a]
Castro	227,800	466,891	16,451	44,257	77	2,970	119
Cochran	2,550	9,927	2,932	-	12[a]	-	25[a]
Crosby	-	10,076	6,440	-	-	212[a]	225[a]
Dawson	-	5,584	3,463	-	670	224	165
Deaf Smith	583,100	592,087	18,272	40,528	155	784[a]	251
Dickens	-	24,878	13,068	-	178	245	397
Floyd	52,700	56,790	5,550	-	56	1,317	935
Gaines	4,250	11,737	8,365[a]	500[a]	12[a]	1,560	172
Garza		11,656	7,637	-	24[a]	12	-
Hale	68,000	132,013	6,742	22,580	342	1,248	1,370
Hockley	1,700	9,188	4,734	-	196	434	1,203
Lamb	106,250	181,045	9,362	37,301	9	377	272
Lubbock	42,500	40,121	5,872	362	3,173	1,856	105,775[a]
Lynn	-	8,338	2,796	-	487	814	255
Motley	-	22,449	12,261	-	-	94	-
Parmer	224,825	335,573	7,560	46,140	24[a]	31	100,750[a]
Swisher	173,400	219,839	12,303	-	24[a]	212[a]	327
Terry	-	17,975	6,065[a]	1,000a	193	212	64
Yoakum	-	9,112	3,768	-	360	312	-
Total	1,533,825	2,317,404	171,539	219,765	6,046	13,568	212,725

[a] Estimated since data withheld

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 2017, there were approximately 157,200 beef cows in the region (beef cows versus cattle and calves in Table 1-8), which is 3 percent of the state's total beef cow population (4,572,742). The leading counties in beef cow numbers are Deaf Smith, Castro, and Dickens.

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.

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. In 2017, fed cattle inventory included 1.53 million head.[29]

Dairies

In the Llano Estacado Region, the dairy industry included a total of 70 dairies. Table 1-9 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.[30]

Table 1-9. Dairy and Milk Cow Production in the Llano Estacado Region

County	Dairies	Milk/month (lbs)	Lbs/cow/day	Milk cows	Dry cows	Total dairy cows
Bailey	10	50,000,000	78	21,017	2,942	23,960
Castro	14	111,500,000	74	49,402	6,916	56,318
Deaf Smith	14	91,500,000	78	38,462	5,385	43,846
Hale	6	48,000,000	74	21,267	2,977	24,245
Lamb	11	71,000,000	78	29,844	4,178	34,023

[29] Weinheimer, B. 2017. Personal communication, Texas Cattle Feeders Association, September 25, 2017.
[30] DeWit, H. 2020. Personal communication, Blue Sky Farms, January 20, 2020.

Table 1-9. Dairy and Milk Cow Production in the Llano Estacado Region

County	Dairies	Milk/month (lbs)	Lbs/cow/day	Milk cows	Dry cows	Total dairy cows
Lubbock	1	4,650,000	82	1,859	260	2,120
Parmer	14	113,000,000	78	47,499	6,650	54,149
Total	70	489,650,000	Average of 77	209,350	29,308	238,661

lbs - pounds

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.

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 region[31] (Table 1-10). In 2017, oil production in the Llano Estacado Region was 75.6 million barrels or 7 percent Texas' total production. The 2017 natural gas production (casing head gas plus gas well gas) was 70,485,337 thousand cubic feet (mcf) or approximately 1 percent of Texas' total production. The wellhead value of oil and gas production of the region in 2017 is estimated at approximately $49.870 billion[32].

Table 1-10. Oil and Gas Production in 2017 for Llano Estacado Region[33]

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	2,764,228	375	1,643,584	68,908
Crosby	1,165,290	0	113,054	0
Dawson	2,712,516	0	1,058,805	0
Deaf Smith	0	0	0	0

[31] The Railroad Commission of Texas. 2019. General Production Query. http://webapps2.rrc.texas.gov/EWA/productionQueryAction.do

[32] Texas Almanac. 2020. State Comptroller of Public Accounts income figures. https://texasalmanac.com/topics/business/petroleum-production-and-income-texas

[33] The Railroad Commission of Texas. 2019. General Production Query. http://webapps2.rrc.texas.gov/EWA/productionQueryAction.do

Table 1-10. Oil and Gas Production in 2017 for Llano Estacado Region[33]

County	Oil (bbl)	Condensate (bbl)	Casing head Gas (mcf)	Gas Well Gas (mcf)
Dickens	491,175	0	18,743	0
Floyd	0	0	0	0
Gaines	23,243,026	9,918	20,239,258	4,408,764
Garza	2,356,682	0	546,318	0
Hale	1,298,148	0	1,272,194	0
Hockley	12,657,606	1,376	7,809,617	37,590
Lamb	262,972	0	195,498	0
Lubbock	1,037,092	0	65,180	0
Lynn	359,690	0	107,037	0
Motley	34,572	0	2,960	0
Parmer	0	0	0	0
Swisher	0	0	0	0
Terry	3,640,642	0	1,950,828	0
Yoakum	23,970,038	0	30,829,481	224,555
Region Total 2017	**75,633,987**	**11,669**	**65,745,520**	**4,739,817**
Region Total 2008	**90,344,960**	**18,356**	**64,743,524**	**16,109,080**
Region Change 2008/2017	**-19%**	**-57%**	**2%**	**-240%**
Texas Total 2017	**1,083,758,987**	**176,265,505**	**2,637,886,440**	**4,811,630,451**
Texas Total 2008	**350,571,741**	**50,140,475**	**739,513,755**	**6,831,555,360**
Texas Change 2008/2017	**68%**	**72%**	**72%**	**-42%**

bbl = barrel; mcf = thousand cubic feet

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 2016 for manufacturing (North American Industry Classification System [NAICS] codes 31-33) , the region's 369 manufacturing establishments contributed and provided 8,882 jobs with an annual payroll of $380.632 million (Table 1-11).

Table 1-11. Manufacturing Activity in 2017 for Llano Estacado Region[34]

County	Total Number of Establishments	Total Number of Employees	Annual Payroll (million-dollars)
Bailey	9	381	7.338
Briscoe	2	10[a]	0.010[d]
Castro	5	44	1.876
Cochran	1	10[a]	0.010[d]
Crosby	2	60[b]	0.010[d]
Dawson	11	112	4.557
Deaf Smith	23	1,648	79.602
Dickens	0	0	0
Floyd	6	40	1.335
Gaines	12	194	8.621
Garza	2	10[a]	0.010[d]
Hale	19	604	23.432
Hockley	10	207	9.828
Lamb	5	73	2.571
Lubbock	228	5,094	226.296
Lynn	4	78	2.762
Motley	1	10[a]	0.010[d]
Parmer	6	1,750[c]	0.010[d]
Swisher	9	121	4.074
Terry	4	59	1.703
Yoakum	10	127	6.574
Total	369	8,882	380.632

[a]Estimate of 0 to 19 employees
[b]Estimate of 20 to 99 employees
[c]Estimate of 1,000 to 2,499 employees
[d]Estimated since data withheld

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

[34] USCB. 2019. 2012 Economic Census, Washington D.C., October 2019. https://www.census.gov/data/tables/2017/econ/economic-census/naics-sector-31-33.html

trade within the Llano Estacado Region being non-durable goods. The region's 769 wholesale trade establishments provide over 10,417 jobs with an annual payroll of over $508.046 million in 2016 (Table 1-12).

Table 1-12. Wholesale Trade 2016 Llano Estacado Region[35]

County	Total Number of Establishments	Total Number of Employees	Annual Payroll (million-dollars)
Bailey	18	164	6.341
Briscoe	2	10[a]	0.010[c]
Castro	13	112	5.632
Cochran	2	10[a]	0.010[c]
Crosby	8	78	5.059
Dawson	19	95	4.466
Deaf Smith	36	458	25.988
Dickens	0	0	0
Floyd	14	150	5.886
Gaines	32	306	17.940
Garza	4	22	0.943
Hale	55	590	30.446
Hockley	32	297	17.850
Lamb	18	148	7.146
Lubbock	429	7,116	335.697
Lynn	6	18	1.999
Motley	2	60[b]	0.010[c]
Parmer	27	204	8.484
Swisher	13	52	2.202
Terry	21	332	20.264
Yoakum	18	195	11.672
Total	769	10,417	508.046

[a]Estimate of 0 to 19 employees
[b]Estimate of 20 to 99 employees
[c]Estimated since data withheld

[35] USCB. 2016. Annual Report for Wholesale Trade: 2016. https://www.census.gov/data/tables/2016/econ/awts/annual-reports.html

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 2016, the region's reported 1,632 retail trade establishments contributed and provided over 24,848 jobs with an annual payroll of over $667.105 million (Table 1-13).

Table 1-13. Retail Trade in 2016 for Llano Estacado Region[36]

County	Total Number of Establishments	Total Number of Employees	Annual Payroll (million-dollars)
Bailey	21	185	4.347
Briscoe	7	21	0.537
Castro	33	176	4.174
Cochran	10	61	1.479
Crosby	18	125	3.661
Dawson	47	674	23.519
Deaf Smith	56	844	21.863
Dickens	9	60	1.047
Floyd	19	110	2.145
Gaines	58	490	13.249
Garza	19	184	3.586
Hale	104	1,401	35.036
Hockley	62	885	20.402
Lamb	38	357	8.037
Lubbock	1,012	18,172	496.320
Lynn	9	67	1.639
Motley	2	10[a]	0.010[b]
Parmer	23	174	3.949
Swisher	18	145	3.381
Terry	37	445	12.017
Yoakum	30	262	6.706

[36] USCB. 2016. Annual Retail Trade Survey: 2016. https://www.census.gov/data/tables/2016/econ/arts/annual-report.html

Table 1-13. Retail Trade in 2016 for Llano Estacado Region[36]

County	Total Number of Establishments	Total Number of Employees	Annual Payroll (million-dollars)
Total	1,632	24,848	667.105

[a]Estimate of 0 to 19 employees
[b]Estimated since data withheld

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 auto 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 2016 Economic Census reported 3,647 services establishments in the Llano Estacado Region, with a value of $1,011.073 million in payroll (Table 1-14).

Table 1-14. Services 2016 Llano Estacado Region[37]

County	Total Number of Establishments	Total Number of Employees	Annual Payroll (million-dollars)
Bailey	47	338	6.688
Briscoe	7	40	0.042[a]
Castro	48	287	6.549
Cochran	12	34	0.212
Crosby	28	101	1.250
Dawson	88	599	10.486
Deaf Smith	119	924	23.508
Dickens	18	60	1.022
Floyd	44	214	3.545
Gaines	126	828	20.750
Garza	32	355	2.655
Hale	216	2,516	41.190
Hockley	138	1,323	22.193
Lamb	72	463	6.244
Lubbock	2,394	34,978	834.274
Lynn	28	110	2.308
Motley	11	30	0.247
Parmer	52	410	4.884
Swisher	44	255	3.797
Terry	71	598	12.731
Yoakum	52	290	6.493
Total	3,647	44,753	1,011.073

[a]Estimated since data withheld

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 2016, the region's 1,441 finance, insurance, and real estate

[37] USCB. 2016. Economic Data. https://www.census.gov/programs-surveys/ces/data/restricted-use-data/economic-data.html

establishments provided nearly 10,000 jobs with an annual payroll of over $494.174 million (Table 1-15).

Table 1-15. Finance, Insurance, and Real Estate 2016 Llano Estacado Region[38]

County	Total Number of Establishments	Total Number of Employees	Annual Payroll (million-dollars)
Bailey	14	77	3.371
Briscoe	4	23	1.129
Castro	19	72	2.816
Cochran	5	19[a]	0.021[b]
Crosby	9	35[a]	1.101
Dawson	31	135	5.751
Deaf Smith	43	258	11.191
Dickens	3	19[a]	0.021[b]
Floyd	13	62[a]	2.288
Gaines	34	146	6.233
Garza	10	36	0.971
Hale	87	322	13.682
Hockley	60	298	15.396
Lamb	27	150[a]	5.415
Lubbock	992	7,782	400.602
Lynn	15	67	2.686
Motley	2	9[a]	0.010[b]
Parmer	17	81	4.357
Swisher	12	51[a]	1.773
Terry	26	113	5.219
Yoakum	18	175	10.139
Total	1,441	9,932	494.174

[a]Estimate of 0 to 19 employees
[b]Estimated since data withheld

Recreation

Most of the region's revenue derived from recreation opportunities comes from spending on hunting and fishing. Based on 2017 data from the Travel Texas-Office of the

[38] USCB. 2016. Economic Data. https://www.census.gov/programs-surveys/ces/data/restricted-use-data/economic-data.html

Governor, visitors to the High Plains spent $3,379 million[39]. Hunters and fishers are the primary travelers to the High Plains and generally spend money on food, lodging, leases, equipment, and other trip-related expenses. Others come to visit museums, parks, and other attractions.

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 fairly 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 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 were irrigated with center pivot systems and 431,778 acres irrigated with subsurface drip irrigation[40]. In 2018, the HPWD reported 2,276,220 irrigated acres within the district. This total included 1,827,794 acres irrigated with center pivots and 448,426 acres irrigated with subsurface drip irrigation[41].

[39] Dean Runyan Associates. 2018. The Economic Impact of Travel on Texas 1994-2017. http://www.deanrunyan.com/doc_library/TXImp.pdf

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

[41] HPWD. 2018. Annual Report. https://static1.squarespace.com/static/53286fe5e4b0bbf6a4535d75/t/5c351bcbc2241b9059d86721/1546984402974/Final+2018+Annual+Report.pdf

Total projected irrigation demand in the Llano Estacado Region in 2020 is 3,182,630 acre-feet per year (ac-ft/yr) and in 2070 is 2,215,638 ac-ft/yr.

1.4.2 Agriculture Livestock Water Use

Cattle feeding and dairy operations constitute approximately 1 percent in 2020 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. Total livestock demand in the Llano Estacado Region in 2020 is 41,589 ac-ft/yr and in 2070 is 60,304 ac-ft/yr.

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 in their operations. Methods used to conserve freshwater may include the use of brackish or saline water or 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 that 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.[42]

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

[42] U.S. Environmental Protection Agency (EPA). 2019. How We Use Water. https://www.epa.gov/watersense/how-we-use-water

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[43], 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, which 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 ¼ inch to 2 ¼ inches per year[44].

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.[45]

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[43] 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.

[44] https://gma2.hpwd.org/

[45] http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/2001483395.pdf

In general, the movement of water in the Ogallala Aquifer is from the northwest to the 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.[46]

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 recommendations for public supplies, although the water from some wells has excessive fluoride content.

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[47]. 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 1-16. 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[48]. However, thin saturated thicknesses limit productivity in some areas.

Table 1-16. Stratigraphy of the Llano Estacado Region

System	Formation	Aquifer
Quaternary	Ogallala	Ogallala
Tertiary		
Cretaceous	Duck Creek	Edwards-Trinity High Plains
	Kiamichi	
	Edwards	
	Comanche Peak	

46 http://www.hpwd.org/aquifers

47 TWDB. 1995. Report 345, Aquifers of Texas. Austin, TX.

48 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.

Table 1-16. Stratigraphy of the Llano Estacado Region

System	Formation	Aquifer
	Walnut	
	Antlers	
Triassic	Cooper Canyon	Upper Dockum
	Trujillo	
	Tecovas	Lower Dockum
	Santa Rosa	
Permian	Dewey Lake	
	Rustler	

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 1.5and Figure 1.7). Within the Llano Estacado Region, most streams and rivers are intermittent. Almost no water flows out of the region via rivers.

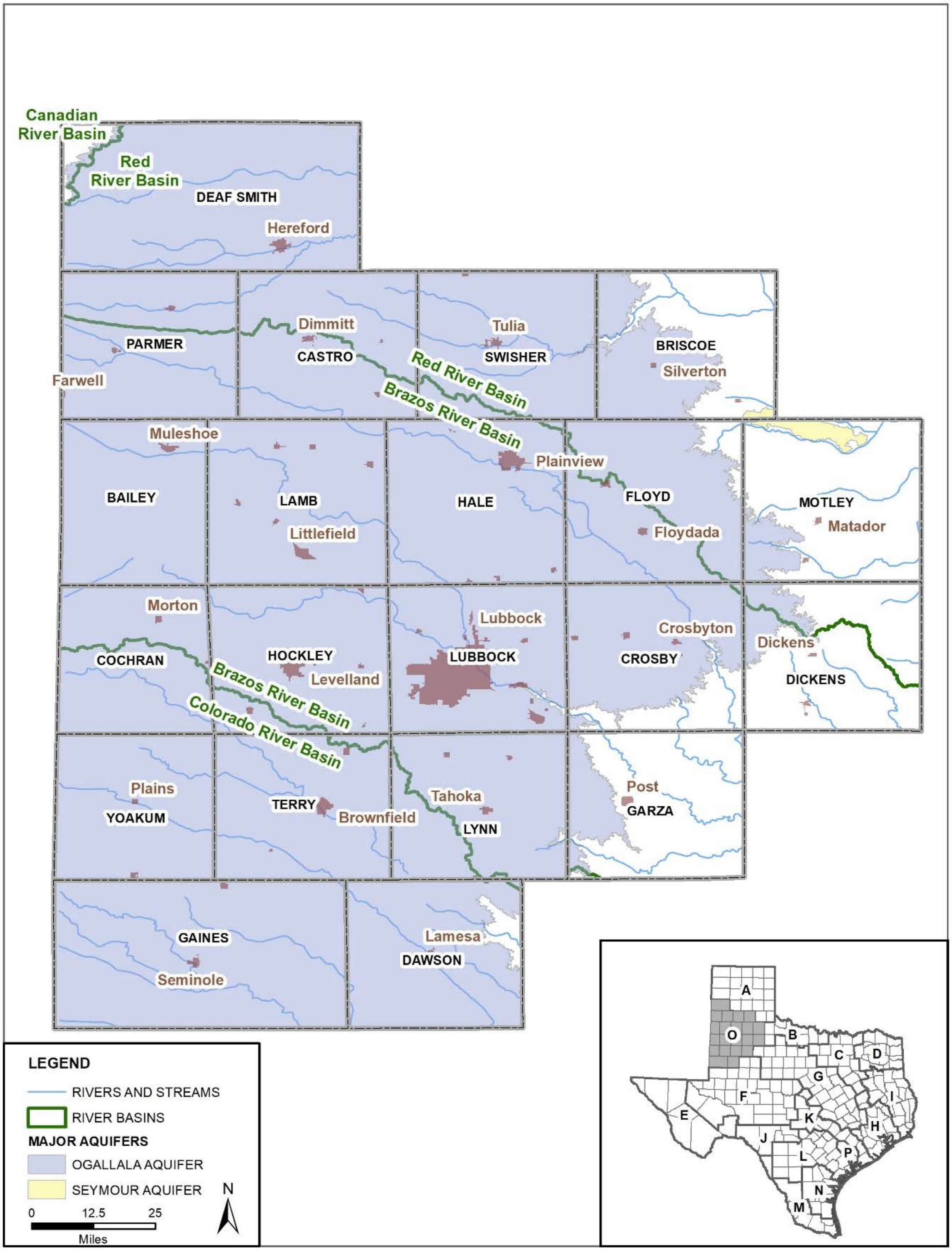

Figure 1.5. Major Aquifers and River Basin Boundaries of the Llano Estacado Region

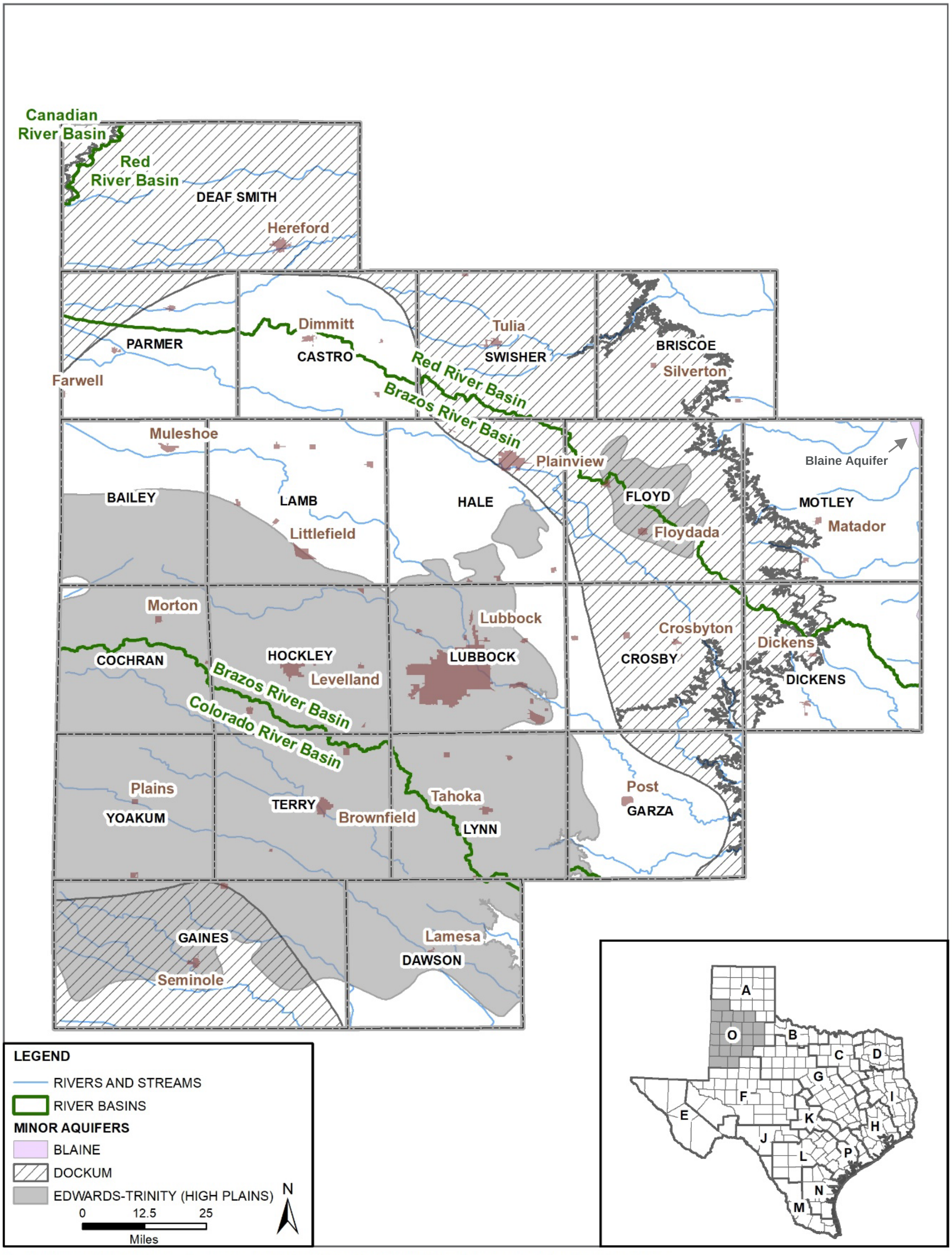

Figure 1.6. Minor Aquifers and River Basin Boundaries of the Llano Estacado Region

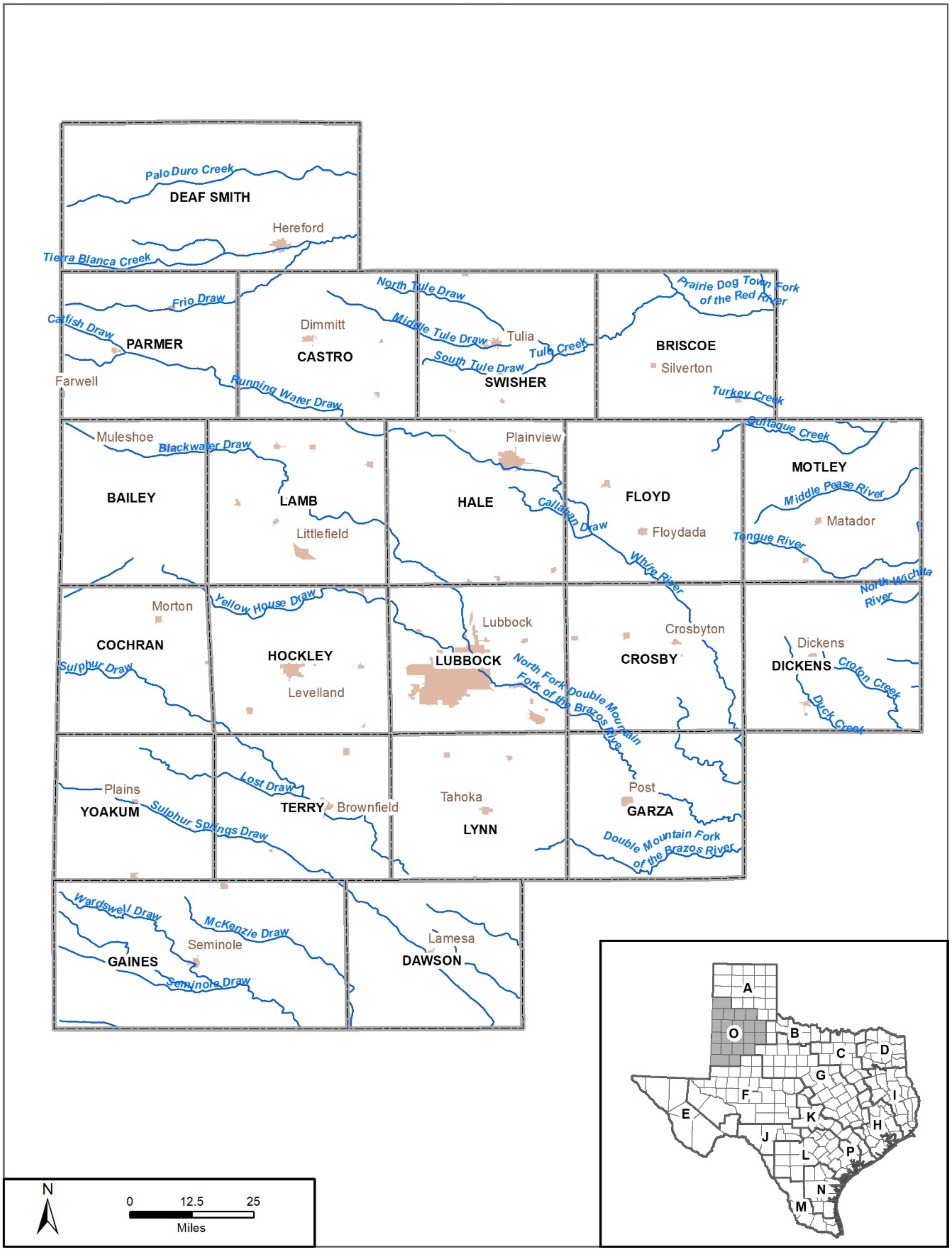

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Figure 1.7. Rivers of the Llano Estacado Region

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.

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 water 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).

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.

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

Mexico. However, there is little flow within the Llano Estacado Region. Major population centers of the region that are 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.

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[49]. Results from the 1995 TWDB hydrographic survey[50] 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 adead 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 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.

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

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

[50] http://www.twdb.texas.gov/surfacewater/surveys/completed/files/meredith/1995-06/Meredith1995_FinalReport.pdf?d=3066.6349999955855

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[51].

Playa Lakes

Runoff in the region is collected in approximately 15,500 playa lakes located within the Llano Estacado Region[52,53] (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."[54]

> *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*

[51] http://www.twdb.texas.gov/surfacewater/surveys/completed/files/AlanHenry/2017-08/AlanHenry2017_FinalReport.pdf?d=4735.469999955967

[52] 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.

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

[54] https://tpwd.texas.gov/landwater/land/habitats/high_plains/wetlands/playa.phtml

> *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.

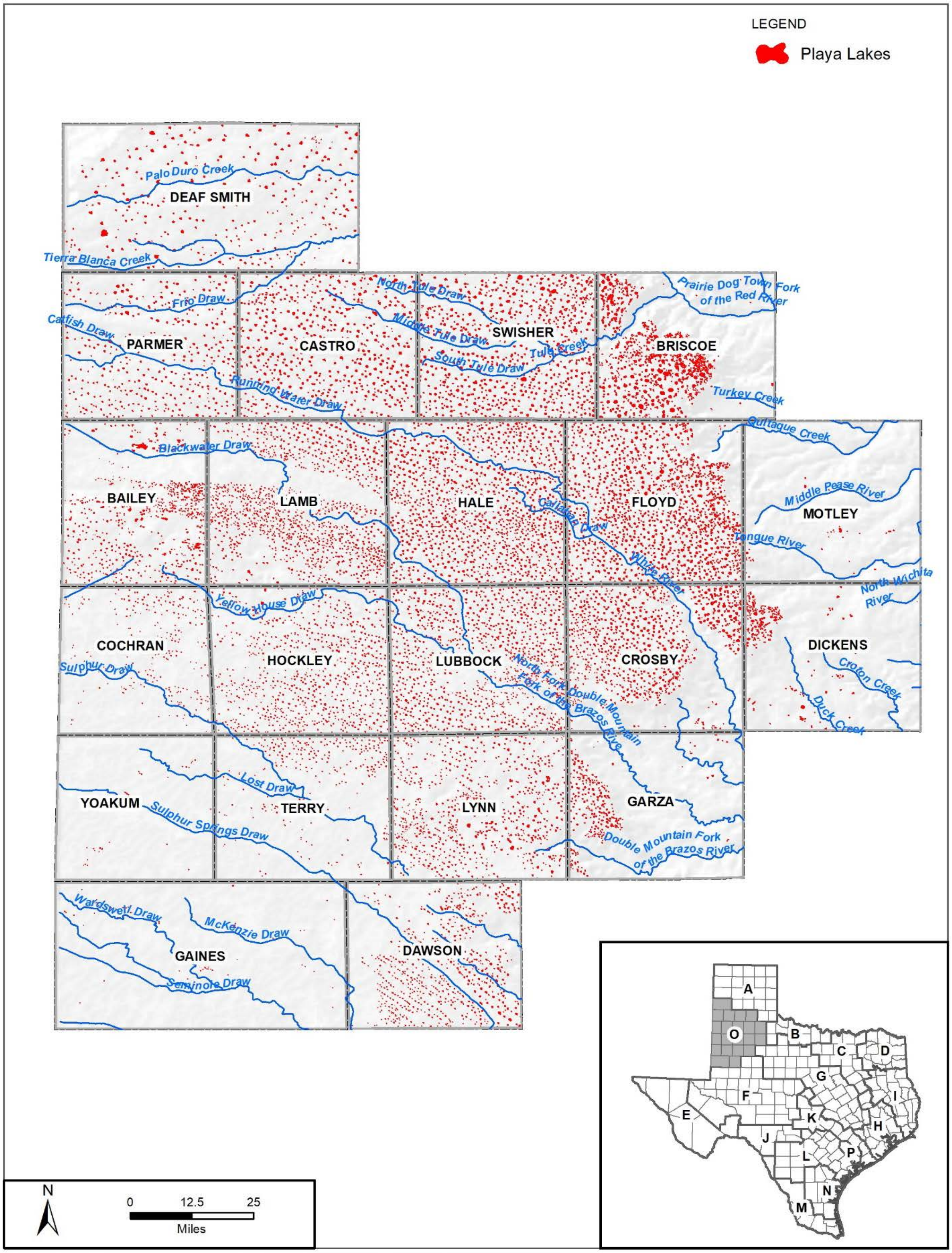

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Figure 1.8. Playa Lakes of the Llano Estacado Region

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).[55] 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)[56].

1.5.4 Reuse

Currently limited reuse occurs within the Llano Estacado Region. According to data provided by the TCEQ[57], 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,

[55] TWDB. 1975. "Major and Historical Springs of Texas (Report No. 189)," March 1975.
[56] Ken Rainwater, Texas Tech University, 2020. Personal communication, February 18, 2020.
[57] Paul Brochi, Water Quality Division, TCEQ. 2019. Personal communication, April 18, 2019.

- Town of Ransom Canyon, and
- 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[58] 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.[59] 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

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

[59] 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.

wells in the ETHP Aquifer. Currently, Tulia is working on the infrastructure to run water from Tulia to Silverton.

1.6.4 White River Municipal Water District

The WRMWD was created in 1957 to manage and operate the White River Lake. It owns a well field, is capable of supplying groundwater, and 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

When lake levels are too low, the district will stop pumping from the lake. The WRMWD also has groundwater, which supplements the water when there is a shortage at the lake.

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)[60] 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.

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

According to State Soil Geographic (STATSGO) dataset[61], 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*).

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.

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

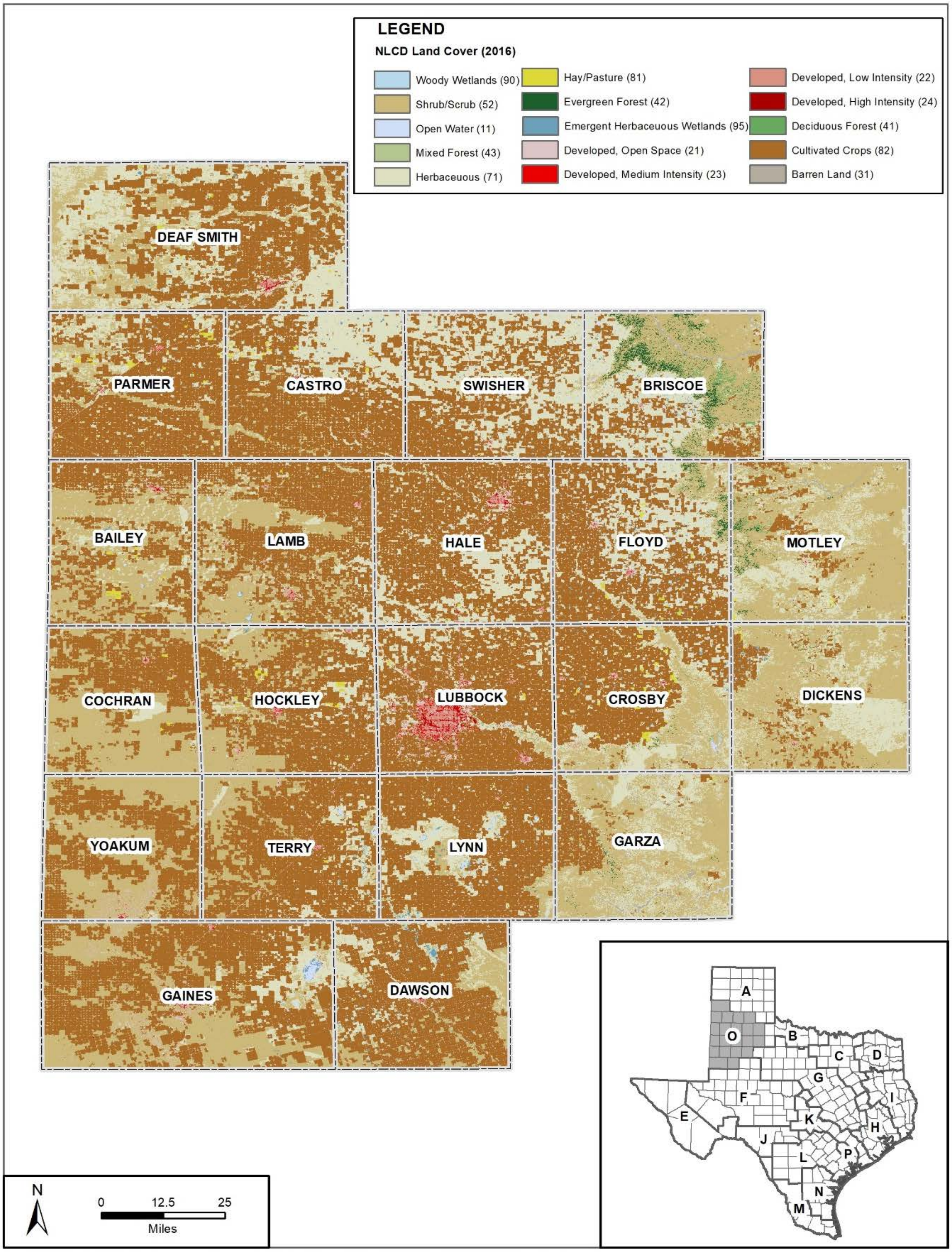

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Figure 1.9. Land Use Covers (NLCD 2016)

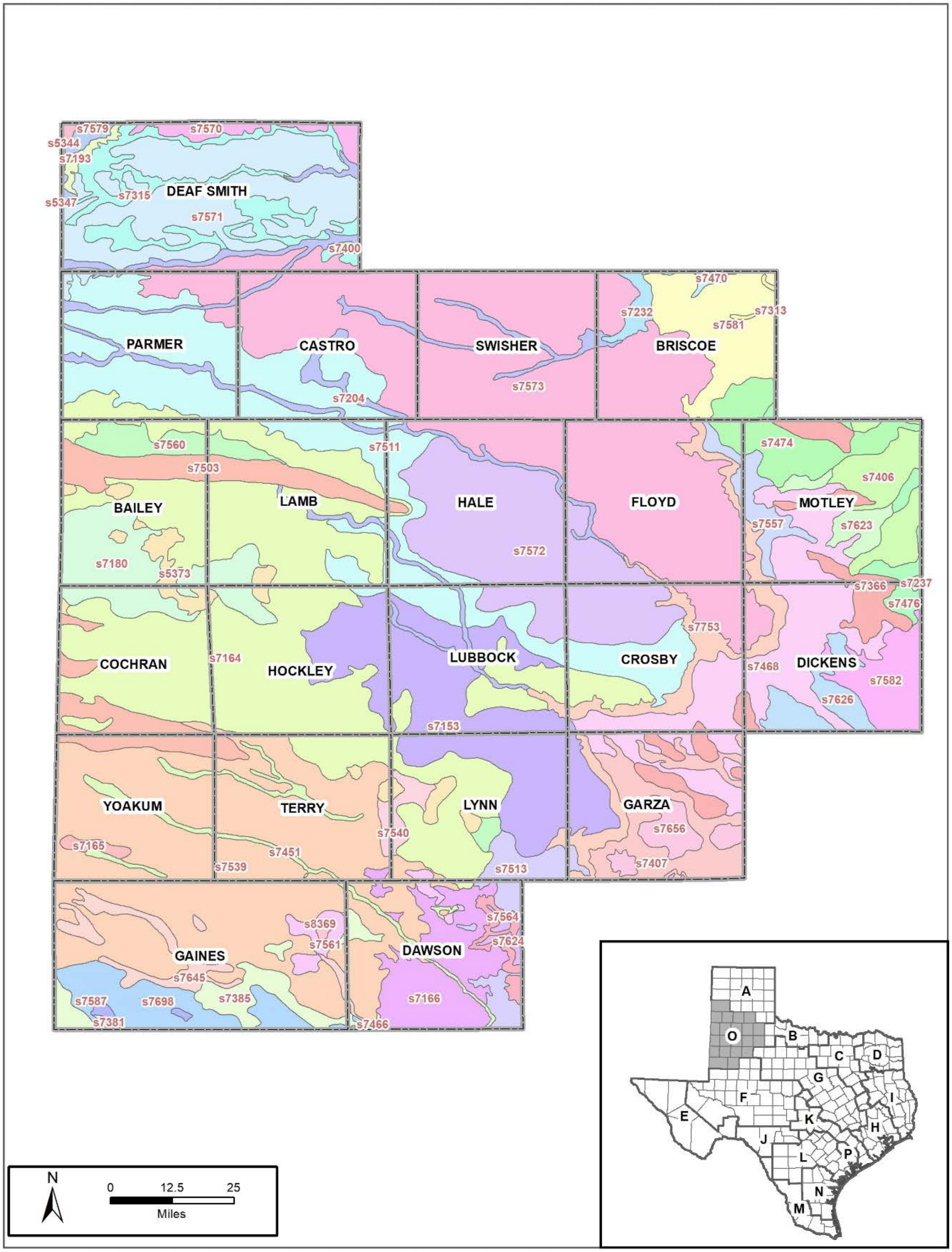

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Figure 1.10. Soils of the Llano Estacado Region (Region O)

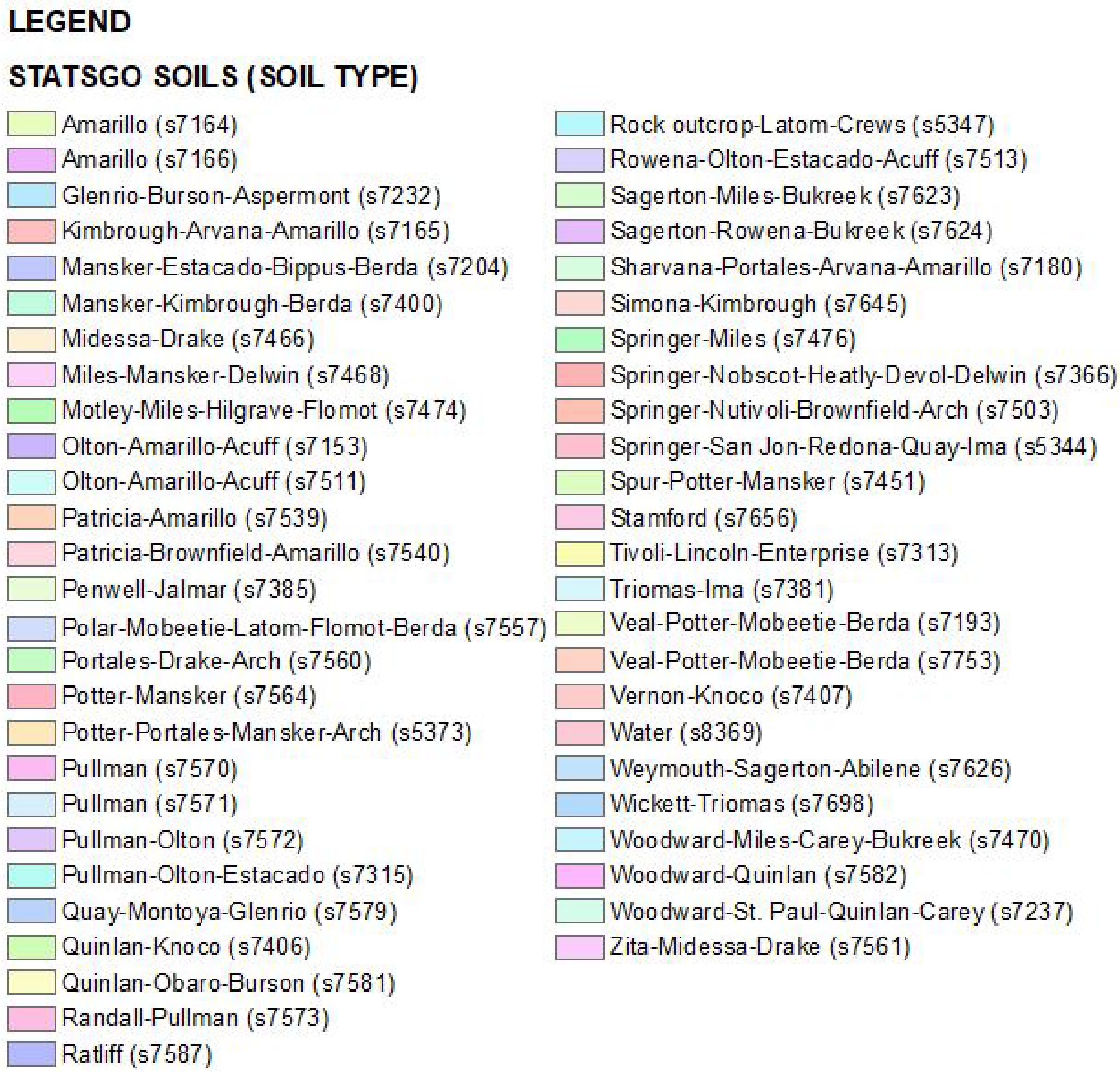

Figure 1.11. Soil Data of the Llano Estacado Region

1.7.2 Wildlife Resources

In the Texas Panhandle, TPWD has listed approximately 16 wildlife species as endangered, threatened, or species of concern but with no official listing.[62] Table 1-17 shows the species in the Llano Estacado Region that are listed as endangered, threatened or species of greatest conservation need (SGCN) for the 21 counties in the region.

[62] TPWD. 2019. Endangered Species. https://tpwd.texas.gov/landwater/land/habitats/high_plains/endangered_species/

Table 1-17. Species Listed as Endangered, Threatened, Candidate, and Species of Greatest Conservation Need for the 21 counties in the Llano Estacado Region [63]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	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	PT	T	Possible migrant
Common black-hawk	*Buteogallus anthracinus*	Cottonwood-lined rivers and streams. Formerly bred in south Texas.	--	T	Possible migrant
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries and along sandy beaches.	--	--	Possible migrant
Lesser prairie chicken	*Tympanuchus pallidicinctus*	Arid grasslands, generally interspersed with shrubs	--	--	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Western burrowing owl	*Athene cunicularia hypugaea*	Open grassland, especially prairie, plains, and savanna	--	--	Resident
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
Zone-tailed hawk	*Buteo albonotatus*	Arid open country, including open deciduous or pine-oak woodland, mesa or mountain country.	--	T	Resident

[63] TPWD. 2020. Annotated County Lists of Rare Species. Revised August 25, 2020. https://tpwd.texas.gov/gis/rtest/

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
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					
Chub shiner	*Notropis potteri*	Large, turbid rivers and smaller tributaries. Found in flowing water with silt or sand substrate. Tolerant of high salinities.	--	--	Resident
Red River pupfish	*Cyprinodon rubrofluviatilis*	Headwater streams of xeric grasslands. River edges, channels, backwaters, over sand bottoms. Euryhaline and eurythermal.	--	--	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*	Endemic to Brazos River drainage. Introduced in Colorado River drainage. Large turbid river, with bottom a combination of sand, gravel, and clay-mud.	LE	--	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.	LE	--	Resident
Texas shiner	*Notropis amabilis*	Typical habitat includes rocky or sandy runs as well as pools.	--	--	Resident
Insects					
A tiger beetle	*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

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Comanche harvester ant	*Pogonomyrmex comanche*	Habitat description is not available at this time.	--	--	Resident
Mammals					
American badger	*Taxidea taxus*	Generalist. Prefers areas with soft soils that sustain ground squirrels for food.	--	--	Resident
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. Found in towns, especially during migration.	--	--	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
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
Mexican free-tailed bat	*Tadarida brasiliensis*	Found in all habitats, forest to desert.	--	--	Resident
Mountain lion	*Puma concolor*	Rugged mountains and riparian zones.	--	--	Resident

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
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, plateau areas of open grassland. Desert grassland and desert-scrub.	--	--	Resident
Swift fox	*Vulpes velox*	Restricted to current and historic shortgrass prairie	--	--	Resident
Texas kangaroo rat	*Dipodomys elator*	Sandy loam surface soils with some clay to support short grasses.	--	T	Resident
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	Found in grassland habitats.	--	--	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 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*	Habitat description is not available at this time.	--	--	Resident
Mollusks					
No common name	*Millerelix gracilis*	Habitat description is not available at this time.	--	--	Resident

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. Marshy, flooded pastureland, grassy or brushy borders of permanent water bodies.	--	--	Resident
Dunes sagebrush lizard	*Sceloporus arenicolus*	Confined to active sand dunes near Monahans; dwarf shin-oak sandhills with sagebrush and yucca.	--	--	Resident
Easter 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
Keeled earless lizard	*Holbrookia propinqua*	Coastal dunes, barrier islands, and other sandy areas.	--	--	Resident
Massasauga	*Sistrurus tergeminus*	Quite common in gently rolling prairie occasionally broken by creek valley or rocky hillside.	--	--	Resident
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
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 hognose snake	*Heterodon nasicus*	Areas with sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semiagricultural areas and irrigation ditch margins.	--	--	Resident

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Western rattlesnake	*Crotalus viridis*	Grassland, both desert and prairie. Shrub desert rocky hillsides, arid and semi-arid river break edges.	--	--	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
Johnston's phlox	*Phlox drummondii ssp. Johnstonii*	Found on sandy soils.	--	--	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
Rolling Plains goldenrod	*Solidago mollis var. angustata*	Occurs on gypsum outcrops and other xeric habitats.	--	--	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
Three-tongue spurge	*Euphorbia chaetocalyx var. triligulata*	In crevices in steep limestone cliffs and on scree and colluvium below.	--	--	Resident

Notes:
Acronyms: USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department;
Statuses: T = State-listed Threatened PT = Potentially Threatened; LE = Federally-listed Endangered

1.8 Identified Water Quality Concerns

1.8.1 Groundwater Quality

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.

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.

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 Lynn, Dawson, Terry, and Gaines counties.

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[64] are shown in Table 1-18.

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

Table 1-18. Surface Water Stream Segments Identified by TCEQ

Stream Segment[1]	Stream Name	County	Segment Class[2]	Impairment[3]	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 (Recreation 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	5c	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 (Recreation 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 (Recreation 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	No	n/a	n/a
0226	South Fork Wichita River	Dickens	Classified	Chloride in water	5c	2020
1238A	Croton Creek	Dickens	Unclassified	No	n/a	n/a
1238B	Duck Creek	Dickens	Unclassified	No	n/a	n/a

Table 1-18. Surface Water Stream Segments Identified by TCEQ

Stream Segment[1]	Stream Name	County	Segment Class[2]	Impairment[3]	Category	Year First Listed
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.

[3]Draft 2020 303d List

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.

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.

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.

Colorado River Basin

The Colorado Basin flows from Dawson County to Matagorda Bay and the Gulf of Mexico. 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[65].

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.

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.

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[65] LCRA, 2014. 2014 Basin Highlights Report. https://www.lcra.org/water/Documents/2014-Basin-Highlights-Report.pdf

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

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[66]. 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

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

projects. This 2018 SWSP is a comprehensive update of the 2013 SWSP and will be updated in the future 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.

2016 Llano Estacado Regional Water Plan

Regional water plans form the basis of the state water plan. The LERWPG approved the final 2016 Llano Estacado Region plan and it was submitted to the TWDB in September 2016. The 2016 Llano Estacado Regional Water Plan (LERWP) recommended the following strategies to meet projected shortages in the region[67].

- Municipal and irrigation water conservation
- Water supply from nearby groundwater sources for cities projected to need additional
- Bailey County Well Field (BCWF) capacity maintenance
- Brackish well field at the South Water Treatment Plant (SWTP)
- South Garza Water Supply
- CRMWA aquifer storage and recovery (ASR)
- Potable reuse
- Jim Bertram Lake 7
- Brush control
- Water loss reduction
- Desalination of brackish groundwater
- Research and development of drought-tolerant crops and new technology
- Stormwater capture and use
- Public education

2017 State Water Plan

In *Water for Texas 2017 State Water Plan* (2017 State Water Plan)[68], the TWDB used information and recommendations from the 16 individual 2016 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

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[67] LERWPG 2015. Llano Estacado (Region O) 2016 Regional Water Plan. http://www.twdb.texas.gov/waterplanning/rwp/plans/2016/

[68] https://www.twdb.texas.gov/waterplanning/swp/2017/

districts, controlling brush, reusing water, continuing support of groundwater availability modeling, providing conservation education, ongoing funding for groundwater supply projects, and supporting alternative water management strategies.

The 2017 State Water Plan projected a Llano Estacado Region water shortage of 2,240,000 ac-ft/yr in 2070[69]. The Llano Estacado Region had the highest unmet needs of any region in Texas, with most of this shortage occurring as irrigation needs. The 2017 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[70]. 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.[71]

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.

[69] TWDB 2017. 2017 State Water Plan, Water for Texas. Table 7.2 https://www.twdb.texas.gov/waterplanning/swp/2017/

[70] 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

[71] https://www.weather.gov/lub/events-2011-20111231-summary

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 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." [72] According to a TCEQ handbook[73], 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,

[72] http://www.twdb.texas.gov/conservation/training/archives/more-than-a-drop-workshop/doc/5_%20TCEQ%20Rules.pdf

[73] 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.

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 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 2021 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 and 2018 water loss audits. The methodology used for the water loss audit forms relies upon self-reporting data provided by public utilities, and the self-reported 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 2021 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 21 public utilities of the Llano Estacado Region that filed a water loss audit report for 2018 (Table 1-19). Thirty-eight percent of the 21 entities report total losses exceeding 15 percent. The total losses for these reporting WUGs range from 1 percent to 54 percent. In accordance with 31 TAC§357.30, the LERWPG has considered strategies to reduce water losses as further described in Chapter 5.

Table 1-19. Summary of Water Loss Percentages Based on 2018 TWDB Water Loss Report

Water User Group	County Name	Total Apparent Losses (gallons)	Total Real Losses (gallons)	Total Loss Percent (%)
City of Ralls	Crosby	1,358,469	3,452,656	7.1
WRMWD	Crosby	462,180	21,641,497	54.4
City of Lamesa	Dawson	50,000	7,723,880	1.4

Table 1-19. Summary of Water Loss Percentages Based on 2018 TWDB Water Loss Report

Water User Group	County Name	Total Apparent Losses (gallons)	Total Real Losses (gallons)	Total Loss Percent (%)
Hereford Municipal Water System	Deaf Smith	91,533,808	8,385,330	5.6
Valley WSC	Dickens	69,650	3,005,023	35.7
City of Seagraves	Gaines	3,024,717	9,536,620	11.5
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	43,694,473	74,128,123	10.7
City of Anton	Hockley	3,933,681	4,814,917	19.4
City of Levelland	Hockley	25,173,701	45,034,776	10.9
City of Smyer	Hockley	1,108,092	512,770	10.1
City of Littlefield	Lamb	16,369,613	52,602,850	21.8
Lubbock Public Water System	Lubbock	398,153,503	833,751,104	9.9
City of Shallowater	Lubbock	3,742,102	18,069,121	16.7
City of New Deal	Lubbock	304,965	382,626	2.8
City of Tahoka	Lynn	5,875,077	17,335,722	17.8
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 2014 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 purposes of 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), which states that in developing regional water plans, regional water planning groups (RWPGs) shall 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

According to the TWDB projections, the population of the Llano Estacado Region is projected to increase from 540,495 in 2020 to 801,719 by 2070, an increase of 48.3 percent (Table 2-1 and Figure 2.1). Approximately 79.7 percent of the population of the region is projected to reside in the Brazos Basin in the year 2070, with 12.3 percent in the Colorado River Basin (Table 2-2).

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 2000 and 2010.

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 equal the total county projection).

The TWDB population projections for 51 municipal WUGs (individual cities and water supply districts and/or authorities), 33 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 84 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:

GPCD = Total annual water used / Total population / 365 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.

When calculating gpcd, the TWDB factors in conservation that will occur in the future due to use of water-efficient appliances. Federal and state governments have passed two main laws encouraging water conservation: the State Water-Efficient Plumbing Act, passed in 1991, and House Bill 2667 (HB 2667), passed by the 81st Texas Legislature in 2009. Due to these laws, the prevalence of water-efficient appliances will increase over time, reducing each WUGs’ gpcd. According to the TWDB policy, no WUG is allowed to have a gpcd projection below 60.

Per capita water use in the Llano Estacado Region is projected to decline over the planning period from 157 gpcd in year 2020 to 148 gpcd in 2070 (Figure 2.2). However, due to projected population growth between 2020 and 2070, municipal water demand in the Llano Estacado Region is projected to increase from 94,899 acre-feet per year (ac-ft/yr) in 2020 to 132,673 ac-ft/yr in 2070 (Figure 2.2 and Table 2-2).[74] The projected municipal water demand for each county in the region is shown in Table 2-2.

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

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

	Population Projections					
	2020	2030	2040	2050	2060	2070
Counties						
Bailey	8,012	8,962	9,906	10,880	11,844	12,790
Briscoe	1,673	1,673	1,673	1,673	1,673	1,673
Castro	8,890	9,650	10,194	10,698	11,091	11,407
Cochran	3,491	3,687	3,717	3,667	3,772	3,807
Crosby	6,526	7,023	7,433	7,850	8,299	8,715
Dawson	14,807	15,577	16,177	16,440	17,098	17,575
Deaf Smith	22,151	25,573	29,314	33,554	36,887	40,531
Dickens	2,164	2,164	2,164	2,164	2,164	2,164
Floyd	6,869	7,294	7,563	7,854	8,081	8,270
Gaines	21,316	25,746	30,997	36,654	41,666	46,886
Garza	7,077	7,510	7,899	8,166	8,569	8,905
Hale	38,314	39,965	40,647	40,307	41,369	41,814
Hockley	25,130	26,734	27,707	27,888	29,134	29,935
Lamb	14,615	15,175	15,438	15,419	15,791	15,975
Lubbock	309,769	343,977	378,320	414,938	449,770	484,316
Lynn	6,279	6,605	6,624	6,594	6,924	7,074
Motley	1,212	1,212	1,212	1,212	1,212	1,212
Parmer	11,424	12,648	13,748	14,827	16,091	17,244
Swisher	8,257	8,670	8,798	8,744	9,175	9,380
Terry	13,599	14,457	15,321	16,108	16,847	17,535
Yoakum	8,920	10,089	11,128	12,232	13,401	14,511
Total	**540,495**	**594,391**	**645,980**	**697,869**	**750,858**	**801,719**
River Basin Summaries						
Brazos	438,884	480,730	519,910	559,076	599,875	638,655
Canadian	8	9	11	12	13	15
Colorado	60,611	67,989	75,814	83,640	91,314	98,865
Red	40,992	45,663	50,245	55,141	59,656	64,184
Total	**540,495**	**594,391**	**645,980**	**697,869**	**750,858**	**801,719**

Source: Texas Water Development Board (TWDB), Consensus Projections adopted by the TWDB, April, 2018.

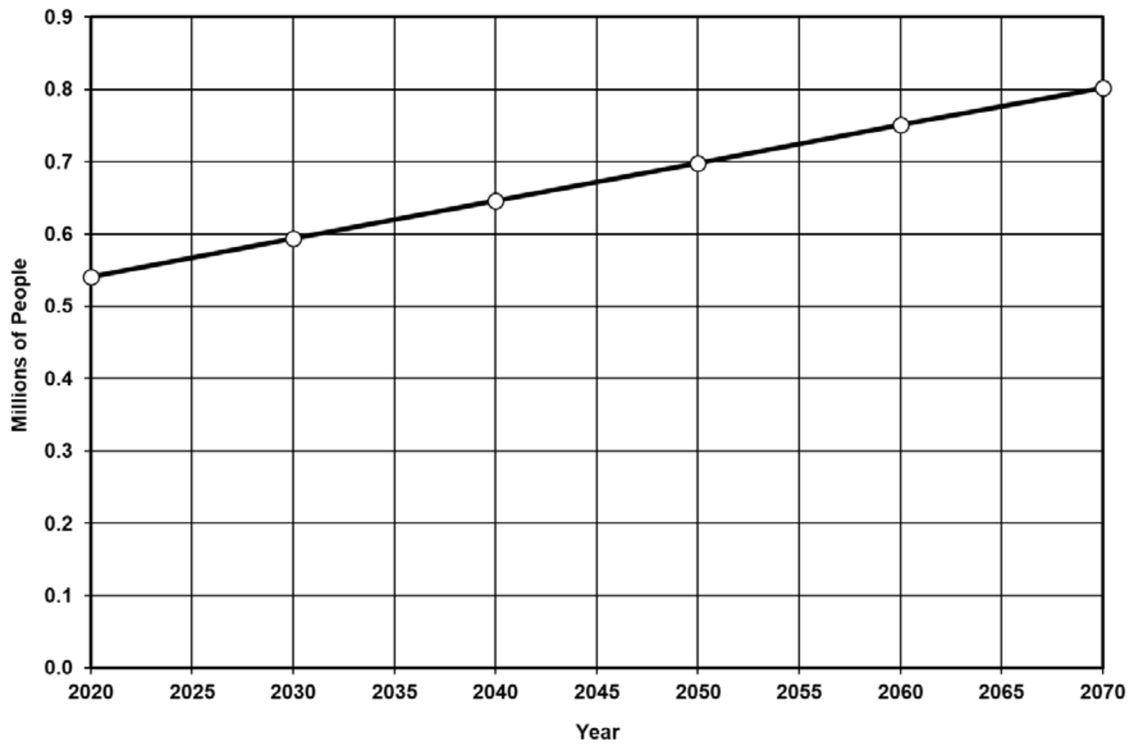

Figure 2.1. Summary of Llano Estacado Region Projected Population

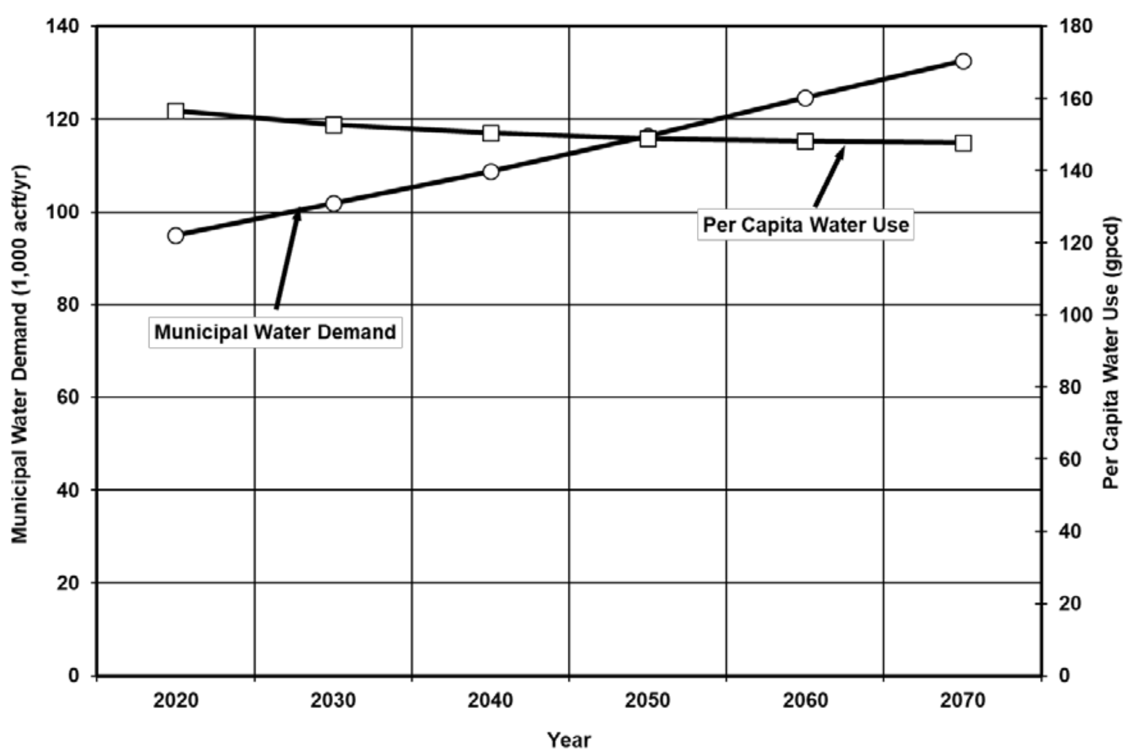

Figure 2.2. Projected Per Capita Water Use and Municipal Water Demand Llano Estacado Region – 2020 to 2070

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

	Water Demand Projections (acre-feet/year)					
	2020	2030	2040	2050	2060	2070
Counties						
Bailey	1,450	1,579	1,717	1,874	2,036	2,198
Briscoe	393	384	377	376	375	375
Castro	1,768	1,870	1,941	2,025	2,097	2,156
Cochran	901	942	946	935	963	972
Crosby	993	1,035	1,073	1,128	1,193	1,250
Dawson	2,864	2,918	2,952	2,972	3,073	3,148
Deaf Smith	4,447	4,764	5,499	6,322	7,048	7,811
Dickens	336	325	319	319	318	319
Floyd	1,041	1,053	1,067	1,099	1,123	1,145
Gaines	4,171	4,764	5,499	6,322	7,048	7,811
Garza	927	955	985	1,010	1,056	1,097
Hale	6,756	6,859	6,832	6,700	6,861	6,934
Hockley	3,939	4,064	4,118	4,107	4,279	4,397
Lamb	2,397	2,412	2,398	2,374	2,426	2,453
Lubbock	53,573	58,186	63,127	68,368	73,730	79,048
Lynn	893	907	887	873	913	934
Motley	328	321	318	317	317	317
Parmer	2,228	2,405	2,568	2,748	2,976	3,188
Swisher	1,321	1,342	1,332	1,314	1,374	1,405
Terry	2,049	2,109	2,183	2,286	2,384	2,480
Yoakum	2,124	2,352	2,559	2,802	3,066	3,319
Total	**94,899**	**101,787**	**108,839**	**116,359**	**124,644**	**132,673**
River Basin Summaries						
Brazos	75,228	80,475	85,748	91,216	97,475	103,462
Canadian	1	1	1	1	1	2
Colorado	11,757	12,726	13,792	14,984	16,199	17,401
Red	7,913	8,585	9,298	10,158	10,969	11,808
Total	**94,899**	**101,787**	**108,839**	**116,359**	**124,644**	**132,673**

Source: Texas Water Development Board (TWDB); Consensus Projections adopted by the TWDB, April 2018.

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 chemical and petroleum refining industries account for nearly 60 percent of Texas' annual industrial water use.

Major water-using manufacturing sectors in the Llano Estacado Region are food processing, industrial machinery and equipment, and fabricated metal products. Eleven 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 10,881 ac-ft/yr of water in 2020 to 12,341 ac-ft/yr in 2070, a 13.4 percent increase (Figure 2.3 and Table 2-3). As can be seen in Figure 2.3, manufacturing water demand is projected to increase from 2020 to 2030 and then remain constant throughout the remainder of the planning period.

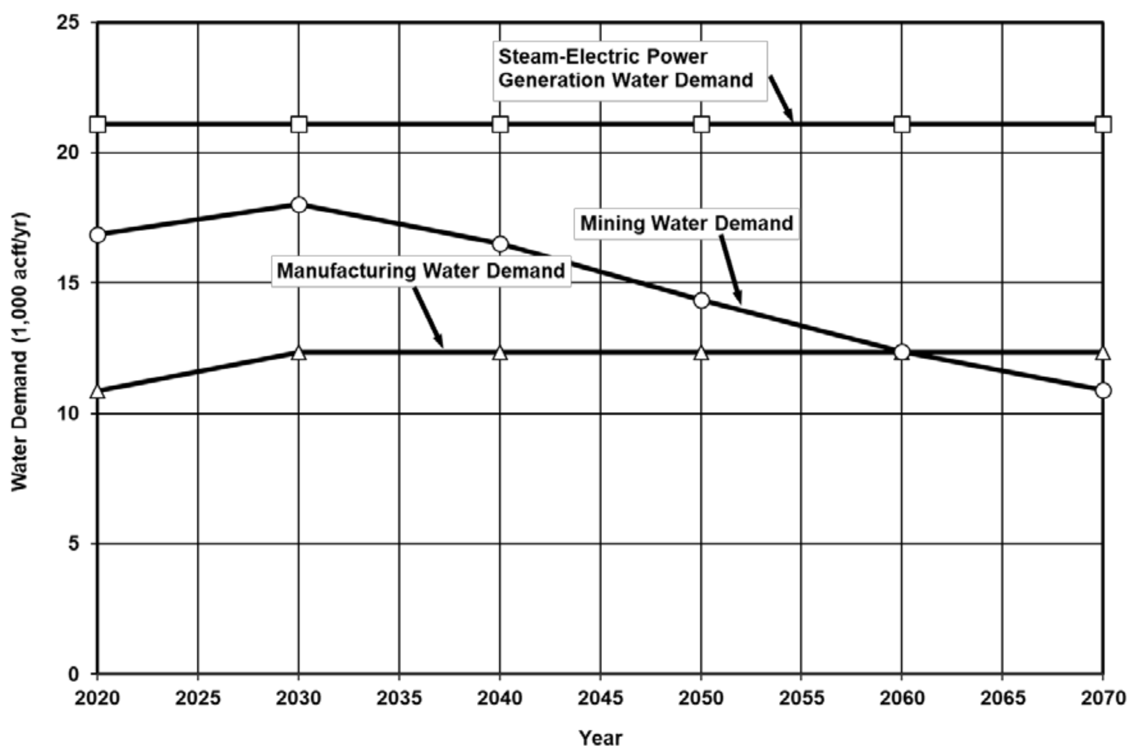

Figure 2.3. Projections of Manufacturing, Steam-Electric, and Mining Water Demands Llano Estacado Region – 2020 to 2070

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

	Water Demand Projections (acre-feet/year)					
	2020	2030	2040	2050	2060	2070
Counties						
Bailey	0	0	0	0	0	0
Briscoe	0	0	0	0	0	0
Castro	61	66	66	66	66	66
Cochran	0	0	0	0	0	0
Crosby	2	3	3	3	3	3
Dawson	0	0	0	0	0	0
Deaf Smith	1,002	1,107	1,107	1,107	1,107	1,107
Dickens	0	0	0	0	0	0
Floyd	0	0	0	0	0	0
Gaines	1,512	1,587	1,587	1,587	1,587	1,587
Garza	2	2	2	2	2	2
Hale	4,383	5,076	5,076	5,076	5,076	5,076
Hockley	576	691	691	691	691	691
Lamb	807	940	940	940	940	940
Lubbock	856	1,011	1,011	1,011	1,011	1,011
Lynn	0	0	0	0	0	0
Motley	0	0	0	0	0	0
Parmer	1,666	1,841	1,841	1,841	1,841	1,841
Swisher	0	0	0	0	0	0
Terry	14	17	17	17	17	17
Yoakum	0	0	0	0	0	0
Total	**10,881**	**12,341**	**12,341**	**12,341**	**12,341**	**12,341**
River Basin Summaries						
Brazos	6,626	7,723	7,723	7,723	7,723	7,723
Canadian	0	0	0	0	0	0
Colorado	1,526	1,604	1,604	1,604	1,604	1,604
Red	2,729	3,014	3,014	3,014	3,014	3,014
Total	**10,881**	**12,341**	**12,341**	**12,341**	**12,341**	**12,341**

Source: Texas Water Development Board (TWDB); Consensus Projections adopted by the TWDB, April 2018.

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.

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) of the Llano Estacado Region have plants that use water in steam-electric power generation. Water demand for steam-electric power generation is projected to be 21,085 ac-ft/yr in 2020 and remain constant throughout the planning period (Table 2-4 and Figure 2.3).

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 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 2030 and then 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 16,869 ac-ft/yr in 2020 and decrease to 10,890 ac-ft/yr in 2070, a decrease of more than 35 percent (Table 2-5 and Figure 2.3).

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

	Water Demand Projections (acre-feet/year)					
	2020	2030	2040	2050	2060	2070
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	31	31	31	31	31	31
Hockley	0	0	0	0	0	0
Lamb	13,450	13,450	13,450	13,450	13,450	13,450
Lubbock	5,694	5,694	5,694	5,694	5,694	5,694
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	1,910	1,910	1,910	1,910	1,910	1,910
Total	**21,085**	**21,085**	**21,085**	**21,085**	**21,085**	**21,085**
River Basin Summaries						
Brazos	19,175	19,175	19,175	19,175	19,175	19,175
Canadian	0	0	0	0	0	0
Colorado	1,910	1,910	1,910	1,910	1,910	1,910
Red	0	0	0	0	0	0
Total	**21,085**	**21,085**	**21,085**	**21,085**	**21,085**	**21,085**

Source: Texas Water Development Board (TWDB); Consensus Projections adopted by the TWDB, April, 2018.

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

	Water Demand Projections (acre-feet/year)					
	2020	2030	2040	2050	2060	2070
Counties						
Bailey	0	0	0	0	0	0
Briscoe	0	0	0	0	0	0
Castro	0	0	0	0	0	0
Cochran	154	208	210	163	115	81
Crosby	994	980	871	757	656	568
Dawson	1,812	1,812	1,812	1,812	1,812	1,812
Deaf Smith	0	0	0	0	0	0
Dickens	12	12	12	12	12	12
Floyd	486	492	489	486	484	485
Gaines	1,829	2,400	2,071	1,527	1,051	776
Garza	395	544	438	334	234	164
Hale	1,168	1,152	1,022	886	766	662
Hockley	18	18	17	17	16	15
Lamb	586	579	513	445	385	333
Lubbock	6,354	6,425	5,913	5,302	4,763	4,314
Lynn	1,166	1,327	1,255	1,033	826	660
Motley	240	213	205	198	179	161
Parmer	0	0	0	0	0	0
Swisher	0	0	0	0	0	0
Terry	355	525	543	416	293	206
Yoakum	1,300	1,334	1,147	957	783	641
Total	**16,869**	**18,021**	**16,518**	**14,345**	**12,375**	**10,890**
River Basin Summaries						
Brazos	10,486	10,842	9,891	8,680	7,593	6,701
Canadian	0	0	0	0	0	0
Colorado	5,501	6,326	5,824	4,913	4,087	3,545
Red	882	853	803	752	695	644
Total	**16,869**	**18,021**	**16,518**	**14,345**	**12,375**	**10,890**

Source: Texas Water Development Board (TWDB); Consensus Projections adopted by the TWDB, April, 2018.

2.6 Irrigation Water Demand Projections

In 2020, is it projected that irrigated agriculture will account for approximately 51 percent of the total water used in the state. It is projected that approximately 9.4 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 this 9.4 million ac-ft of water to be used for irrigation in Texas, groundwater will be approximately 70 percent and surface water will be approximately 30 percent. The TWDB irrigation water demand projections show annual use in the Llano Estacado Region to be 3,182,630 ac-ft/yr in 2020, approximately 34 percent of the total projected irrigation water use in Texas in 2020 (Figure 2.4 and Table 2-6). Projected irrigation water demands in the region in 2070 are 2,215,638 ac-ft/yr, approximately 18.0 percent less than those in 2020 (Figure 2.4 and Table 2-6). The projected decline is based upon expected increases in irrigation efficiency, reductions in profitability of irrigated agriculture, and a reduction in groundwater availability.

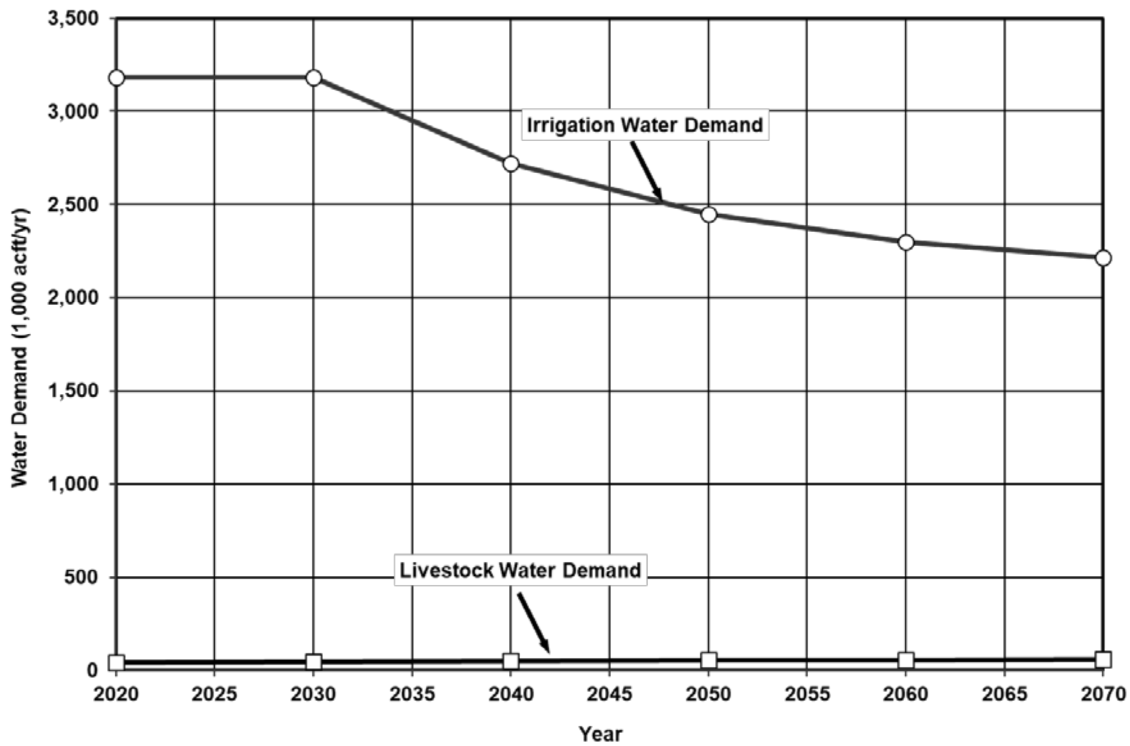

Figure 2.4. Projections of Irrigation and Livestock Water Demands Llano Estacado Region – 2020 to 2070

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

	Water Demand Projections (acre-feet/year)					
	2020	2030	2040	2050	2060	2070
Counties						
Bailey	88,108	88,108	72,000	63,505	58,659	55,616
Briscoe	26,417	26,417	20,687	17,833	16,225	15,231
Castro	379,863	379,863	300,493	253,018	232,579	222,898
Cochran	99,449	99,449	84,800	75,704	68,156	62,972
Crosby	107,583	107,583	107,583	85,141	73,840	67,695
Dawson	106,312	106,312	106,312	91,799	84,126	79,443
Deaf Smith	210,016	210,016	162,701	138,274	125,446	118,219
Dickens	9,039	9,039	9,039	9,039	9,039	9,039
Floyd	128,837	128,837	102,500	88,789	80,896	76,235
Gaines	362,482	362,482	328,442	306,787	291,887	282,438
Garza	10,353	10,353	10,353	10,353	10,353	10,353
Hale	310,542	310,542	266,277	244,333	233,354	227,568
Hockley	131,866	131,866	97,749	83,766	77,166	73,589
Lamb	259,451	259,451	218,589	203,951	197,509	194,185
Lubbock	144,866	144,866	132,596	124,312	118,397	114,260
Lynn	88,921	88,921	88,921	88,921	88,921	88,921
Motley	9,426	9,426	9,426	9,426	9,426	9,426
Parmer	239,225	239,225	207,386	191,864	182,837	177,802
Swisher	135,396	135,396	110,041	97,668	90,775	86,540
Terry	172,785	172,785	145,901	134,704	128,891	125,527
Yoakum	161,693	161,693	138,141	127,049	121,210	117,681
Total	**3,182,630**	**3,182,630**	**2,719,937**	**2,446,236**	**2,299,692**	**2,215,638**
River Basin Summaries						
Brazos	1,710,791	1,710,791	1,463,562	1,318,525	1,243,370	1,201,405
Canadian	2,101	2,101	1,628	1,383	1,255	1,183
Colorado	840,498	840,498	750,310	688,673	651,940	629,223
Red	629,240	629,240	504,437	437,655	403,127	383,827
Total	**3,182,630**	**3,182,630**	**2,719,937**	**2,446,236**	**2,299,692**	**2,215,638**

Source: Texas Water Development Board (TWDB); Consensus Projections adopted by the TWDB, April, 2018.

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 2020, it is projected that water use in the Llano Estacado Region for livestock purposes will be 41,589 ac-ft/yr (Figure 2.4 and Table 2-7). In 2070, it is projected that water used for livestock purposes will be 60,304 ac-ft/yr (a 45 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

	Water Demand Projections (acre-feet/year)					
	2020	2030	2040	2050	2060	2070
Counties						
Bailey	2,428	2,821	3,070	3,341	3,639	3,958
Briscoe	286	300	315	331	347	352
Castro	6,721	7,589	8,179	8,820	9,517	10,261
Cochran	102	106	109	113	117	118
Crosby	171	179	188	197	207	209
Dawson	53	55	58	61	64	65
Deaf Smith	11,170	12,157	12,933	13,766	14,661	15,604
Dickens	387	406	426	447	470	475
Floyd	1,168	1,189	1,212	1,237	1,262	1,268
Gaines	123	126	129	133	136	137
Garza	148	155	162	170	179	181
Hale	2,752	3,111	3,325	3,561	3,820	4,098
Hockley	133	138	144	150	156	157
Lamb	3,940	4,529	4,910	5,325	5,780	6,271
Lubbock	1,088	1,138	1,173	1,212	1,253	1,287
Lynn	65	68	71	74	78	79
Motley	276	290	305	320	336	340
Parmer	7,339	8,318	8,967	9,674	10,444	11,276
Swisher	2,728	2,864	3,007	3,157	3,314	3,469
Terry	420	461	492	526	562	586
Yoakum	91	96	101	106	111	113
Total	**41,589**	**46,096**	**49,276**	**52,721**	**56,453**	**60,304**
River Basin Summaries						
Brazos	22,899	25,777	27,677	29,747	32,005	34,365
Canadian	112	122	130	138	147	157

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

	Water Demand Projections (acre-feet/year)					
	2020	2030	2040	2050	2060	2070
Colorado	724	775	817	864	912	940
Red	17,854	19,422	20,652	21,972	23,389	24,842
Total	**41,589**	**46,096**	**49,276**	**52,721**	**56,453**	**60,304**

Source: Texas Water Development Board (TWDB); Consensus Projections adopted by the TWDB, April, 2018.

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 3,637,953 ac-ft/yr in 2020, 2,927,996 ac-ft/yr in 2040, and 2,452,931 ac-ft/yr in 2070 (Table 2-8 and Figure 2.5).

The use sector compositions of projected water demands in the Llano Estacado Region are summarized at years 2020, 2040, and 2070 in Table 2-9. As shown in Table 2-9, municipal, manufacturing, steam-electric, and livestock percentages of total water demands are expected to increase, while irrigation and mining percentages are expected to decrease during the planning period.

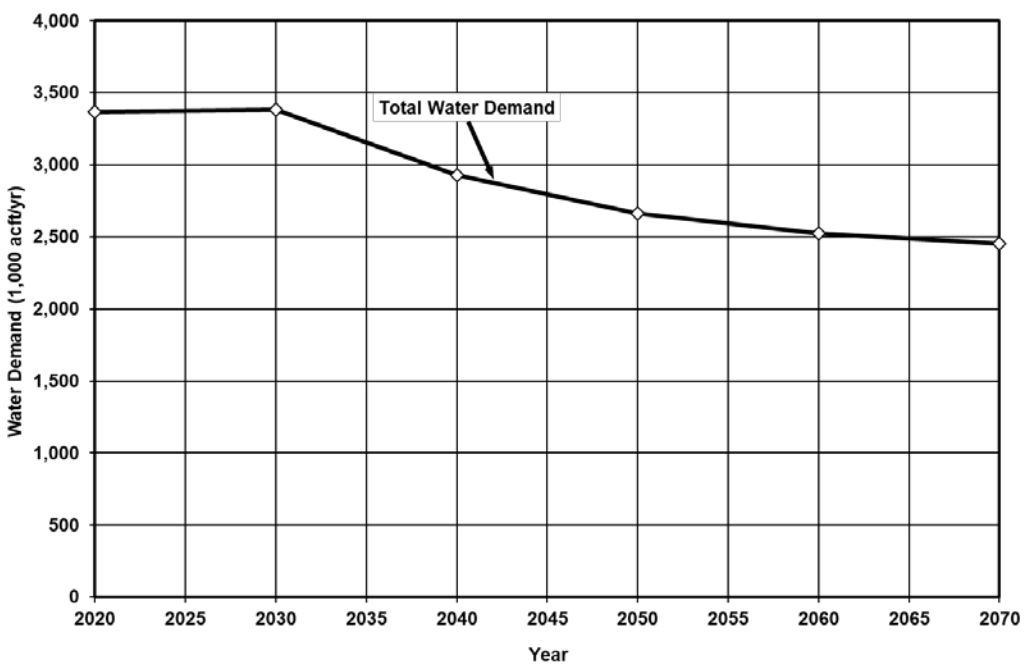

Figure 2.5. Total Water Demand Projections Llano Estacado Region – 2020 to 2070

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

	Water Demand Projections (acre-feet/year)					
	2020	2030	2040	2050	2060	2070
Counties						
Bailey	91,986	92,508	76,787	68,720	64,334	61,772
Briscoe	27,096	27,101	21,379	18,540	16,947	15,958
Castro	388,413	389,388	310,679	263,929	244,259	235,381
Cochran	100,606	100,705	86,065	76,915	69,351	64,143
Crosby	109,743	109,780	109,718	87,226	75,899	69,725
Dawson	111,041	111,097	111,134	96,644	89,075	84,468
Deaf Smith	226,635	228,285	182,382	159,557	148,250	142,657
Dickens	9,774	9,782	9,796	9,817	9,839	9,845
Floyd	131,532	131,571	105,268	91,611	83,765	79,133
Gaines	370,117	371,359	337,728	316,356	301,709	292,749
Garza	11,825	12,009	11,940	11,869	11,824	11,797
Hale	325,632	326,771	282,563	260,587	249,908	244,369
Hockley	136,532	136,777	102,719	88,731	82,308	78,849
Lamb	280,631	281,361	240,800	226,485	220,490	217,632
Lubbock	212,431	217,320	209,514	205,899	204,848	205,614
Lynn	91,045	91,223	91,134	90,901	90,738	90,594
Motley	10,270	10,250	10,254	10,261	10,258	10,244
Parmer	250,458	251,789	220,762	206,127	198,098	194,107
Swisher	139,445	139,602	114,380	102,139	95,463	91,414
Terry	175,623	175,897	149,136	137,949	132,147	128,816
Yoakum	167,118	167,385	143,858	132,824	127,080	123,664
Total	**3,367,953**	**3,381,960**	**2,927,996**	**2,663,087**	**2,526,590**	**2,452,931**
River Basin Summaries						
Brazos	1,845,205	1,854,783	1,613,776	1,475,066	1,407,341	1,372,831
Canadian	2,214	2,224	1,759	1,522	1,403	1,342
Colorado	861,916	863,839	774,257	712,948	676,652	654,623
Red	658,618	661,114	538,204	473,551	441,194	424,135
Total	**3,367,953**	**3,381,960**	**2,927,996**	**2,663,087**	**2,526,590**	**2,452,931**

Source: Texas Water Development Board (TWDB); Consensus Projections adopted by the TWDB, April, 2018.

Table 2-9. Composition of Projected Water Demands Llano Estacado Region 2020, 2040, and 2070

Water Use	2020		2040		2070	
	ac-ft	% Total	ac-ft	% Total	ac-ft	% Total
Municipal	94,899	2.82%	108,839	3.72%	132,673	5.41%
Manufacturing	10,881	0.32%	12,341	0.42%	12,341	0.50%
Steam-Electric Power	21,085	0.63%	21,085	0.72%	21,085	0.86%
Mining	16,869	0.50%	16,518	0.56%	10,890	0.44%
Irrigation	3,182,630	94.50%	2,719,937	92.89%	2,215,638	90.33%
Livestock	41,589	1.23%	49,276	1.68%	60,304	2.46%
Total	**3,367,953**	**100.00%**	**2,927,996**	**100.00%**	**2,452,931**	**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, and 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 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.

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). All 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 projected to be used by CRMWA customers located in the Llano Estacado Region in 2020 is 45,656 ac-ft/yr and is 59,855 ac-ft/yr in 2070. 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.

2.10.2 City of Lubbock

Lubbock has wholesale water supply contracts with Buffalo Springs Lake Water Supply Corporation (Garza County-Other), Lake Ransom Canyon, Shallowater, Lubbock-Reese Redevelopment Authority (Lubbock County-Other), and is in the process of negotiating a wholesale water supply contract with the Lake Alan Henry Water Supply District (Garza County-Other). In addition, 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 49,863 ac-ft/yr in 2020 and 71,477 ac-ft/yr in 2070 (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 2020 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 supply 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 2020 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 2020 is 17 ac-ft/yr and 24 ac-ft/yr in 2070 (Table 2-10).

Table 2-10. Major Water Provider Projected Demands

Major Water Providers with Lists of Customers	Projections (acre-feet)					
	2020	2030	2040	2050	2060	2070
Canadian River MWA						
Amarillo (Region A)	46,000	50,000	50,000	50,000	50,000	50,000
Borger (Region A)	7,054	7,091	7,072	7,068	7,064	7,063
Brownfield (Region O)	1,500	1,550	1,650	1,750	1,750	1,750
Lamesa (Region O)	1,750	1,950	2,300	2,750	2,750	2,750
Levelland (Region O)	2,301	2,400	2,500	2,588	2,671	2,743
Lubbock (Region O)	35,600	39,000	43,500	47,000	47,000	47,000
O'Donnell (Region O)	124	125	123	123	128	132
Pampa Municipal Water System (Region A)	2,361	2,833	3,196	3,989	4,628	4,680
Plainview (Region O)	2,500	3,000	3,250	3,500	3,500	3,500
Slaton (Region O)	1,405	1,430	1,455	1,479	1,477	1,477
Tahoka Public Water System (Region O)	476	486	477	470	492	503
Llano Estacado (Region O) Total	45,656	49,941	55,255	59,660	59,768	59,855
Panhandle Region (Region A) Total	55,415	59,924	60,268	61,057	61,692	61,743
CRMWA Total	***101,071***	***109,865***	***115,523***	***120,717***	***121,460***	***121,598***
City of Lubbock						
Lubbock	46,775	51,386	56,443	60,464	64,576	68,389
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	***49,863***	***54,474***	***59,531***	***63,552***	***67,664***	***71,477***
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

Table 2-10. Major Water Provider Projected Demands

Major Water Providers with Lists of Customers	Projections (acre-feet)					
	2020	2030	2040	2050	2060	2070
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)	11	12	13	14	15	16
County-Other (Motley)	6	6	7	7	8	8
Red River Authority Total	***17***	***18***	***20***	***21***	***23***	***24***

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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 could be 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 that includes Ogallala and Edwards-Trinity High Plains (ETHP) aquifers (Figure 3-1).[75] 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 describes these aquifers in detail, including water quality characteristics. For the water supply analyses in this chapter, following are brief aquifer descriptions.

[75] In most areas in the Llano Estacado Region, the Texas Water Development Board has considered the Ogallala and High Plains Aquifers to be the same aquifer.

3.1.1 Ogallala and Edwards-Trinity Aquifer

The Ogallala and ETHP Aquifer (Figure 1.5 and Figure 1.6) is the major water-bearing formation in most of the 21 counties of the Llano Estacado Region. Most of the communities within the region obtain water from the Ogallala and ETHP Aquifer as their main source of drinking water; however, approximately 95 percent of the water obtained from the Ogallala and ETHP Aquifer is used for irrigation.

3.1.2 Seymour Aquifer

The Seymour Formation (Figure 1.5), considered a major aquifer in Texas by the TWDB, 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 ETHP Aquifer 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. The Dockum Aquifer supplies small quantities of water for municipal, irrigation, and livestock uses in Briscoe, Castro, Crosby, Deaf Smith, Dickens, Floyd, Garza, Hockley, Motley, Parmer, and Swisher counties. There are some areas in the region, particularly in Deaf Smith County, where the Dockum Aquifer produces usable supplies of fresh water.

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 size of many of the aquifers in Texas, numerous conservation districts manage the resources of a given aquifer. The eight GCDs in the Llano Estacado Region serve an important role in the implementation of groundwater management strategies (Table 3-1and Figure 3.1). The GCDs' responsibilities and authorities vary depending upon creating legislation and governing law.

Table 3-1. Groundwater Conservation Districts

Groundwater Conservation District	Year of Establishment	Counties	
		Within Region O	In Other Region(s)
Garza County UWCD	1996	Garza	None
Gateway GCD	2003	Motley	Childress, Cottle, Foard, Hardeman, King

Table 3-1. Groundwater Conservation Districts

Groundwater Conservation District	Year of Establishment	Counties	
		Within Region O	In Other Region(s)
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	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

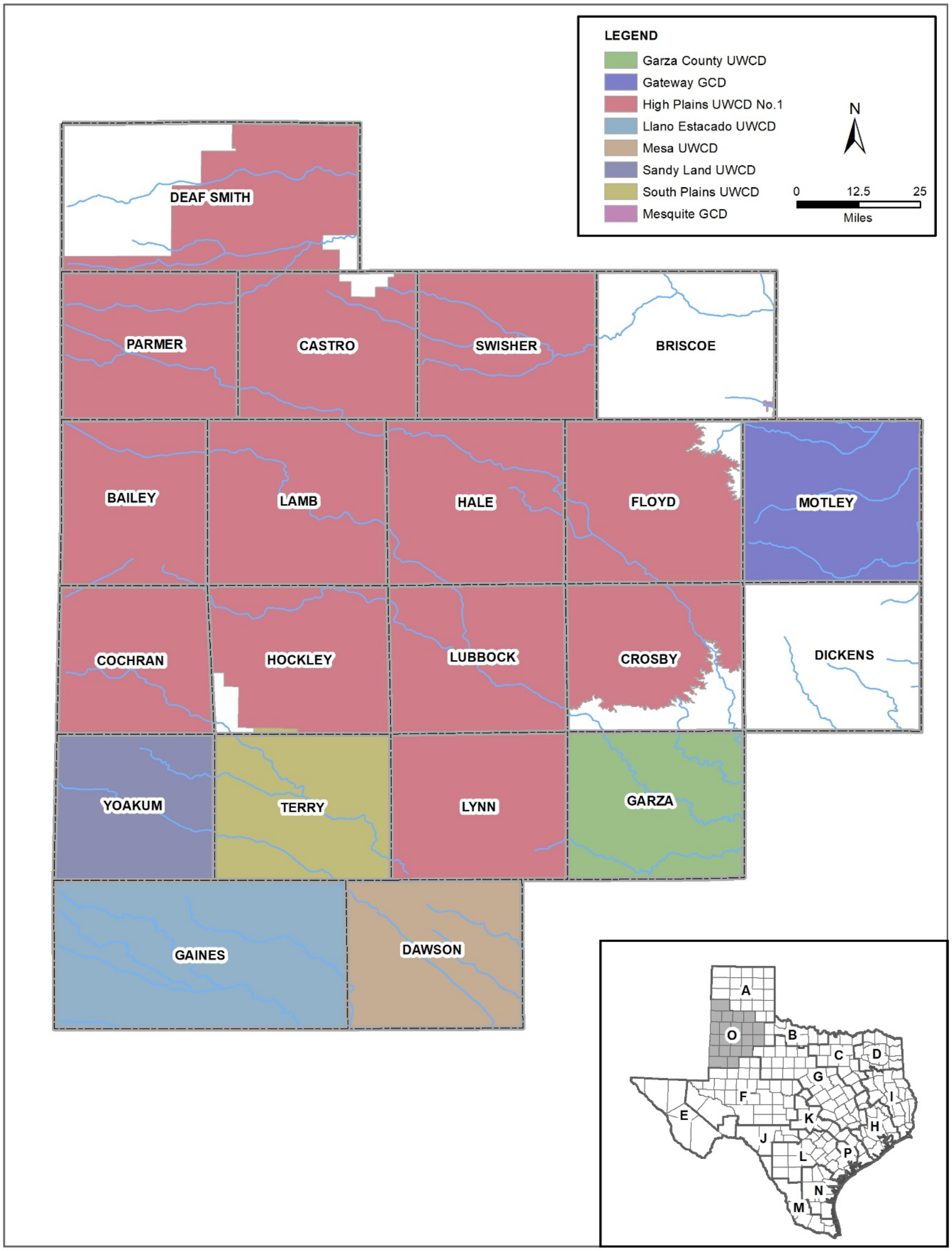

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Figure 3.1 Groundwater Conservation Districts of the Llano Estacado Region

3.2.2 Groundwater Management Areas

In 1995, groundwater management areas[76] (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 Texas Water Development Board (TWDB) was delegated responsibility to delineate GMAs, and subsequently divided Texas into 16 GMAs in 2002 (Source: TWDB

Figure 3.2). 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

[76] TWDB. 2019. Texas Water Development Board Groundwater Management Areas. Online: http://www.twdb.state.tx.us/groundwater/management_areas/

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 between 23 and 27 feet for all of GMA 2 from 2012 to 2070.	10/19/2016
2	Dockum	Average drawdown of 27 feet for all of GMA 2 from 2012 to 2070.	10/19/2016
6	Dockum	27 feet decline from 2020 - 2070	11/17/2016
6	Ogallala	23 - 27 feet decline from 2020 - 2070	11/17/2016
6	Seymour	15 feet decline from 2020 - 2070	11/17/2016

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, within 50 years, critical groundwater problems, 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[77]. 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. This PGMA was designated by TCEQ 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

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

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.

For those areas of the PGMA for which modeled available groundwater (MAG) has been established, the resulting water availability numbers from that process were used. In areas not covered by a MAG or for aquifers not included in the MAG process, alternative methodologies were used to determine the groundwater available as described in Section 3.3.

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. Multiple 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 aquifer has been deemed "non-relevant" by the GMA. This is the case for the Seymour Aquifer in Briscoe County, and 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 was the case with the Seymour Aquifer in Briscoe County, which used the "non-relevant" estimates from Run 16-031 (Shi, 2017)[78]. In the absence of "non-relevant" estimates, availability was determined based on historical groundwater pumpage reports from TWDB, which contain estimates for each county by river basin and aquifer. The maximum annual pumpage for years 2007 to 2015 (rounded up to the nearest 1,000 acre-feet per year [ac-ft/yr]) was assumed to be available. This strategy was used for the Ogallala and Dockum aquifers availability 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 recognized by the TWDB. The "other" aquifer designation occurs in Briscoe, Crosby, Dickens, Floyd, Garza, Hale, and Motley counties. For these counties, "other" aquifer availability was determined based on historical groundwater pumpage reports from TWDB. The maximum annual pumpage for years 2007 to 2015 (rounded up to the nearest 1,000 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 2070. This volume of groundwater can be used for WMSs.

For municipal utilities, existing supplies, after generally accounting for the ratio of peak to average-day water demands, 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 3,091,566 ac-ft/yr in 2020, 1,540,292 ac-ft/yr in 2040, and 1,019,716 ac-ft/yr in 2070 (Table 3-4). Supplies from the Ogallala Aquifer and other aquifers are projected to hold steady on an annual basis throughout the 2020 to 2070 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 3,001,657 ac-ft/yr in 2020 to 931,551 ac-ft/yr in 2070.

3.4 Assumptions for Groundwater Supply Assessment

1. Groundwater availability by county is subdivided into river basin parts 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.

[78] Shi, Jerry, 2017. GAM Run 16-031 MAG: Modeled Available Groundwater for the Seymour, Blaine, Ogallala, and Dockum Aquifers in Groundwater Management Area 6. Texas Water Development Board Groundwater Division.

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 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 groundwater amount pumped over the 2007 to 2015 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 maximum industrial groundwater amount pumped over the 2007 to 2015 time period; however, some adjustments were made in some counties.

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 maximum irrigation groundwater amount pumped over the 2007 to 2015 time period; however, some adjustments were made in some counties. 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. If additional reductions were required in the projected aquifer demand, mining supply was reduced after the reduction in irrigation demand.

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 groundwater amount pumped over the 2007 to 2015 time period; however, some adjustments were made to some counties. In cases in which 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. If additional reductions were required in the projected aquifer demand, mining supply was reduced after the reduction in irrigation demand.

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 manufacturing groundwater amount pumped over the 2007 to 2015 time period; however, some adjustments were made in some counties.

Table 3-3. Summary of Groundwater Availability, Existing Supply, and Volume Remaining for Water Management Strategies (2070)

County	Aquifer	2070 Modeled Available Groundwater (MAG) Volume (ac-ft/yr)	2070 Non-MAG Groundwater Volume (ac-ft/yr)	2070 Existing Supply (ac-ft/yr)	Availability Remaining for Water Management Strategies
Bailey	ETHP	34,815	--	16,259	18,556
	Dockum	833	--	0	833
Briscoe	ETHP	6,451	--	6,351	100
	Dockum	0	--	0	0
	Seymour	--	313	313	0
	Other	--	6,000	5,127	873
Castro	ETHP	27,505	--	27,505	0
	Dockum	425	--	425	0
Cochran	ETHP	42,675	--	42,675	0
	Dockum	972	--	0	972
Crosby	ETHP	31,290	--	30,650	640
	Dockum	3,858	--	3,686	172
	Other	--	9,000	8,462	538
Dawson	ETHP	69,927	--	68,254	1,673
	Dockum	0	--	0	0
Deaf Smith	ETHP	45,606	--	44,156	1,450
	Dockum	4,401	--	3,424	977
Dickens	Ogallala	--	1,300	1,244	56
	Dockum	--	200	106	94
	Other	--	10,000	9,739	261
Floyd	ETHP	41,537	--	41,537	0
	Dockum	3,226	--	250	2,976
	Other	--	16,000	15,485	515
Gaines	ETHP	138,294	--	128,327	9,967
	Dockum	0	--	0	0
Garza	ETHP	10,855	--	10,855	0
	Dockum	911	--	416	495
	Other	--	2,000	1,430	570
Hale	ETHP	31,954	--	26,989	4,965
	Dockum	1,121	--	0	1,121
Hockley	ETHP	53,610	--	53,610	0
	Dockum	1,057	--	28	1,029

Table 3-3. Summary of Groundwater Availability, Existing Supply, and Volume Remaining for Water Management Strategies (2070)

County	Aquifer	2070 Modeled Available Groundwater (MAG) Volume (ac-ft/yr)	2070 Non-MAG Groundwater Volume (ac-ft/yr)	2070 Existing Supply (ac-ft/yr)	Availability Remaining for Water Management Strategies
Lamb	ETHP	46,816	--	28,206	18,610
	Dockum	923	--	0	923
Lubbock	ETHP	90,798	--	83,637	7,161
	Dockum	1,086	--	0	1,086
Lynn	ETHP	71,640	--	70,840	800
	Dockum	912	--	0	912
Motley	Ogallala	409	--	371	38
	Dockum	92	--	92	0
	Seymour	3,961	--	844	3,117
	Other	--	13,000	12,318	682
Parmer	ETHP	30,536	--	30,536	0
	Dockum	4,589	--	1,225	3,364
Swisher	ETHP	22,783	--	22,783	0
	Dockum	1,576	--	1,535	41
Terry	ETHP	85,519	--	84,719	800
Yoakum	ETHP	48,940	--	48,300	640
	Totals	**961,903**	**57,813**	**932,709**	**87,007**

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

Table 3-4. Available Groundwater Supply by Aquifer

Aquifer Name	Annual Quantity Available					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
ETHP	3,001,657	1,992,068	1,450,383	1,169,053	1,018,537	931,551
Ogallala	1,709	1,709	1,709	1,709	1,709	1,709
Dockum	27,044	27,044	27,044	27,043	26,283	26,182
Seymour	5,156	6,992	5,156	5,143	4,285	4,274
Other	56,000	56,000	56,000	56,000	56,000	56,000
Total	3,091,566	2,083,813	1,540,292	1,258,948	1,106,814	1,019,716
Percent of Total						
ETHP	97.09%	95.60%	94.16%	92.86%	92.02%	91.35%
Ogallala	0.06%	0.08%	0.11%	0.14%	0.15%	0.17%
Dockum	0.87%	1.30%	1.76%	2.15%	2.37%	2.57%
Seymour	0.17%	0.34%	0.33%	0.41%	0.39%	0.42%
Other	1.81%	2.69%	3.64%	4.45%	5.06%	5.49%
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

3.5 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[79]. 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 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.

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

There are a limited number of surface water rights within the region (Table 3-5); however, none of those rights is 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 contains a list of all surface water rights in the region and their authorized diversion volumes. Appendix C includes the 2018 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.

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 Silverton, Tulia, Floydada, and Lockney. 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 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, total storage capacity of 31,846 ac-ft, and can supply 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[80], 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 conduct analyses using a standalone WAM developed specifically for LAH. As a result of a new DOR

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

occurring during the 2010s in the upper Brazos River Basin, the City of Lubbock requested that HDR Engineering, Inc. (HDR) perform a yield analysis of LAH with a period of record extending through 2016 in order to account for the reduction of yield to LAH from the new DOR. Based upon the hydrologic record for the period 1940 through 2002, LAH's firm yield was calculated at 21,400 ac-ft/yr in 2020.

Table 3-5. Surface Water Supplies

Source	Annual Quantity Available (acre-feet)					
	2020	2030	2040	2050	2060	2070
Lake Alan Henry	21,400	20,940	20,480	20,020	19,560	19,100
Lake Mackenzie	4,530	4,530	4,530	4,530	4,530	4,530
White River Reservoir	0	0	0	0	0	0
Reservoir Total	**25,930**	**25,470**	**25,010**	**24,550**	**24,090**	**23,630**
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	**26,048**	**25,588**	**25,128**	**24,668**	**24,208**	**23,748**

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 2020 to 2070. In the Llano Estacado Region, 12 counties have water availability from direct reuse. Lubbock County has the largest direct reuse availability with 10,889 ac-ft in 2020, increasing to 15,852 ac-ft in 2070. 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.

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

County	Annual Quantity Available					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (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	10,889	11,640	12,555	13,671	15,031	15,852
Lynn	346	346	346	346	346	346
Parmer	2,887	2,887	2,887	2,887	2,887	2,887
Total	37,311	38,062	38,977	40,093	41,453	42,274

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 2070 in Figure 3.3.

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

	2020	2030	2040	2050	2060	2070
	acre-feet					
Reuse	37,311	38,062	38,977	40,093	41,453	42,274
Surface Water	26,048	25,588	25,128	24,668	24,208	23,748
Groundwater	3,091,566	2,083,813	1,540,292	1,258,948	1,106,814	1,019,716

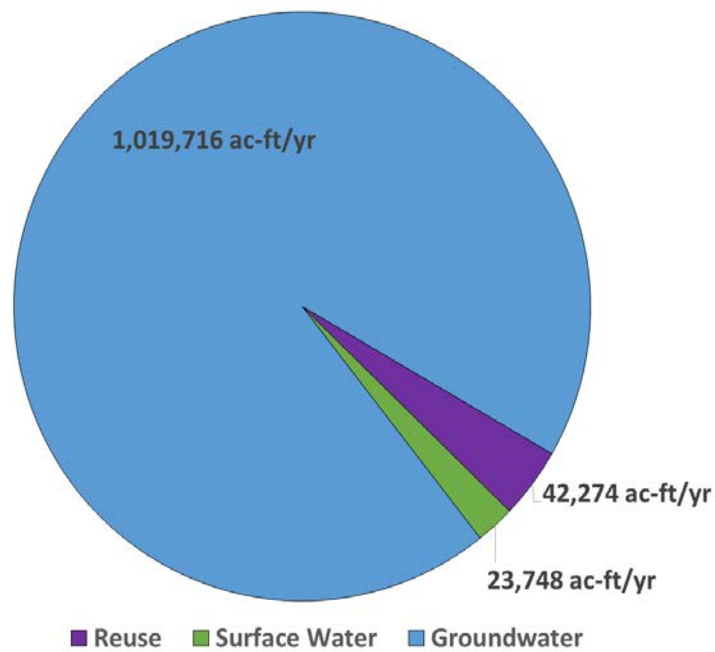

Figure 3.3. 2070 Water Supplies in the Llano Estacado Region

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.[81]

[81] Only supplies used within Region O 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)					
		2020	2030	2040	2050	2060	2070
Canadian River MWA	Municipal	39,866	40,057	39,988	38,758	35,793	35,788
	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	**39,866**	**40,057**	**39,988**	**38,758**	**35,793**	**35,788**
City of Lubbock	Municipal	44,709	44,564	44,275	42,758	39,725	37,669
	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	**44,709**	**44,564**	**44,275**	**42,758**	**39,725**	**37,669**
Mackenzie MWA	Municipal	4,530	4,530	4,530	4,530	4,530	4,530
	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	**4,530**	**4,530**	**4,530**	**4,530**	**4,530**	**4,530**
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

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

Major Water Provider	Category of Use	Supplies Available (ac-ft/yr)					
		2020	2030	2040	2050	2060	2070
	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 2070. 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 280 acre-feet of water (ac-ft) of water in the year 2010, and for the county-other category in each county. 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 726,021 ac-ft in 2020, increasing to 1,499,897 ac-ft by 2070 (Table 4-1, end of table). The irrigation need in 2020 is 705,992 ac-ft (or 97 percent of the total need), and increasing to 1,445,026 ac-ft in 2070 (or 96 percent of the total need).

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

Water User Group	Year					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (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	15,298	45,670	45,670	45,670	45,670	45,670
Livestock	0	0	0	264	562	881
County Total	**15,298**	**45,670**	**45,670**	**45,934**	**46,232**	**46,551**
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	4,234	4,234	4,234	4,234	4,234
Livestock	0	0	0	0	0	0
County Total	**0**	**4,234**	**4,234**	**4,234**	**4,234**	**4,234**
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

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

Water User Group	Year					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
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	125,042	207,865	207,865	207,865	207,865	207,865
Livestock	0	0	0	0	0	0
County Total	**125,042**	**207,865**	**207,865**	**207,865**	**207,865**	**207,865**
Cochran County						
Morton Public Watery 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	42,778	47,340	40,014	35,349	31,132	28,190
Livestock	0	0	0	0	0	0
County Total	**42,778**	**47,340**	**40,014**	**35,349**	**31,132**	**28,190**
Crosby County						
Crosbyton	0	0	0	0	0	0
Lorenzo	0	0	0	0	0	0
Ralls	78	89	98	112	129	146
County-Other	0	0	0	0	0	0
Municipal Total	**78**	**89**	**98**	**112**	**129**	**146**

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

Water User Group	Year					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	368	363	322	280	243	210
Irrigation	1,056	1,246	28,302	28,302	28,302	28,302
Livestock	0	0	0	0	0	0
County Total	**1,502**	**1,698**	**28,722**	**28,694**	**28,674**	**28,658**
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	1,546	1,546	1,546	1,546	1,546	1,546
Irrigation	0	0	13,407	13,475	13,505	13,519
Livestock	0	0	0	0	0	0
County Total	**1,546**	**1,546**	**14,953**	**15,021**	**15,051**	**15,065**
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	998	1,103	1,103	1,103	1,103	1,103
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	18,836	87,769	87,769	87,769	87,719	87,669
Livestock	112	122	844	1,677	2,572	3,515

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

Water User Group	Year					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
County Total	**19,946**	**88,994**	**89,716**	**90,549**	**91,394**	**92,287**
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**
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	41,938	42,645	26,307	23,187	23,187	23,187
Livestock	0	0	0	0	0	0
County Total	**41,938**	**42,645**	**26,307**	**23,187**	**23,187**	**23,187**
Gaines County						
Seagraves	0	0	0	0	0	0
Seminole	551	774	1,050	1,363	1,614	1,878

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

Water User Group	Year					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
County-Other	0	10	452	938	1,398	1,880
Municipal Total	**551**	**784**	**1,502**	**2,301**	**3,012**	**3,758**
Manufacturing	968	1,043	1,043	1,043	1,043	1,043
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	105,558	167,104	167,104	167,104	167,104	167,104
Livestock	0	0	0	0	0	0
County Total	**107,077**	**168,931**	**169,649**	**170,448**	**171,159**	**171,905**
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**

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

Water User Group	Year					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
Manufacturing	2,967	3,660	3,660	3,660	3,660	3,660
Steam-Electric Power	0	0	0	0	0	0
Mining	953	937	807	671	551	447
Irrigation	106,582	211,765	211,765	211,765	211,765	211,765
Livestock	0	0	0	0	0	0
County Total	**110,502**	**216,362**	**216,232**	**216,096**	**215,976**	**215,872**
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	0	43,079	30,841	27,096	27,096	27,096
Livestock	0	0	0	0	0	0
County Total	**0**	**43,079**	**30,841**	**27,096**	**27,096**	**27,096**
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**

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

Water User Group	Year					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	478	471	405	337	277	225
Irrigation	75,376	186,771	186,771	186,771	186,771	186,771
Livestock	0	0	0	100	555	1,046
County Total	**75,854**	**187,242**	**187,176**	**187,208**	**187,603**	**188,042**
Lubbock County						
Abernathy	0	0	0	0	0	0
Idalou	0	0	0	0	0	0
Lubbock	3,716	8,472	13,818	19,356	26,501	32,370
New Deal	0	0	0	0	0	0
Ransom Canyon	0	0	0	0	0	0
Shallowater	0	0	0	0	0	0
Slaton	0	0	0	0	0	0
Wolfforth	0	0	0	43	204	366
County-Other	0	0	0	0	0	0
Municipal Total	**3,716**	**8,472**	**13,818**	**19,399**	**26,255**	**32,736**
Manufacturing	521	676	676	676	676	676
Steam-Electric Power	0	0	0	0	0	0
Mining	5,372	5,443	4,931	4,320	3,781	3,332
Irrigation	3,892	40,264	41,064	41,064	41,064	41,064
Livestock	0	0	0	0	0	0
County Total	**13,501**	**54,855**	**60,489**	**65,459**	**72,226**	**77,808**
Lynn County						
O'Donnell	0	0	0	0	0	0
Tahoka Public WS	0	0	0	0	0	0

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

Water User Group	Year					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
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	635	785	718	511	319	165
Irrigation	0	0	5,465	12,311	16,566	19,274
Livestock	0	0	0	0	0	0
County Total	**635**	**785**	**6,183**	**12,822**	**16,885**	**19,439**
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

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

Water User Group	Year					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
Steam-Electric Power	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Irrigation	122,909	161,748	161,748	161,748	160,988	160,887
Livestock	0	0	0	0	0	0
County Total	**122,909**	**161,748**	**161,748**	**161,748**	**160,988**	**160,887**
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	13,178	70,822	70,822	70,822	71,362	70,500
Livestock	0	0	0	0	0	0
County Total	**13,178**	**70,822**	**70,822**	**70,822**	**71,362**	**70,500**
Terry County						
Brownfield	0	0	0	49	216	291
County-Other	0	0	0	0	0	0
Municipal Total	**0**	**0**	**0**	**49**	**216**	**291**
Manufacturing	0	0	0	0	0	0
Steam-Electric Power	0	0	0	0	0	0
Mining	230	388	405	287	172	91
Irrigation	351	42,583	42,583	42,743	42,743	42,743
Livestock	0	0	0	0	0	0
County Total	**581**	**42,971**	**42,988**	**43,079**	**43,131**	**43,125**

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

Water User Group	Year					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
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	536	570	383	193	19	0
Irrigation	33,198	79,186	79,186	79,186	79,186	79,186
Livestock	0	0	0	0	0	0
County Total	**33,734**	**79,756**	**79,569**	**79,379**	**79,205**	**79,186**
Llano Estacado Region (Region O—All Counties)						
Municipal	4,345	9,345	15,418	21,861	30,062	36,931
Manufacturing	5,454	6,482	6,482	6,482	6,482	6,482
Steam-Electric Power	0	0	0	0	0	0
Mining	10,118	10,503	9,517	8,145	6,908	6,016
Irrigation	705,992	1,440,091	1,450,917	1,446,461	1,445,719	1,445,026
Livestock	112	122	844	2,041	3,689	5,442
Region Total	**726,021**	**1,466,543**	**1,483,178**	**1,484,990**	**1,492,860**	**1,499,897**

ac-ft = acre-feet

4.1.1 Municipal WUGs with Needs

There are six municipal WUGs with a projected need (shortage) between 2020 and 2070. The total municipal need for the region in 2020 is 4,345 acre-feet per year (ac-ft/yr), increasing to 36,931 ac-ft/yr in 2070 (Table 4-1). Four counties (Crosby, Gaines, Lubbock, and Terry) 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

The total manufacturing need for the region in 2020 is 5,454 ac-ft/yr, increasing to 6,482 ac-ft/yr in 2070 (Table 4-1). Four counties (Deaf Smith, Gaines, Hale, and Lubbock) are projected to have manufacturing need (shortage) during the planning period, as shown in Figure 4.2.

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

The total mining need for the region in 2020 is 10,118 ac-ft/yr, decreasing to 6,016 ac-ft/yr in 2070 (Table 4-1). Eight counties (Crosby, Dawson, Hale, Lamb, Lubbock, Lynn, Terry, and Yoakum) are projected to have a mining need (shortage) during the planning period, as shown in Figure 4.3.

4.1.5 Irrigation WUGs with Needs

The total irrigation need for the region in 2020 is 705,992 ac-ft/yr, increasing to 1,445,026 ac-ft/yr in 2070 (Table 4-1). Eighteen counties (all counties, except Dickens, Garza, and Motley) are projected to have an irrigation need (shortage) during the planning period, as shown in Figure 4.4.

4.1.6 Livestock WUGs with Needs

The total livestock need for the region in 2020 is 112 ac-ft/yr, increasing to 5,442 ac-ft/yr in 2070 (Table 4-1). Three counties (Bailey, Deaf Smith, and Lamb) are projected to have a livestock need (shortage) during the planning period, as shown in Figure 4.5.

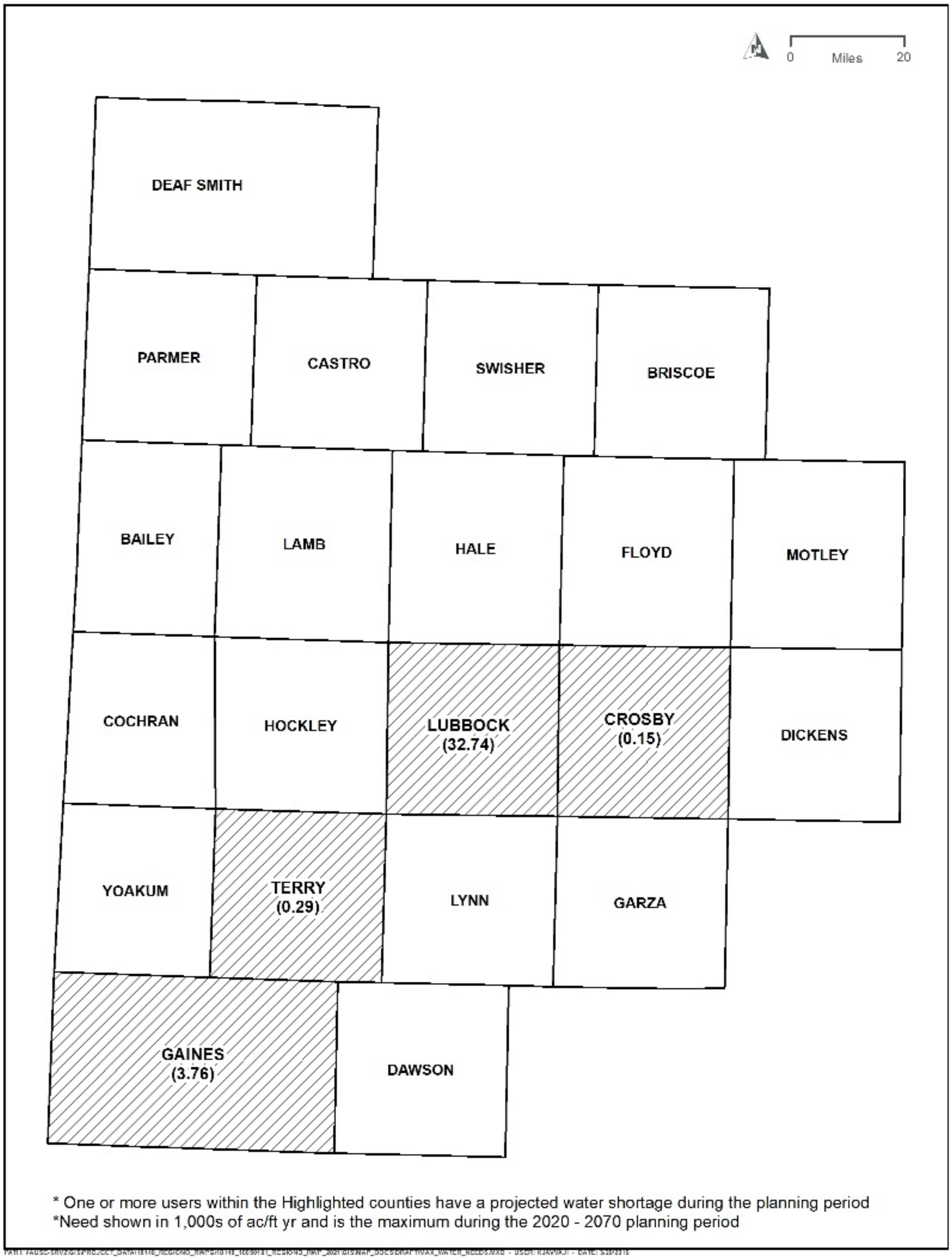

Figure 4.1 Municipal Water Needs

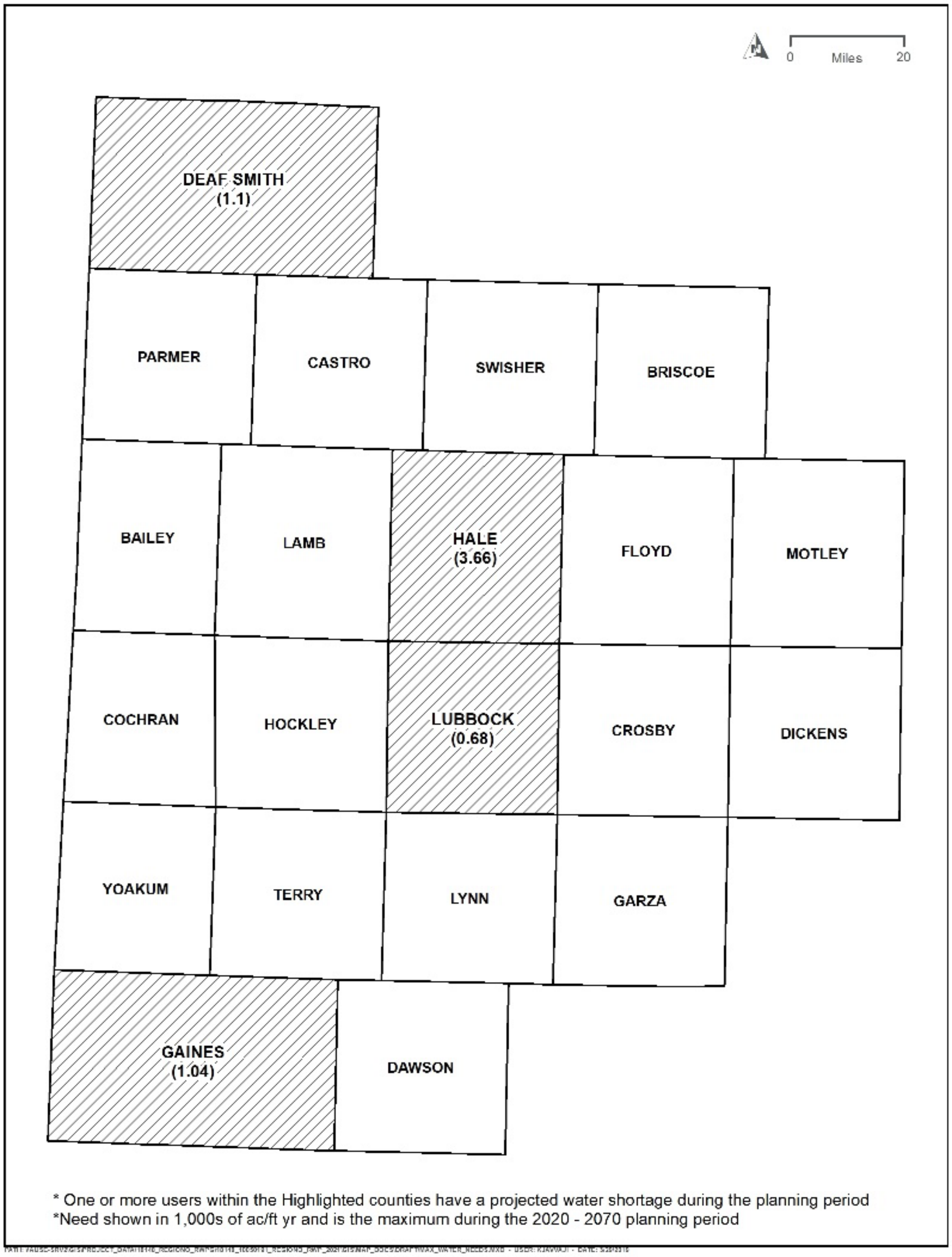

Figure 4.2 Manufacturing Water Needs

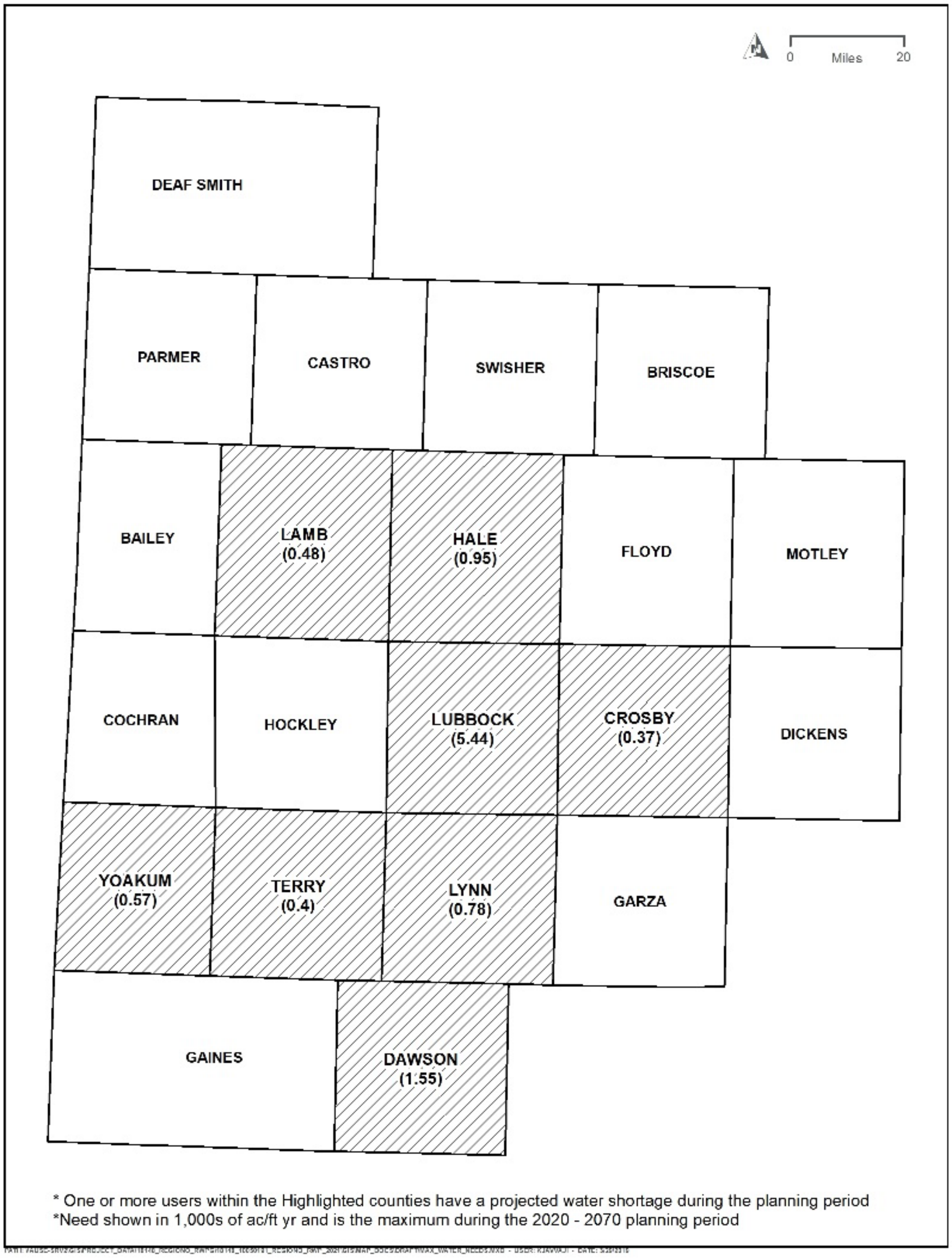

Figure 4.3 Mining Water Needs

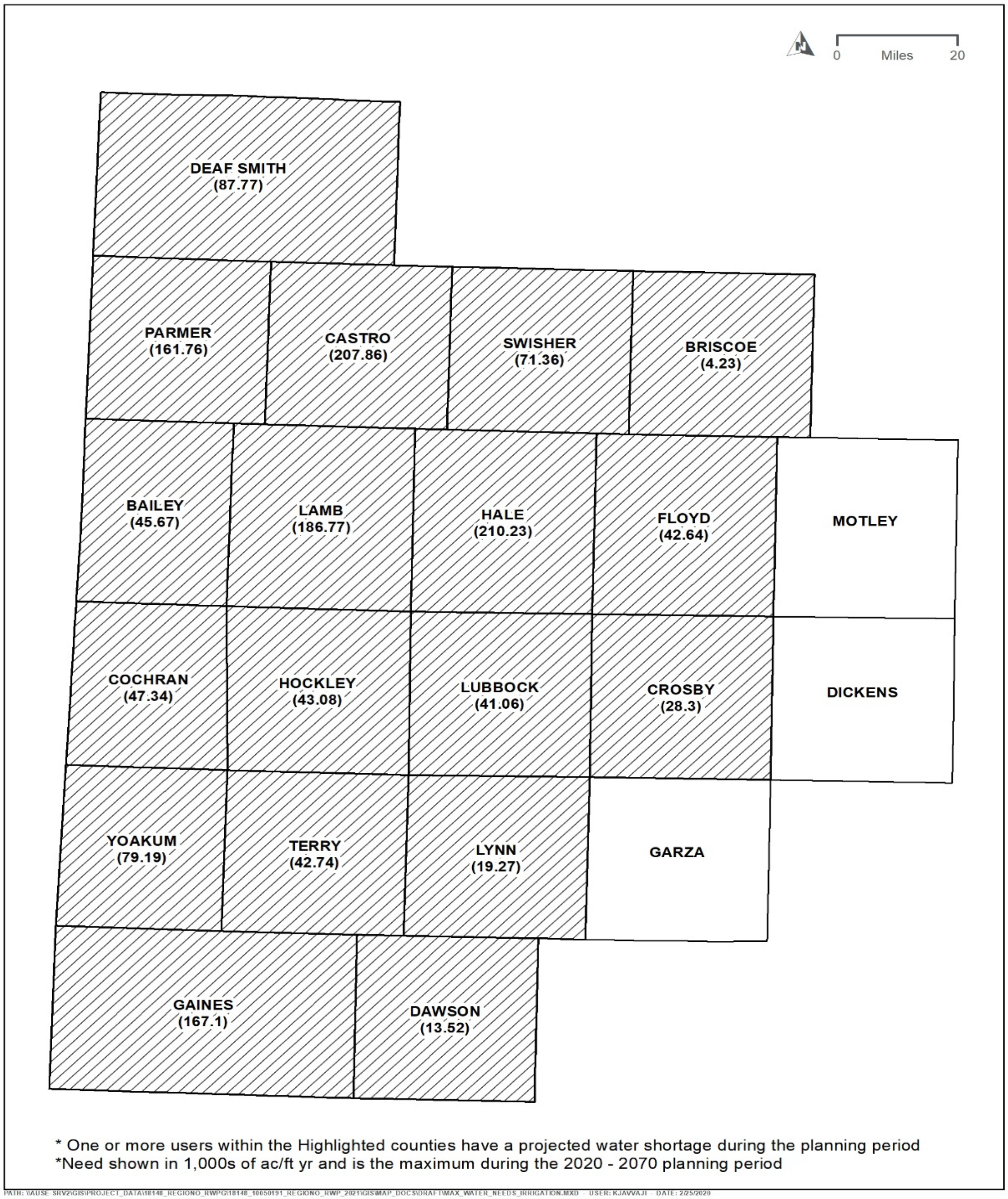

Figure 4.4 Irrigation Water Needs

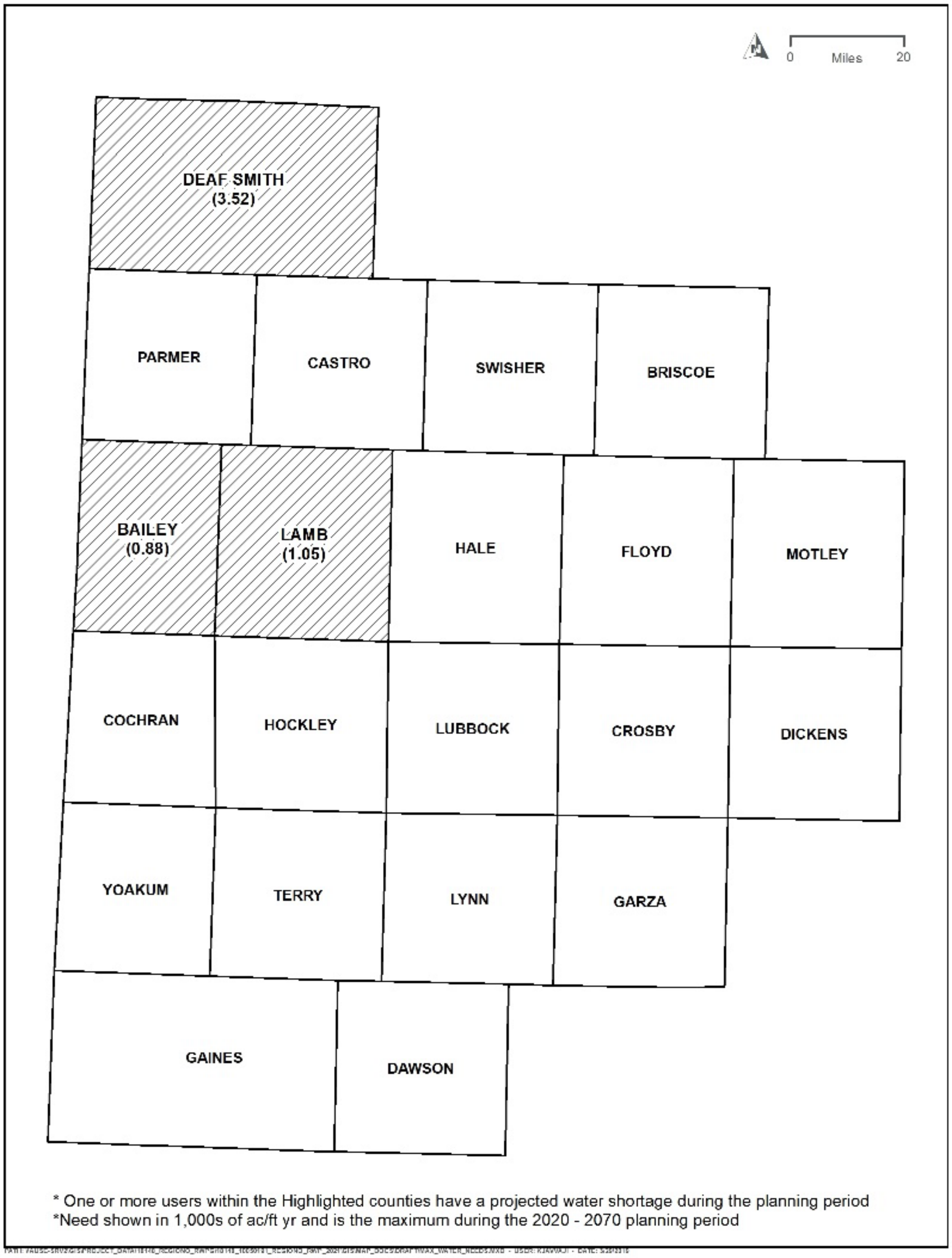

Figure 4.5 Livestock Water Needs

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					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
Canadian River Municipal Water Authority (CRMWA)						
Demands (Region O Only)	**45,656**	**49,941**	**55,255**	**59,660**	**59,768**	**59,855**
Supplies (Region O Only)						
Lake Meredith	11,188	11,230	11,767	12,142	12,072	12,061
Ogallala Aquifer (Roberts County)	28,678	28,827	28,221	26,616	23,721	23,727
Total Supplies	**39,866**	**410,057**	**39,988**	**38,758**	**35,793**	**35,788**
CRMWA System Management Supplies/(Needs)	***(5,790)***	***(9,884)***	***(15,267)***	***(20,902)***	***(23,975)***	***(24,067)***
City of Lubbock						
Demands	**49,863**	**54,474**	**59,531**	**63,552**	**67,664**	**71,477**
Supplies						
Lake Alan Henry	8,000	8,000	8,000	8,000	8,000	8,000
Ogallala Aquifer (Bailey County)	2,500	2,329	2,082	1,797	1,474	594
Ogallala Aquifer (Lamb County)	2,500	2,329	2,082	1,797	1,474	344
CRMWA	31,709	31,906	32,111	31,164	28,777	28,731
Total Supplies	**44,709**	**44,564**	**44,275**	**42,758**	**39,725**	**37,669**
Lubbock System Management Supplies/(Needs)	***(5,154)***	***(9,910)***	***(15,256)***	***(20,794)***	***(27,939)***	***(33,808)***
Mackenzie Municipal Water Authority (MMWA)						
Demands	**568**	**568**	**568**	**568**	**568**	**568**
Supplies						
Lake Mackenzie	4,530	4,530	4,530	4,530	4,530	4,530
Total Supplies	**4,530**	**4,530**	**4,530**	**4,530**	**4,530**	**4,530**
MMWA System Management Supplies/(Needs)	***3,962***	***3,962***	***3,962***	***3,962***	***3,962***	***3,962***
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)	**17**	**18**	**20**	**21**	**23**	**24**
Supplies (Region O Only)						

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

Major Water Providers with Lists of Customers	Projections					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
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)	***0***	***0***	***0***	***0***	***0***	***0***

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)					
		2020	2030	2040	2050	2060	2070
Canadian River MWA	Municipal	(5,790)	(9,884)	(15,267)	(20,902)	(23,975)	(24,067)
	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)	**(5,790)**	**(9,884)**	**(15,267)**	**(20,902)**	**(23,975)**	**(24,067)**
City of Lubbock	Municipal	(5,154)	(9,910)	(15,256)	(20,794)	(27,939)	(33,808)
	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)	**(5,154)**	**(9,910)**	**(15,256)**	**(20,794)**	**(27,939)**	**(33,808)**
Mackenzie MWA	Municipal	3,962	3,962	3,962	3,962	3,962	3,962
	Manufacturing	0	0	0	0	0	0

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)					
		2020	2030	2040	2050	2060	2070
	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)	**3,962**	**3,962**	**3,962**	**3,962**	**3,962**	**3,962**
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	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**

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 652,262 ac-ft/yr in 2020. Most of this is associated with irrigated agriculture that has not fully realized the benefits of conservation. By 2070, the projected need is 1,339,193 ac-ft/yr (Table 4-4), which represents an 11 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)					
	2020	2030	2040	2050	2060	2070
Municipal	2,930	8,394	15,314	21,742	29,916	28,685
Manufacturing	5,376	6,219	6,043	6,043	6,043	6,043
Mining	9,986	10,101	8,896	7,593	6,439	5,609
Steam-Electric Power	0	0	0	0	0	0
Irrigation	633,858	1,301,313	1,267,948	1,278,971	1,287,960	1,293,031
Livestock	112	122	844	2,041	3,794	5,825
Total Second Tier Needs	**652,262**	**1,326,149**	**1,299,045**	**1,316,390**	**1,334,152**	**1,339,193**

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 whether 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)					
	2020	2030	2040	2050	2060	2070
Canadian River MWA	4,203	9,407	15,250	20,878	23,943	24,023
City of Lubbock	3,848	9,503	15,243	20,780	27,922	33,788
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

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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

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

Potentially Feasible WMS	Entity	County
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
Jim Bertram Lake 7	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 Wellfield)	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 discusses 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 infeasiblity associated with pumping water from the Gulf of Mexico 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.

In some cases, selected WMSs are shown as providing supply in 2020. It is anticipated that those projects will be constructed and delivering water by January 5, 2023.

5.1 Strategy Evaluation

In accordance with 31 Texas Administrative Code (TAC) § 357.34, WMS are evaluate 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 Jim Bertram Lake 7

The Jim Bertram Lake 7 (Lake 7) strategy is included in the *2018 Lubbock Strategic Water Supply Plan*[82] 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.

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 a 21.4-million gallon per day (mgd) intake structure and pump station at Lake 7;
- Construct a new 21.4 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.

[82] 2018 Strategic Water Supply Plan, City of Lubbock. https://ci.lubbock.tx.us/storage/images/4G1pIUEKJzRJftCGkkPQyFewa9PVdySLl4ekNLWV.pdf

Figure 5.1. Jim Bertram Lake 7 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 9,800 acre-feet per year (ac-ft/yr) of playa lake-developed stormwater would contribute to Lake 7 inflows.

Water availability analyses were performed for Lake 7 using Run 3 of the Texas Commission on Environmental Quality (TCEQ) Brazos River Basin water availability model (Brazos WAM). The Brazos WAM was modified to include the reclaimed water and playa lake-developed stormwater. The resulting Lake 7 firm yield with these supplemental inflow sources is calculated to be 12,700 ac-ft/yr. However, the City of Lubbock would manage Lake 7 with a safety reserve. As a result, the City of Lubbock plans for the Lake 7 strategy to provide a supply of 11,975 ac-ft/y.

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;
- Transmission facilities are sized with a 2.0 peaking factor; and
- The project is assumed to have a 2-year construction period.

Table 5-2. Jim Bertram Lake 7 Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Dam and Reservoir (20,000 ac-ft, 774 acres)	$30,519,000
Intake and Pump Station (21.4 mgd)	$32,781,000
Transmission Pipeline (36-in dia., 12 miles)	$24,368,000
Advanced Water Treatment Plant (21.4 mgd)	$86,217,000
TOTAL COST OF FACILITES	**$173,885,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$59,642,000
Environmental & Archaeology Studies	$308,000
Land Acquisition for Reservoir Mitigation (774 acres)	$1,935,000
Reservoir Land Acquisition and Surveying (774 acres)	$1,974,000
Pipeline Land Acquisition and Surveying (29 acres)	$210,000
Interest During Construction (3% for 2 years with a 0.5% ROI)	$13,089,000

Table 5-2. Jim Bertram Lake 7 Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
TOTAL COST OF PROJECT	**$251,043,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$14,315,000
Reservoir Debt Service (3.5%, 40 years)	$2,229,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$244,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$820,000
Dam and Reservoir (1.5% of Cost of Facilities)	$458,000
Advanced Water Treatment Plant	$1,768,000
Pumping Energy Costs (0.08 $/kW-hr)	$680,000
TOTAL ANNUAL COST	**$20,514,000**
Available Project Yield (ac-ft/yr)	11,975
Annual Cost of Water ($ per ac-ft), based on PF=2	$1,713
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=2	$332
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$5.26
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$1.02

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

Environmental Issues

The project occurs within the High Plains vegetational area[83] and is within the Kansan biotic province.[84] 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.[85] The mesquite-lotebush brush vegetation type is distributed through parts of 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*),

[83] Gould, F.W. 1975. The Grasses of Texas. Texas A&M University Press. College Station, Texas.
[84] Blair, W.F. 1950. "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117.
[85] 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.

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[86]. 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.[87] . Because this strategy includes a reservoir, it is expected that extensive coordination with USACE and an individual permit would be required.

The TCEQ *2016 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted October 17, 2018[88], and the TCEQ Surface Water Quality Viewer show that the North Fork (Segment 1241A) and Buffalo Springs Lake (Segment 1241C) were both fully supporting their designated uses and contained no impairments.[89]

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 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 cemeteries, historical

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

[87] National Wetland Inventory (NWI). 2019. Surface Waters and Wetlands HUC 12100203. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html April 23, 2019.

[88] Texas Commission on Environmental Quality (TCEQ). 2018. Draft 2016 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, May 28, 2019.

[89] TCEQ. 2019. Surface Water Quality Viewer. Accessed https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 April 23, 2019.

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 May 22, 2019, the whooping crane (*Grus Americana*), sharpnose shiner (*Notropis oxyrhynchus*), and the smalleye shiner (*Notropis buccula*) could be affected by the proposed project. 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). 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 whether populations of threatened or endangered species, or potential habitats used by listed species occur in the area to be affected. A determination on whether any impacts or effects to listed species may occur would then be made. Lake 7 would impound water and would have the potential to 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 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 Texas horned lizard (*Phrynosoma cornutum*) (Texas listed threatened species) is thriving in the project vicinity, so additional evaluation and a management and mitigation plan would be necessary if the reservoir is built; and
- 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.

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 to be 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, results of effluent quality sampling/monitoring data, 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.

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 currently uses approximately 8,000 ac-ft/yr 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; and
- A 48-inch diameter raw water transmission pipeline from the PPS to the SWTP,

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 LAHPS and PPS; and
- 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.

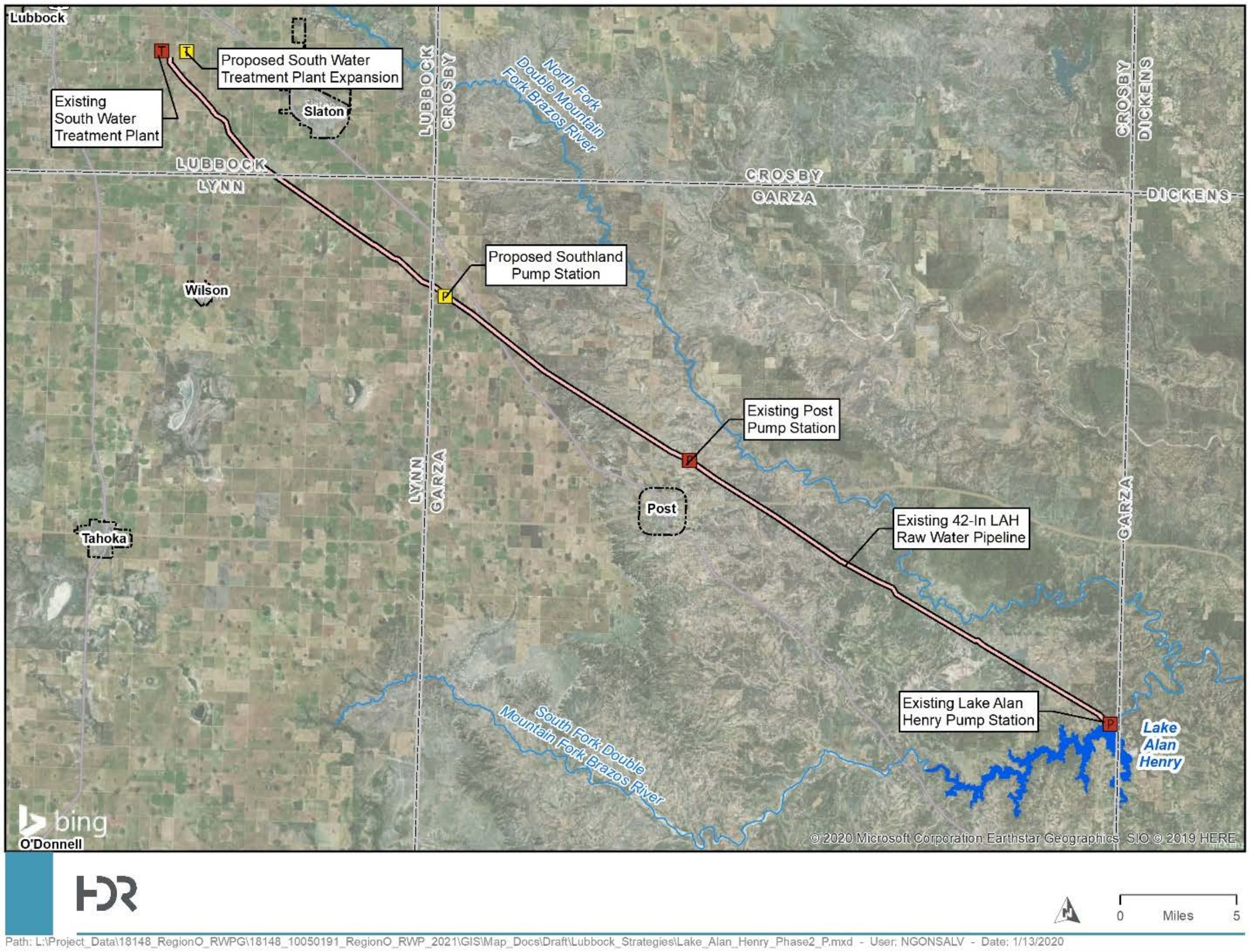

Figure 5.2. Lake Alan Henry Phase 2

5.3.1 Quantity of Available Water

The City of Lubbock intends to operate LAH near the 2-year safe yield of 13,100 ac-ft/yr. The current water supply infrastructure is capable of delivering 8,000 ac-ft/yr with a peaking capacity of 15 mgd. Phase 2 would increase the total deliverable volume to the 2-year safe yield of 13,100 ac-ft/yr, an incremental increase of 5,100 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.

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 4.6 mgd (5,100 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 2018 Dollars)

Item	Estimated Cost for Facilities
Lake Alan Henry Pump Station Expansion (additional 15 mgd)	$11,604,000
Post Pump Station Expansion (additional 15 mgd)	$7,313,000
Southland Pump Station (30 mgd)	$21,855,000
Water Treatment Plant Expansion (additional 15 mgd)	$31,653,000
TOTAL COST OF FACILITES	**$72,425,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$25,349,000
Environmental & Archaeology Studies and Mitigation	$0
Land Acquisition and Surveying (0 acres)	$0
Interest During Construction (3% for 2 years with a 0.5% ROI)	$5,378,000
TOTAL COST OF PROJECT	**$103,152,000**
ANNUAL COSTS	
Debt Service (3.5%, 20 years)	$7,258,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$10,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$995,000
South Water Treatment Plant Expansion	$2,216,000
Pumping Energy Costs (0.08 $/kW-hr)	$770,000
TOTAL ANNUAL COST	**$11,249,000**
Available Project Yield (ac-ft/yr)	5,100
Annual Cost of Water ($ per ac-ft), based on PF=2.6	$2,206
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=2.6	$783
Annual Cost of Water ($ per 1,000 gallons), based on PF=2.6	$6.77
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2.6	$2.40

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

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[90]. EAs have also been completed for the locations of the proposed SLPS[91] and the SWTP expansion[92]. The project occurs within the Rolling Plains and High Plains physiographic regions and is within the Kansan biotic province.[93] The TPWD categorized vegetation within the project area into four primary groups: mesquite-lotebush brush, mesquite-juniper brush, juniper, and crops.[94] 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 the construction and expansion of 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[95]. 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[96] delineation of wetlands indicate 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. A Section 404 permit from USACE is required for construction within waters of the U.S. for the proposed

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

[91] 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.

[92] 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.

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

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

[95] FEMA. 2019. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd May 28, 2019

[96] NWI. 2019. National Wetlands Inventory – Surface Waters and Wetlands. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html May 28, 2019.

project.[97] This could include Nationwide Permit (NWP) coverage, a 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 *2016 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted October 17, 2018[98], 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 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.

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 May 28, 2019, the whooping crane, sharpnose shiner, and the smalleye shiner 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. TPWD's TXNDD documents the occurrences of rare species in Texas. The Western spotted skunk (*Spilogale gracilis*), an SGCN-designated species, has been documented near the western end of LAH with one undated specimen. No other occurrences of threatened, endangered, candidate, or rare species were documented within one mile of the proposed project area.

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[97] NWI. 2019. Surface Waters and Wetlands HUC 12100203. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html April 23, 2019.

[98] TCEQ. 2018. Draft 2016 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 May 28, 2019.

A biological survey and habitat assessment 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. A determination on whether any impacts or effects to listed species may occur would then be made. 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.

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.

Other Issues

No other issues are known for this strategy.

5.4 Post Reservoir

The Post Reservoir strategy is included in the *2018 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 8.4-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); and
- Expand the SWTP by 8.4 mgd;

Figure 5.3 provides the location of infrastructure included in the Post Reservoir strategy.

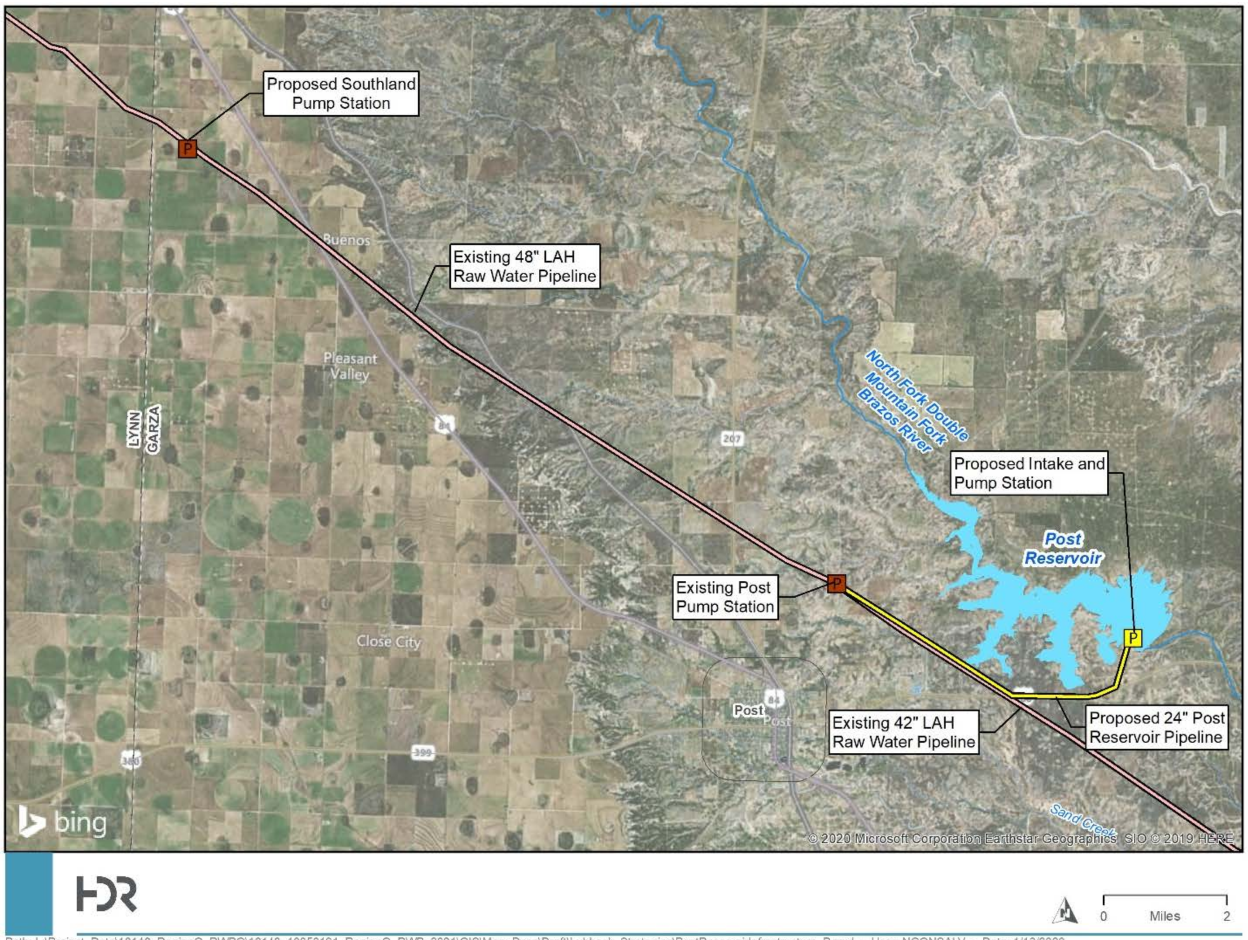

Figure 5.3. Post Reservoir Strategy

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.

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 2018 Dollars)

Item	Estimated Costs for Facilities
Dam and Reservoir (57,420 ac-ft, 2,280 acres)	$26,689,000
Intake and Pump Station (8.4 mgd)	$12,876,000
Transmission Pipeline (24-in dia., 6 miles)	$5,210,000
South Water Treatment Plant Expansion (8.4 mgd)	$20,729,000
TOTAL COST OF FACILITIES	**$65,505,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$27,666,000
Environmental & Archaeology Studies	$187,000
Land Acquisition for Reservoir Mitigation (2,280 acres)	$5,700,000
Reservoir Land Acquisition and Surveying (2,280 acres)	$5,814,000
Pipeline Land Acquisition and Surveying (51 acres)	$141,000
Interest During Construction (3% for 2 years with a 0.5% ROI)	$5,777,000
TOTAL COST OF PROJECT	**$110,790,000**
ANNUAL COSTS	
Debt Service (3.5%, 20 years)	$3,980,000
Reservoir Debt Service (3.5%, 40 years)	$2,539,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$61,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$322,000
Dam and Reservoir (1.5% of Cost of Facilities)	$388,000
South Water Treatment Plant Expansion	$1,484,000
Post Pipeline Pumping Energy Costs (0.08 $/kW-hr)	$272,000

Table 5-4. Post Reservoir Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Lake Alan Henry Pipeline Pumping Energy Costs (0.08 $/kW-hr)	$473,000
TOTAL ANNUAL COST	**$9,519,000**
Available Project Yield (ac-ft/yr)	8,962
Annual Cost of Water ($ per ac-ft), based on PF=1	$1,062
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$335
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$3.26
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.03

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

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[99]. According to *The Vegetation Types of Texas*, the project components are within the following vegetation communities: mesquite-lotebush brush, Havard Shin oak-mesquite brush, juniper, and crops[100]. 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

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

[100] 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.

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.[101] 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[102] nor the TCEQ *2016 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted October 17, 2018[103], 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.

Several archeological surveys have been conducted in the 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.

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.

According to IPaC, provided by the USFWS on May 2, 2019, the whooping crane, sharpnose shiner, and the smalleye shiner 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 TPWD's TXNDD documents the occurrences of

[101] FEMA, 2019. FEMA Flood Map Service Center: Search by Address. Accessed online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd May 1, 2019.

[102] TCEQ. 2019. Surface Water Quality Viewer. Accessible online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd accessed May 1, 2019.

[103] TCEQ. 2018. Draft 2016 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 May 28, 2019.

rare species in Texas. No occurrences of threatened, endangered, candidate or SGCN were documented within one mile of the proposed project area.

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. 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 issue related to this strategy is the change in land use of 2,280 acres from ranchland to a reservoir site. There would be a loss of riverine habitat and high impact on animal habitats that must be mitigated. It is anticipated that the construction of the reservoir would have low to moderate impacts related to these concerns. Studies would be necessary to determine the actual impact to cultural resources, wetlands, and threatened and endangered species, although 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, which could preclude construction of this project.

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.

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 is included in the *2018 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, 96-inch pipeline. The intake, pump station, and pipeline would have a capacity of 162.4 mgd (251 cubic feet per second [cfs]), making the transmission system capable of diverting 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.

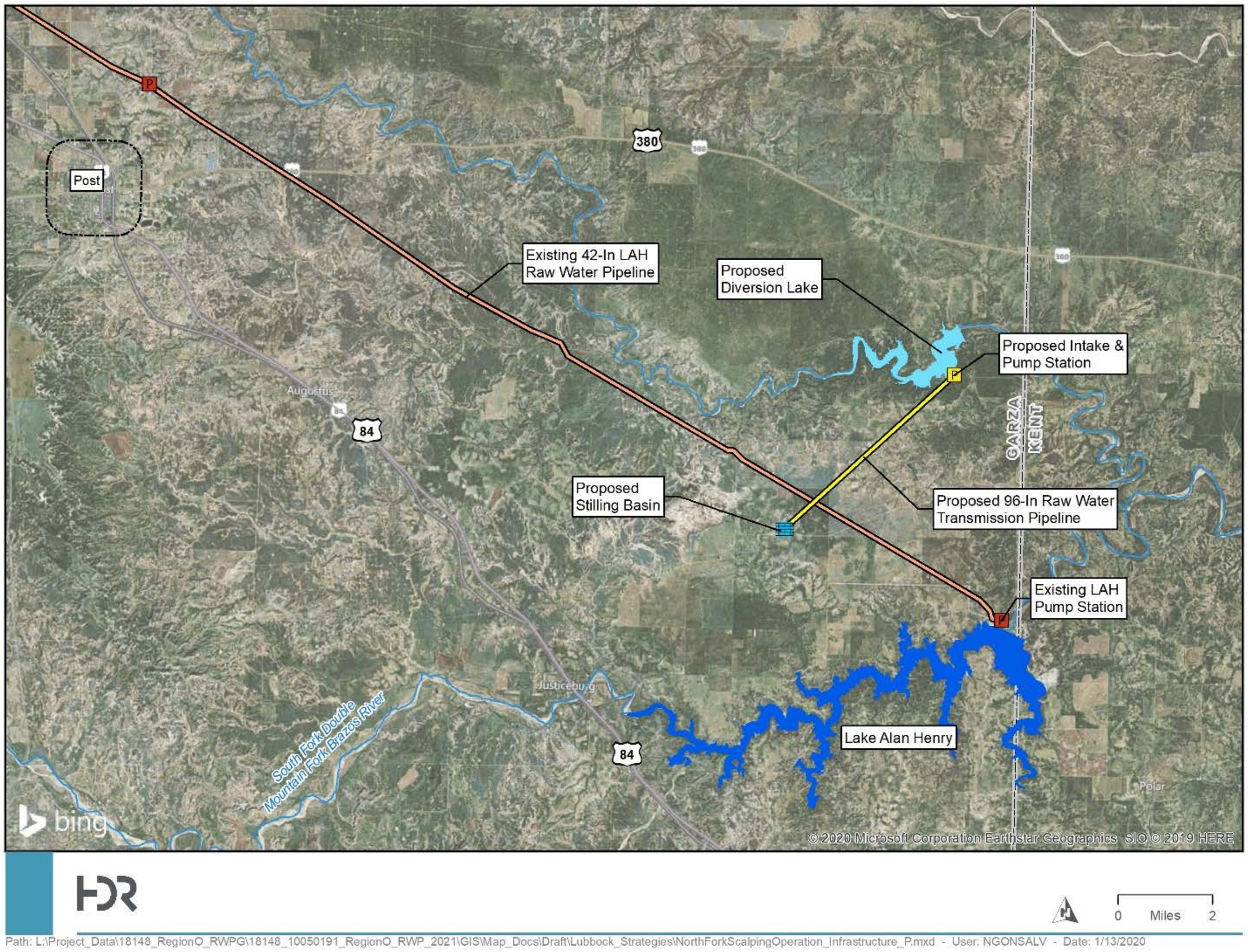

Figure 5.4. North Fork Scalping Operation Strategy

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. Analyses using the TCEQ Brazos WAM indicate the North Fork Scalping Operation would increase the firm yield of LAH by 13,700 ac-ft/yr, considering only available natural inflows with a Possum Kingdom Reservoir subordination agreement and no developed playa stormwater or reclaimed water. However, the City of Lubbock would manage the new supply with a safety reserve in LAH. As a result, the City of Lubbock plans for the strategy to provide a supply of 7.8 mgd or 8,725 ac-ft/yr.

5.5.2 Strategy Costs

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

- Energy costs to transmit the additional water through the LAH 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 5-5. North Fork Scalping Operation Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Dam and Reservoir (Conservation Pool 1,000 ac-ft, 650 acres)	$3,113,000
Intake and Pump Station (162.4 mgd)	$50,134,000
Transmission Pipeline (96-in dia., 5 miles)	$26,020,000
Stilling Basin	$756,000
South Water Treatment Plant Expansion (7.8 mgd)	$19,554,000
TOTAL COST OF FACILITIES	**$99,577,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$33,551,000
Environmental & Archaeology Studies and Mitigation	$1,768,000
Land Acquisition and Surveying (687 acres)	$1,758,000
Interest During Construction (3% for 2 years with a 0.5% ROI)	$7,517,000
TOTAL COST OF PROJECT	**$144,171,000**
ANNUAL COSTS	
Debt Service (3.5%, 20 years)	$9,588,000
Reservoir Debt Service (3.5%, 40 years)	$370,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$268,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$1,253,000
Dam and Reservoir (1.5% of Cost of Facilities)	$47,000
South Water Treatment Plant Expansion	$1,414,000
Pumping Energy Costs (0.08 $/kW-hr)	$264,000
Lake Alan Henry Pumping Energy Costs (0.08 $/kW-hr)	$1,058,000
TOTAL ANNUAL COST	**$14,262,000**
Available Project Yield (ac-ft/yr)	8,725
Annual Cost of Water ($ per ac-ft), based on PF=20.9	$1,635
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=20.9	$493
Annual Cost of Water ($ per 1,000 gallons), based on PF=20.9	$5.02
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=20.9	$1.51

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

5.5.3 Implementation Issues

Environmental Issues

This strategy would convert 650 acres of ranchland to reservoir use. Additionally, there would be permanent land use impacts for the stilling basin, new intake structure, and 96-inch transmission pipeline. Smaller land use impacts are expected with the expansion of the SWTP.

The proposed North Fork Scalping Operation strategy would occur within the Southwestern Tablelands physiographic region of Texas and within the Kansan biotic province[104]. According to *The Vegetation Types of Texas*, the new project components and reservoir site are within the mesquite-lotebush brush vegetation community[105]. The mesquite-lotebush brush, principally found in the Rolling Plains, commonly includes yucca, skunkbush sumac, agarita, juniper, silver bluestem, Texas grama, sideoats grama, among other species. Impacts to vegetation would include inundation of the 650-acre reservoir site and stilling basin. Areas would likely be cleared for installing approximately 5 miles of 96-inch diameter transmission pipeline, depending upon method of installation.

FEMA has not mapped the project area for 100-year floodplains.[106] The proposed Diversion 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 and South Fork of the Double Mountain Fork of the Brazos River (South Fork) may be impacted by the new transmission pipeline, stilling basin, and intake structure. Early coordination with USACE is recommended for this project. LAH (Segment 1241B) and Double Mountain Fork Brazos River (Segment 1241) were classified as impaired stream segments on the TCEQ *2016 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted October 17, 2018[107], and shown on as impaired on the TCEQ Surface Water Quality Viewer[108]. LAH is the receiving water for the stormwater inflows transmitted to Gobbler Creek and is impaired for mercury in edible tissue. Double Mountain Fork Brazos River is approximately 4 miles downstream of LAH and the existing LAHPS, and bacteria is listed as the impairment[109].

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

[105] 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.

[106] FEMA. 2019. FEMA Flood Map Service Center: Search by Address. Accessed online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd May 2, 2019.

[107] TCEQ. 2018. Draft 2016 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 May 28, 2019.

[108] TCEQ. 2019. Surface Water Quality Viewer. Accessible online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd accessed May 1, 2019.

[109] TCEQ. 2016. Draft 2016 Texas Integrated Report – Texas 303(d) List (Category 5) (adopted October 17, 2018). Accessed online https://www.tceq.texas.gov/waterquality/assessment/16twqi/16txir May 2, 2019.

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.

Several archeological surveys have been conducted in the 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.

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.

According to IPaC, provided by USFWS on May 28, 2019, the whooping crane, sharpnose shiner, and the smalleye shiner 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 Western spotted skunk, a SGCN-designated species, has been documented near the western end of LAH with one undated specimen. No other occurrences of threatened, endangered, or candidate were documented within one mile of the proposed project area.

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 would then be made on whether any impacts or effects to listed species may occur. 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. Since this project could affect critical habitat for the sharpnose and smalleye shiner, it is anticipated that extensive coordination with USFWS would be required.

Summary

This project should have low to moderate impacts on the environment, including habitats, cultural resources, wetlands, and threatened or endangered species. Some concern exists that discharging stormwater from the North Fork into LAH could encourage golden algae growth in LAH. Golden alga is an organism that is toxic to fish under certain conditions, and has been found in lakes along the North Fork. The sharpnose shiner and smalleye shiner are listed as endangered species on the federal list. These fish have been found along this reach of the North Fork and could potentially be impacted by the diversion lake, although the diversion dam could be designed to mitigate those impacts by allowing passage of the shiners during all but high-flow events. Additionally, increased flows into Gobbler Creek may change the size and configuration of the channel.

Permitting Issues

A new water use permit from TCEQ would be required for impounding and diverting water from the North Fork and the conveyance of the diverted water into LAH. Diversions would be subject to instream flow requirements. A USACE Section 404 permit would be required prior to commencing construction of the diversion facilities. Mitigation plans for the project's environmental impacts must be developed and agreed upon by USACE and other interested state and federal resource agencies. TCEQ must review and approve construction of proposed facilities.

Other Issues

Property would need to be acquired for the diversion reservoir, dam, and pump station. In addition, pipeline utility easements would be necessary to construct a raw water transmission line to Gobbler Creek.

5.6 Direct Potable Reuse to North Water Treatment Plant

This Direct Potable Reuse to North Water Treatment Strategy is included in the *2018 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, 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 to discharge the RO reject water.

Figure 5.5 provides the location of the infrastructure needed for the strategy.

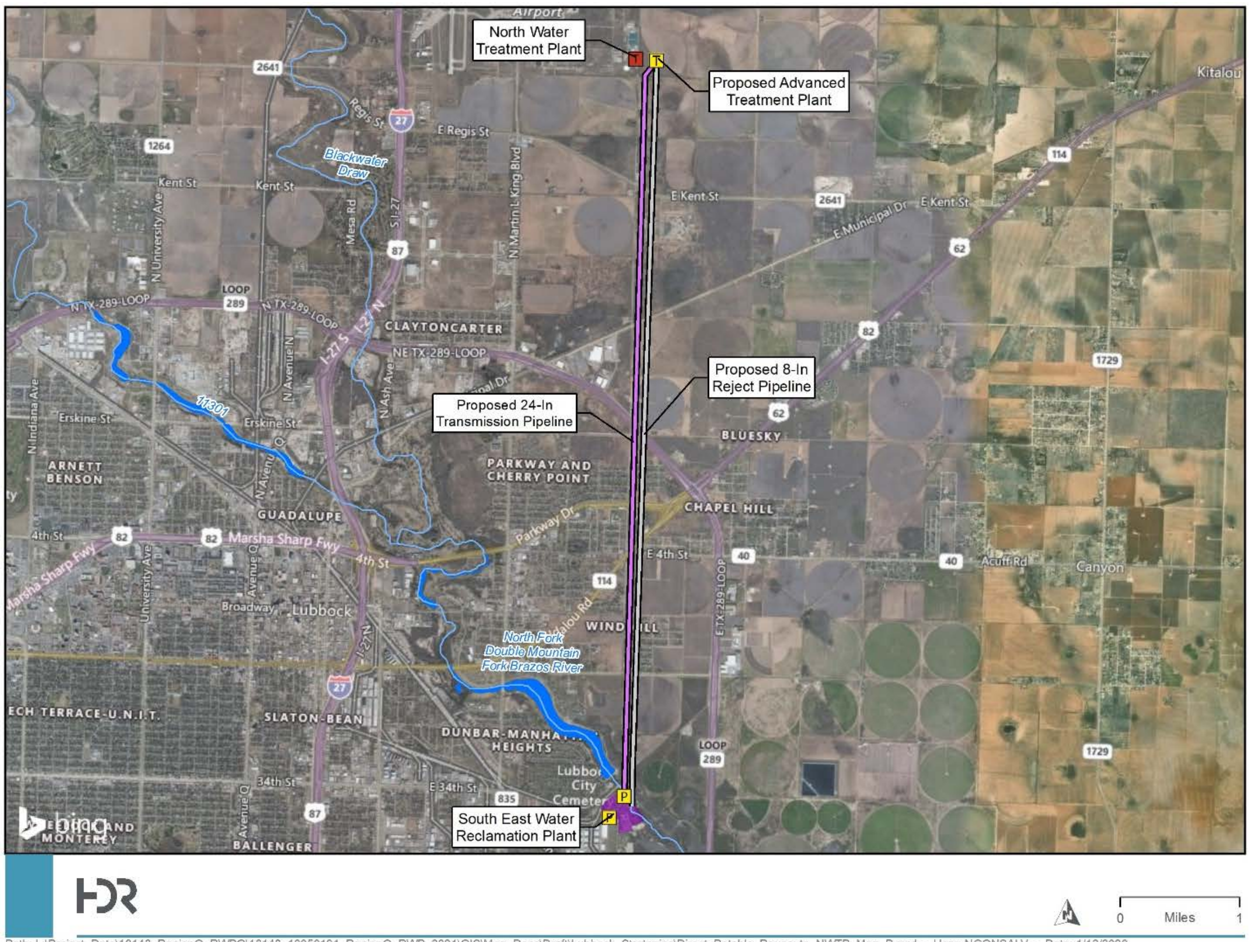

Figure 5.5. Direct Potable Reuse to North Water Treatment Plant

5.6.1 Quantity of Available Water

This strategy is designed to treat and deliver an average of 9 mgd (10,089 ac-ft/yr) to the advanced treatment plant; the efficiency of the RO is assumed to be 80 percent resulting in 1.8 mgd of reject and 7.2 mgd (9,274 ac-ft/yr) of treated reclaimed water to the NWTP each year.

5.6.2 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 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 5-6. Direct Potable Reuse to North Water Treatment Plant Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Pump Station at Southeast Water Reclamation Plant (9.5 mgd)	$4,580,000
Transmission Pipeline (24-in dia., 6 miles)	$10,418,000
Transmission Pipeline (8-in dia., 6 miles)	$1,674,000
Advanced Treatment Plant (9.5 mgd)	$71,915,000
TOTAL COST OF FACILITIES	**$88,587,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$30,401,000
Environmental & Archaeology Studies and Mitigation	$194,000
Land Acquisition and Surveying (53 acres)	$145,000
Interest During Construction (3% for 2 years with a 0.5% ROI)	$6,563,000
TOTAL COST OF PROJECT	**$125,890,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$8,858,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$121,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$115,000
Water Treatment Plant	$1,643,000
Pumping Energy Costs (0.08 $/kW-hr)	$720,000
TOTAL ANNUAL COST	**$11,457,000**
Available Project Yield (ac-ft/yr)	8,064
Annual Cost of Water ($ per ac-ft), based on PF=1	$1,421
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$322
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$4.36

Table 5-6. Direct Potable Reuse to North Water Treatment Plant Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.99

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

Environmental Issues

TCEQ is currently developing the requirements for 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.[110] TPWD defines vegetation within the project area as crops and urban.[111] The crops vegetation type includes any cultivated cover crops or row crops which 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 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 south of the NWTP where the proposed pipeline would intersect E. PR-6250[112]. Only a small portion of the proposed pipeline would be located within the 100-year floodplain.

The proposed pump station would be located on the south side of the North Fork. NWI shows the impounded portion of the river as a lake and the area downstream as fringed by freshwater forested/shrub wetland. 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

[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. 1984. “The Vegetation Types of Texas – Including Crops. Accessed online: https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/

[112] FEMA. 2019. FEMA’s National Flood Hazard Layer (NFHL) Viewer. Accessed online https://www.fema.gov/national-flood-hazard-layer-nfhl April 17, 2019.

the proposed project.[113]. This could include NWP coverage, a 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 a NWP.

The TCEQ *2016 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted October 17, 2018[114], and the TCEQ Surface Water Quality Viewer show that the North Fork (Segment 1241A) is fully supporting its designated uses and contains no water quality concerns.[115] 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 available GIS datasets, the City of Lubbock Cemetery is located just to the northwest of the SEWTP. 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.

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 June 2, 2019, the whooping crane, sharpnose shiner, and the smalleye shiner 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. TPWD's TXNDD documents the occurrences of rare species in Texas. The swift fox, an SGCN-designated species, was documented just southeast of the SEWRP with one sighting of a skin only in 1966. No other occurrences of threatened,

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[113] NWI. 2019. Surface Waters and Wetlands HUC 12100203. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html April 23, 2019.

[114] TCEQ. 2018. Draft 2016 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 May 28, 2019.

[115] TCEQ. 2019. Surface Water Quality Viewer. Accessed online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 May 10, 2019.

endangered, candidate, or SGCN species were documented within one mile of the proposed project area.

If this strategy is selected, a biological survey of the project area should be completed. The survey would determine whether populations of threatened or endangered species, or potential habitats used by listed species occur in the area to be affected. 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.

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.

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 12.

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.

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 *2018 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 500-horsepower (hp) pump station at the SEWRP;
- Install a 7.5-mile, 24-inch diameter transmission pipeline to the SWTP.
- Install an 8-inch, 7.5-mile transmission line to the North Fork to discharge the RO reject water; and
- Expand the SWTP's treatment facilities by 8.3 mgd.

Figure 5.6 provides the relative locations of the infrastructure needed for the strategy.

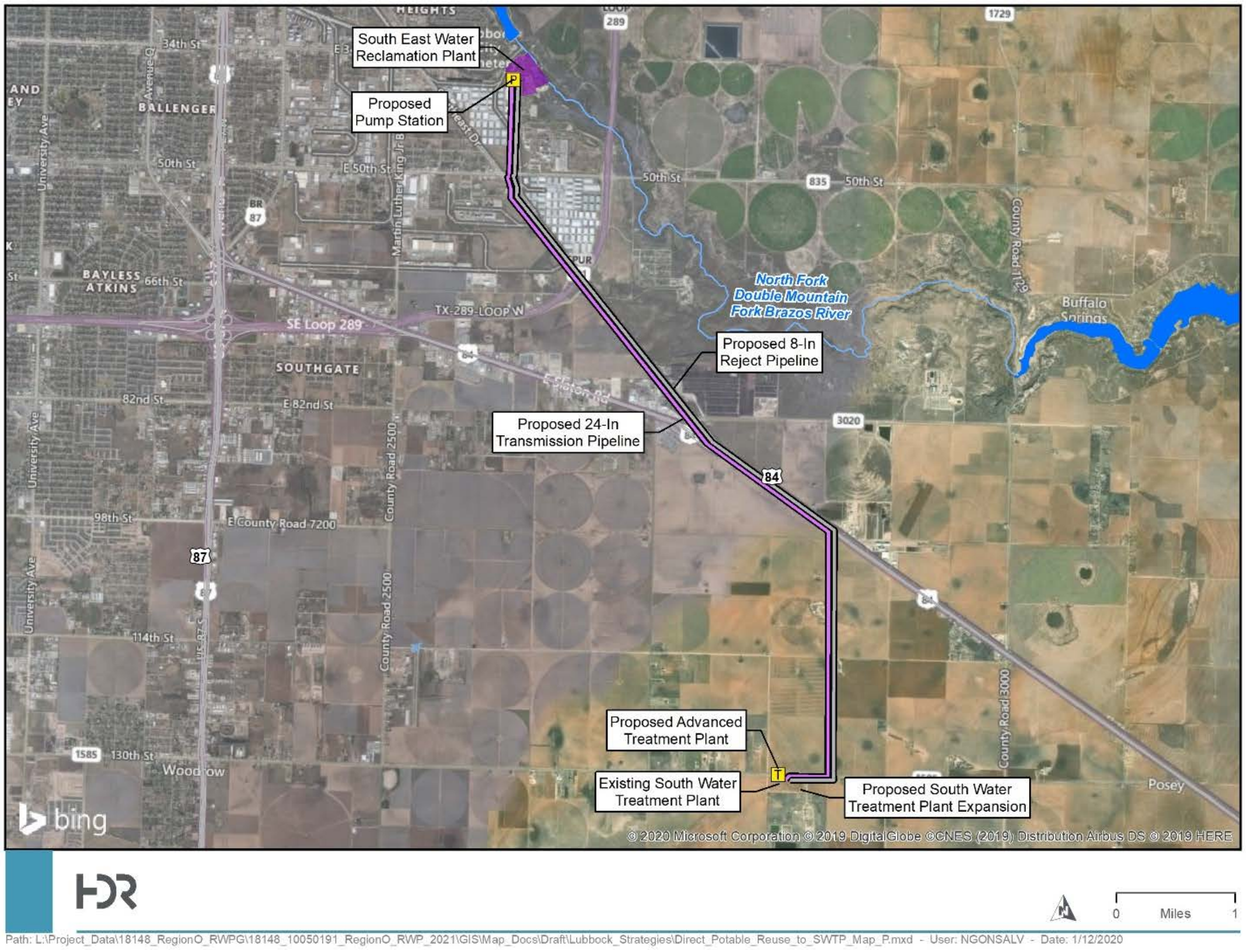

Figure 5.6. Direct Potable Reuse to South Water Treatment Plant

5.7.1 Quantity of Available Water

This strategy is designed to treat and deliver an average of 9 mgd (10,089 ac-ft/yr) to the advanced treatment plant; the efficiency of the RO is assumed 80 percent resulting in 1.82 mgd of reject and 7.2 mgd of treated reclaimed water to the SWTP each year.

5.7.2 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;
- 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 5-7. Direct Potable Reuse to South Water Treatment Plant Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Pump Station and Storage Tank (9.5 mgd)	$4,217,000
Transmission Pipeline (24-in dia., 7.5 miles)	$7,010,000
RO Concentrate Pipeline (8-in dia., 7.5 miles)	$1,573,000
South Water Treatment Plant Expansion (8.3 mgd)	$20,533,000
Advanced Treatment Plant (9.5 mgd)	$71,915,000
TOTAL COST OF FACILITIES	**$105,248,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$36,408,000
Environmental & Archaeology Studies and Mitigation	$375,000
Land Acquisition and Surveying (46 acres)	$125,000
Interest During Construction (3% for 2 years with a 0.5% ROI)	$7,819,000
TOTAL COST OF PROJECT	**$149,975,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$10,552,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$96,000
Pump Stations (2.5% of Cost of Facilities)	$80,000
Water Treatment Plant	$3,014,000
Pumping Energy Costs (0.08 $/kW-hr)	$586,000
TOTAL ANNUAL COST	**$14,328,000**
Available Project Yield (ac-ft/yr)	8,064
Annual Cost of Water ($ per ac-ft), based on PF=1	$1,777
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$468
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$5.45
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.44

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

Environmental Issues

TCEQ is currently developing the requirements for DPR projects, which will 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[116] and is within the Kansan biotic province.[117] According to *The Vegetation Types of Texas*, the project components are within the following vegetation communities: crops and urban.[118] 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.[119.]

NWI's database indicates that the North Fork adjacent to the SEWRP is a freshwater emergent wetland and riverine. Additionally, a few freshwater ponds and freshwater emergent wetlands were identified along the proposed pipeline route. A Section 404 permit from the USACE is required for construction within waters of the U.S. for the proposed project.[120] This could include NWP coverage, a NWP with a pre-construction notification, or an individual permit depending upon the impacts.[121] .

The TCEQ *2016 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted October 17, 2018[122,] and the TCEQ Surface Water Quality Viewer show that the North Fork (Segment 1241A) and Buffalo Springs Lake (Segment 1241C) were both fully supporting their designated uses and contained no impairments.[123]

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

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

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

[118] 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/

[119] FEMA. 2019. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd June 2, 2019.

[120] NWI. 2019. Surface Waters and Wetlands HUC 12100203. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html April 23, 2019.

[121] NWI. 2019. Surface Waters and Wetlands HUC 12100203. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html April 23, 2019.

[122] TCEQ. 2018. Draft 2016 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 May 28, 2019.

[123] TCEQ. 2019. Surface Water Quality Viewer. Accessed https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 April 23, 2019.

Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of 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.

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 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 June 2, 2019, the whooping crane, sharpnose shiner, and the smalleye shiner 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. TPWD’s TXNDD documents the occurrences of rare species in Texas. The swift fox, a species of greatest conservation need, was been documented in the northern portion of the project area, near the SEWRP (in 1966). No other occurrences of threatened, endangered, candidate, or SGCN 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 whether populations of threatened or endangered species, or potential habitats used by listed species occur in the area to be affected. 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 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 concentrate water should be selected to avoid potentially sensitive areas.

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 12.

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.

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 *2018 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 7.6 mgd (sized to include an estimated 5 percent downtime and 20 percent RO reject)

Figure 5.7 depicts the relative locations of the required CR 7300 infrastructure.

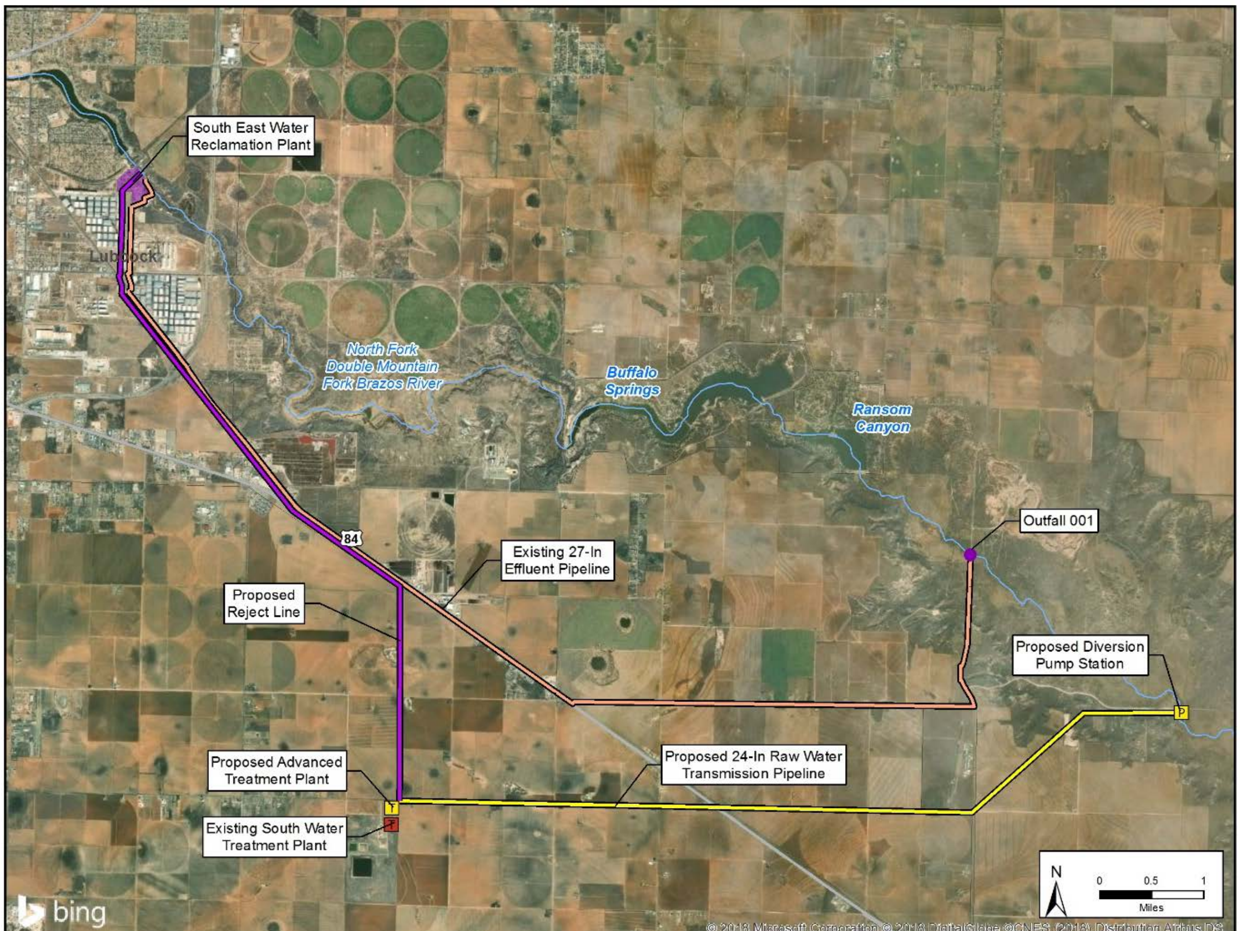

Figure 5.7. North Fork Diversion at County Road 7300

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 0.47 percent, and the efficiency of the RO is assumed at 80 percent. The resulting average supply delivered to the SWTP is 7.2 mgd or 8,030 ac-ft/yr.

5.8.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-8. 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 5-8. North Fork Diversion at County Road 7300 Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Channel Dam and Intake Pump Station (9.5 mgd)	$23,998,000
Transmission Pipeline (24-in dia., 8 miles)	$7,435,000
Reverse Osmosis Concentrate Pipeline (8-in dia., 7.5 miles)	$1,976,000
South Water Treatment Plant Expansion (7.6 mgd)	$19,162,000
Advanced Treatment Plant (9.5 mgd)	$71,915,000
TOTAL COST OF FACILITIES	**$124,486,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$43,099,000
Environmental & Archaeology Studies and Mitigation	$396,000
Land Acquisition and Surveying (98 acres)	$269,000
Interest During Construction (3% for 2 years with a 0.5% ROI)	$9,254,000
TOTAL COST OF PROJECT	**$177,504,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$12,489,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$94,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$538,000
Dam and Reservoir (1.5% of Cost of Facilities)	$37,000
Water Treatment Plant	$2,843,000

Table 5-8. North Fork Diversion at County Road 7300 Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Advanced Water Treatment Facility	$7,919,000
Pumping Energy Costs (0.08 $/kW-hr)	$921,000
TOTAL ANNUAL COST	**$24,841,000**
Available Project Yield (ac-ft/yr)	8,030
Annual Cost of Water ($ per ac-ft), based on PF=1	$3,093
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$1,538
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$9.49
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$4.72

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

Environmental Issues

The project occurs within the High Plains vegetational area[124] and is within the Kansan biotic province.[125] 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.[126] 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. 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

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

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

[126] 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/

along an area flanking the perimeter of the North Fork[127]. 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 waters of the U.S. for the proposed project.[128.] This could include NWP coverage, a NWP with a pre-construction notification, or an individual permit depending upon the impacts.

The TCEQ *2016 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted October 17, 2018[129], and the TCEQ Surface Water Quality Viewer show that the North Fork (Segment 1241A) and Buffalo Springs Lake (Segment 1241C) were both fully supporting their designated uses and contained no impairments.[130] No impaired surface water segments were 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 (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 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 June 5, 2019, the whooping crane, 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

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

[128] NWI. 2019. Surface Waters and Wetlands, HUC 12100203. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html April 23, 2019.

[129] TCEQ. 2018. Draft 2016 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, May 28, 2019.

[130] TCEQ. 2019. Surface Water Quality Viewer. Accessed https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 April 23, 2019.

proposed project area. 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 whether populations of threatened or endangered species, or potential habitats used by listed species occur in the area to be affected. 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 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.

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.

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 *2018 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.

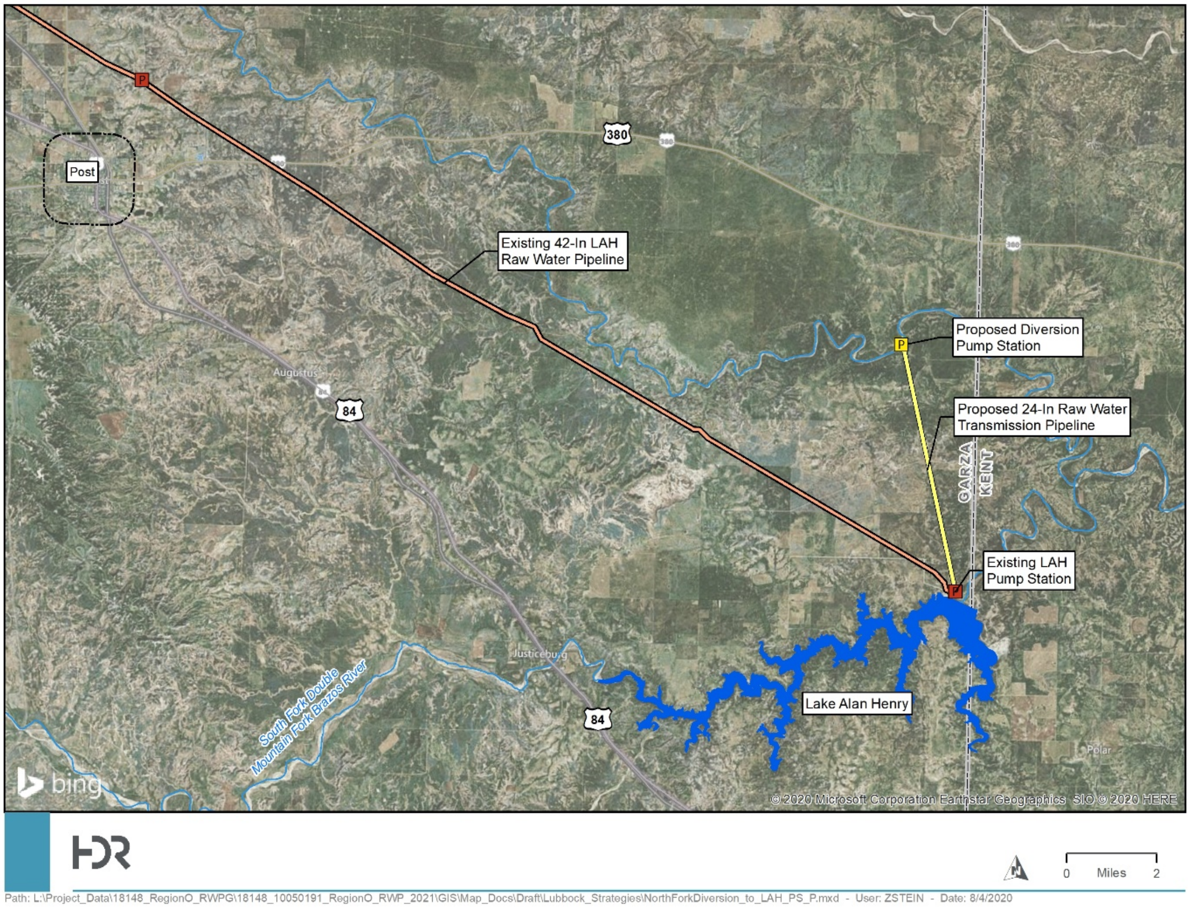

Figure 5.8. North Fork Diversion to Lake Alan Henry Pump Station

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 5-9. 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 5-9. North Fork Diversion to Lake Alan Henry Pump Station Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Intake Pump Stations and Channel Dam (7.1 mgd)	$12,781,000
Transmission Pipeline (24-in dia., 5 miles)	$4,675,000
South Water Treatment Plant Expansion (6.7 mgd)	$17,399,000
TOTAL COST OF FACILITIES	**$34,856,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$11,966,000
Environmental & Archaeology Studies and Mitigation	$169,000
Land Acquisition and Surveying (37 acres)	$129,000
Interest During Construction (3% for 2 years with a 0.5% ROI)	$2,592,000
TOTAL COST OF PROJECT	**$49,712,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,498,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$47,000
Dam and Reservoir (1.5% of Cost of Facilities)	$37,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$258,000
Water Treatment Plant	$1,286,000
Pumping Energy Costs (0.08 $/kW-hr)	$1,109,000
TOTAL ANNUAL COST	**$6,235,000**
Available Project Yield (ac-ft/yr)	7,510
Annual Cost of Water ($ per ac-ft), based on PF=1	$830
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$364
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$2.55

Table 5-9. North Fork Diversion to Lake Alan Henry Pump Station Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.12

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

Environmental Issues

The strategy occurs within the High Plains vegetational area[131] and is within the Kansan biotic province.[132] 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.[133] 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 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[134].

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. A Section 404 permit from USACE is required for construction within waters of the U.S. for the proposed project.[135.] This could include NWP coverage, a NWP with a pre-construction notification, or an individual permit depending upon project impacts.

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

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

[133] 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/

[134] FEMA. 2019. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd May 31, 2019.

[135] NWI. 2019. Surface Waters and Wetlands, HUC 12100203. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html April 23, 2019.

The TCEQ *2016 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted October 17, 2018[136], and the TCEQ Surface Water Quality Viewer identify 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.[137]

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.

According to IPaC, accessed on the USFWS website on May 31, 2019, the whooping crane, sharpnose shiner, and the smalleye shiner 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. 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 whether populations of threatened or endangered species, or potential habitats used by listed species occur in the area to be affected. A determination on whether any impacts or effects to listed species may occur would then be made.

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[136] TCEQ. 2018. Draft 2016 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, May 28, 2019.

[137] TCEQ. 2019. Surface Water Quality Viewer. Accessed https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 May 31, 2019.

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 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 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.

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 submit an application 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.

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

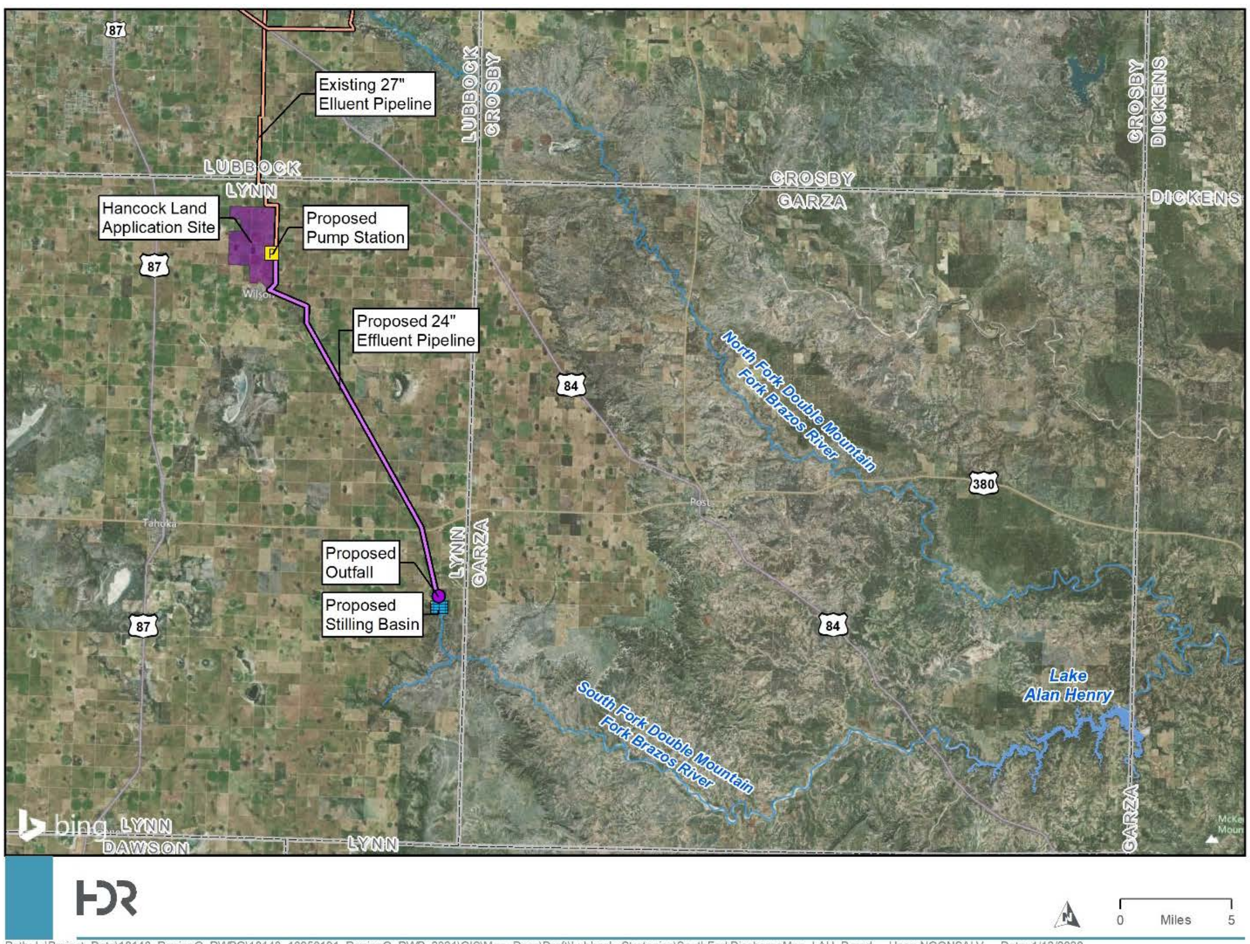
The South Fork Discharge strategy is an indirect reuse strategy included in the *2018 Lubbock Strategic Water Supply Plan*. The strategy would discharge treated effluent into the South Fork to increase the firm yield of LAH. The City of Lubbock operates an existing pipeline that transports reclaimed 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.

Figure 5.9 provides the relative locations of the infrastructure needed for strategy.



Path: L:\Project_Data\18148_RegionO_RWPG\18148_10050191_RegionO_RWP_2021\GIS\Map_Docs\Draft\Lubbock_Strategies\SouthForkDischargeMap_LAH_P.mxd - User: NGONSALV - Date: 1/12/2020

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 5-10. 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 5-10. South Fork Discharge Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Pump Station (9 mgd)	$2,159,000
Transmission Pipeline (24-in dia., 18 miles)	$16,191,000
South Water Treatment Plant Expansion (7.3 mgd)	$18,574,000
TOTAL COST OF FACILITIES	**$36,924,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$12,116,000
Environmental & Archaeology Studies and Mitigation	$451,000
Land Acquisition and Surveying (106 acres)	$306,000
Interest During Construction (3% for 2 years with a 0.5% ROI)	$2,739,000
TOTAL COST OF PROJECT	**$52,536,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,696,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Facilities)	$162,000

Table 5-10. South Fork Discharge Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Intakes and Pump Stations (2.5% of Cost of Facilities)	$54,000
Water Treatment Plant	$1,356,000
Pumping Energy Costs (0.08 $/kW-hr)	$1,028,000
TOTAL ANNUAL COST	**$6,296,000**
Available Project Yield (ac-ft/yr)	8,183
Annual Cost of Water ($ per ac-ft), based on PF=2.1	$769
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=2.1	$318
Annual Cost of Water ($ per 1,000 gallons), based on PF=2.1	$2.36
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2.1	$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

5.10.3 Implementation Issues

Environmental Issues

The proposed project improvements occur within the High Plains vegetational area[138] and within the Kansan biotic province.[139] According to *The Vegetation Types of Texas*, the project components are within the crops vegetation community.[140] 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.

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.[141].

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

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

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

[140] 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/

[141] FEMA. 2019. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd May 29, 2019.

the NWI as freshwater ponds or freshwater emergent wetlands. Care should be taken to avoid impacts to 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.[142.] This could include NWP coverage, a NWP with a pre-construction notification, or an individual permit depending upon the impacts.[143]

The TCEQ *2016 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, adopted October 17, 2018[144], 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.[145]

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.

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,

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142 NWI. 2019. Surface Waters and Wetlands HUC 12100203. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html April 23, 2019.

143 NWI. 2019. Surface Waters and Wetlands HUC 12050004. Downloaded from https://www.fws.gov/wetlands/Data/Mapper.html April 23, 2019.

144 TCEQ. 2018. Draft 2016 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 May 28, 2019.

145 TCEQ. 2019. Surface Water Quality Viewer. Accessed https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 April 23, 2019.

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 May 29, 2019, the whooping crane, 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. 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 whether populations of threatened or endangered species, or potential habitats used by listed species occur in the area to be affected. 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 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.

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.

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 0.5 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 mgd as a peak use irrigation supply.

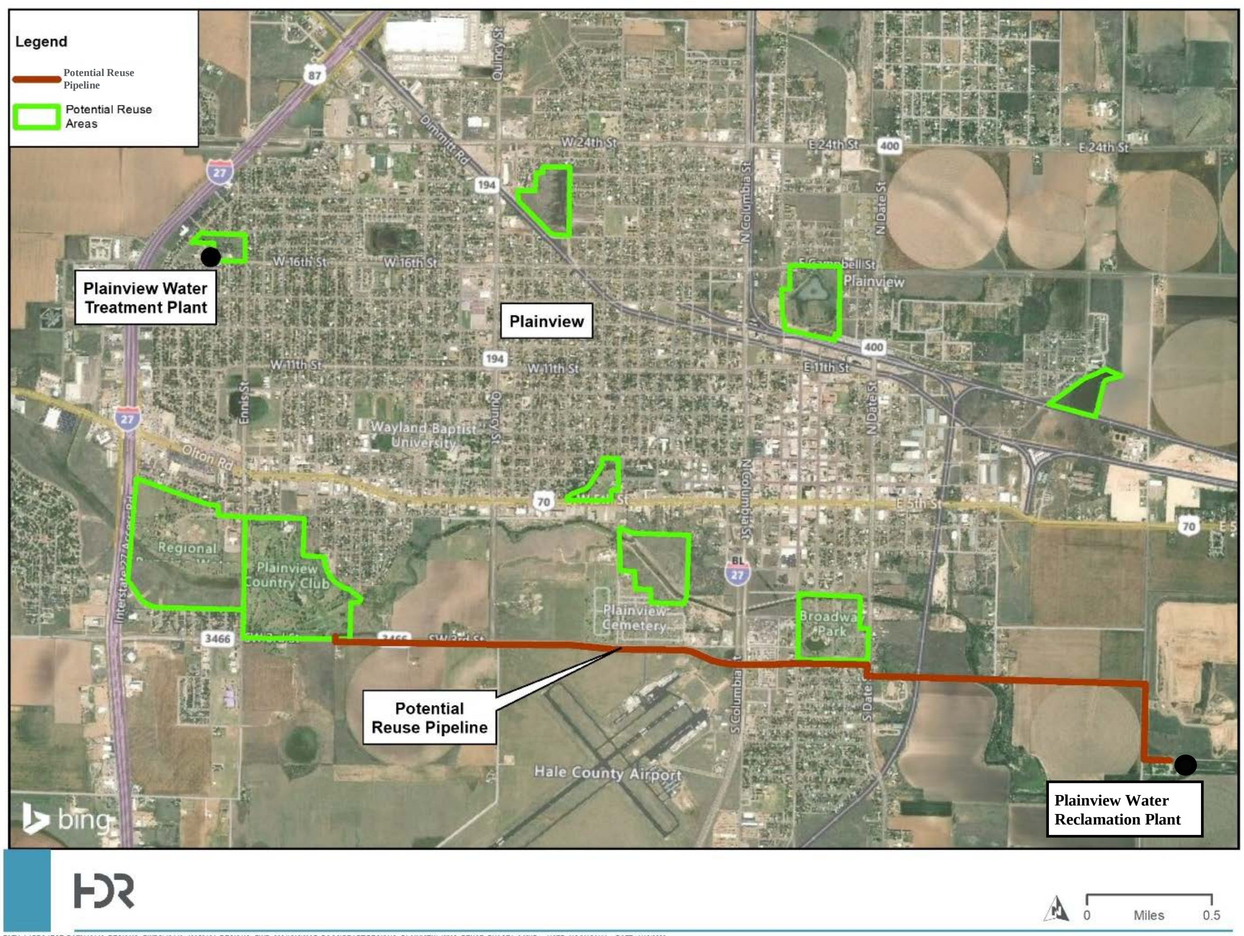

Figure 5.10. City of Plainview Reuse Option, Phase 1

Phase 2 of the project would use up to 100 percent of the average effluent discharge from the WWTP, or about 1.0 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-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).

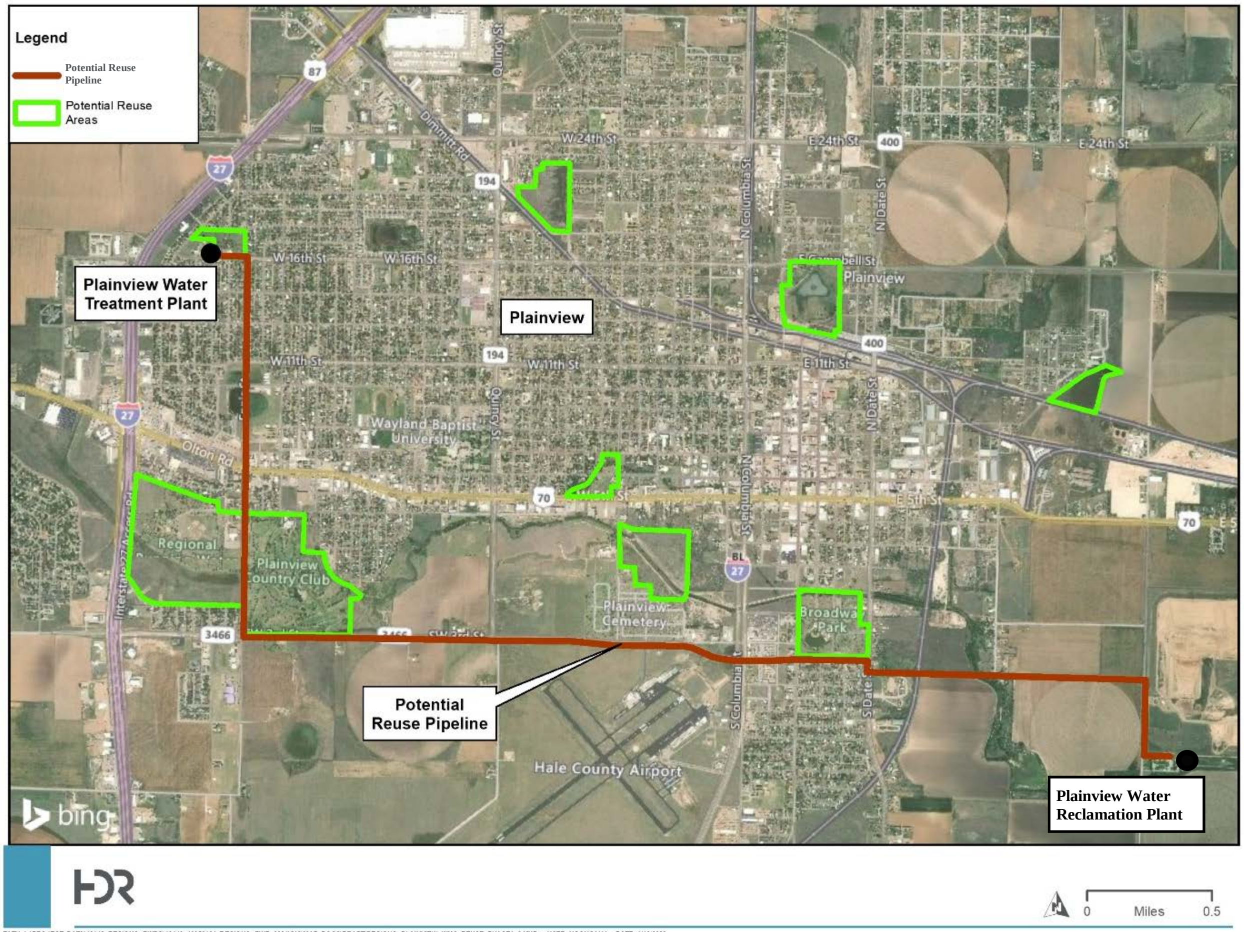

Figure 5.11. City of Plainview Reuse Option, Phase 2

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 5-11. 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 5-11. 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 5-12. 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 5-12. City of Plainview Reuse Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities	
	Phase 1	Phase 1+2
Primary Pump Station (2 MGD)	$1,006,000	$1,072,000
Transmission Pipeline (12 in dia., 19897 feet)	$3,328,000	$5,148,000
Transmission Pump Station(s) & Storage Tank(s)	$1,297,000	$1,297,000
Two Water Treatment Plants (2 MGD and 2 MGD)	$1,707,000	$1,707,000
Advanced Water Treatment Facility (1 MGD)	---	$9,445,000
TOTAL COST OF FACILITIES	**$7,338,000**	**$18,669,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,402000	$6,277,000
Environmental & Archaeology Studies and Mitigation	$108,000	$160,000
Land Acquisition and Surveying (23 acres)	$224,000	$361,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$277,000	$701,000
TOTAL COST OF PROJECT	**$10,349,000**	**$26,168,000**
ANNUAL COST		
Debt Service (3.5 percent, 20 years)	$728,000	$1,841,000
Operation and Maintenance		
Pipeline and Storage Tanks (1% of Facilities)	$46,000	$64,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$25,000	$27,000
Water Treatment Plant	$602,000	$602,000
Pumping Energy Costs (0.08 $/kW-hr)	$5,000	$17,000
TOTAL ANNUAL COST	**$1,406,000**	**$3,193,000**
Available Project Yield (ac-ft/yr)	560	1,120
Annual Cost of Water ($ per ac-ft)	$2,511	$2,851
Annual Cost of Water After Debt Service ($ per ac-ft)	$1,211	$1,207
Annual Cost of Water ($ per 1,000 gallons)	$7.70	$8.75
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$3.71	$3.70

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 nonpotablereuse

Phase 1 + 2 – Direct potable reuse

5.11.5 Implementation Issues

Environmental Issues

TCEQ is currently developing the requirements for DPR projects that 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 proposed project occurs within the High Plains physiographic region of Texas and is within the Kansan biotic province[146]. The project components are within areas defined as mesquite shrub and crops vegetation types[147]. 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[148], 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. A freshwater emergent wetlands, forested/shrub wetland, and pond 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 waters of the U.S. No surface waters were identified on the TCEQ Surface Water Quality Viewer[149] 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, 1228, 1403, 1477, 1949, 2327, 3017, 3445, 4598, 5389, 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.

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

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

[147] 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.

[148] TPWD, Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

[149] TCEQ, Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed January 13, 2020.

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 the IPaC website[150] maintained by USFWS, the whooping crane could be a migrant through the project area, but no adverse impacts to the whooping crane would be expected. 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 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.

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.

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 12.

[150] USFWS. 2020. Information for Planning and Consultation. Accessed online https://ecos.fws.gov/ipac/location/2CDHNRFRWZBEFN2BCFV527IIXM/resources January 13, 2020.

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.

B. Potentially Feasible Water Management Strategies: Groundwater

5.12 Groundwater Sources

The principal aquifer in the Llano Estacado Region is the Edwards-Trinity High Plains (ETHP) Aquifer[151]. 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.

5.13 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

[151] 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.

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 groundwater availability model (GAM)[152] was published in 2008. A follow-up GAM of the High Plains Aquifer System (HPAS)[153],[154] 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. With this in mind, the bottom part of the Lower Dockum is consider the target zone for Dockum water wells. Figure 5.12 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 and Pecos River Alluvium Approximate, which is approximately the top of the Dockum Aquifer (Figure 5.13). Top of the Dockum 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 and top of Lower Dockum (Figure 5.14). 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 (Figure 5.15). The regional dip of the Dockum is south-southeast at slightly more than 15 fpm.
- Thickness of Lower Dockum (Figure 5.16). 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.

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[152] 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

[153] 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

[154] 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

- Net sand thickness in the Lower Dockum (Figure 5.17). In Bailey County, the cumulative thickness of sand layers ranges from approximately 150 to 250 feet.
- TDS in the Dockum (Figure 5.18). 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 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 wells in the BCWF.
- The water treatment plant is to be located near the BCWF ground storage and pump station.
- Dockum wells are to be designed to draw water from the Santa Rosa Formation, which is at the bottom of the Lower Dockum. 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. Well 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 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 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 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;
- 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, 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 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.

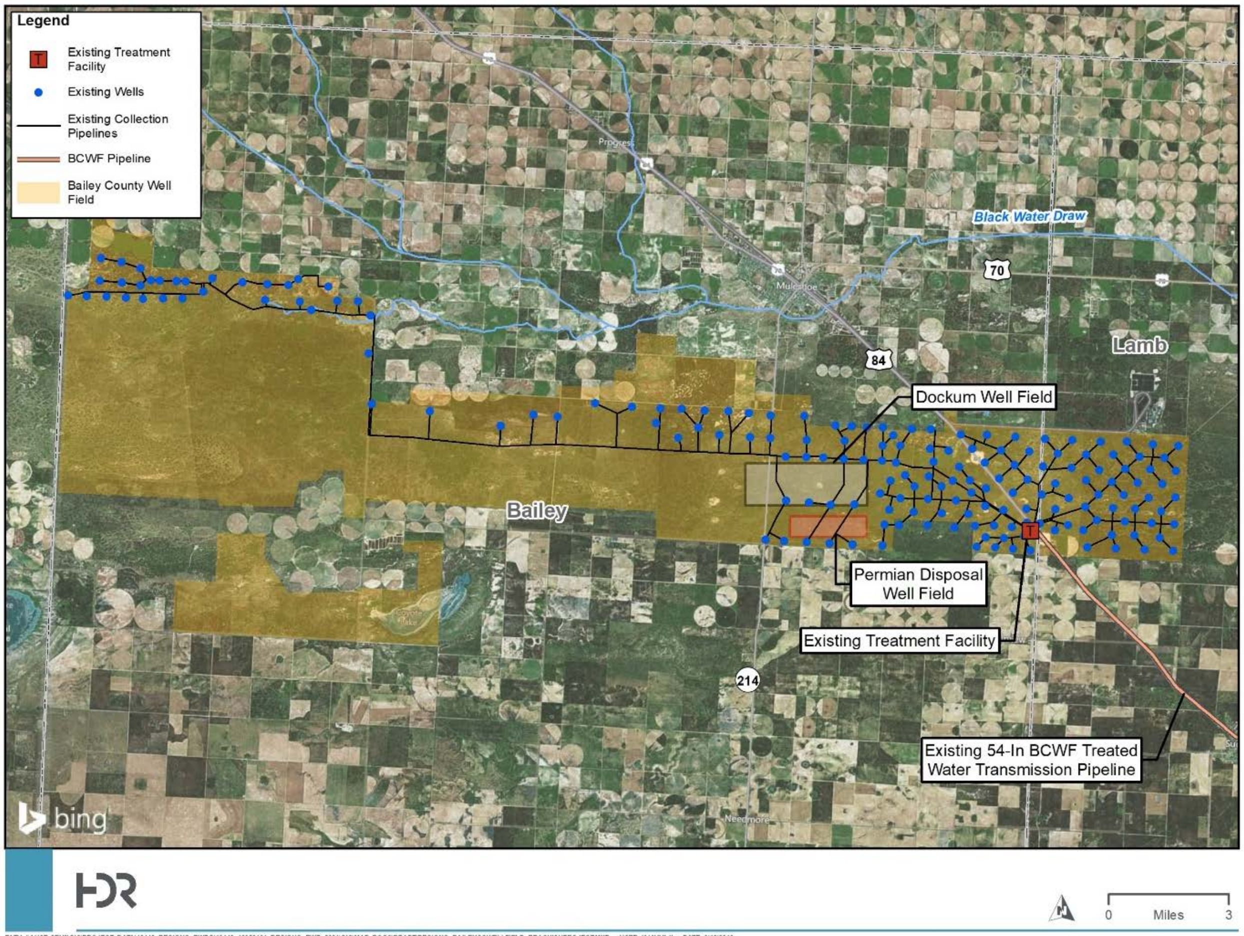

Figure 5.12. Area of Potential New Well Locations for BCWF Brackish Water Strategy

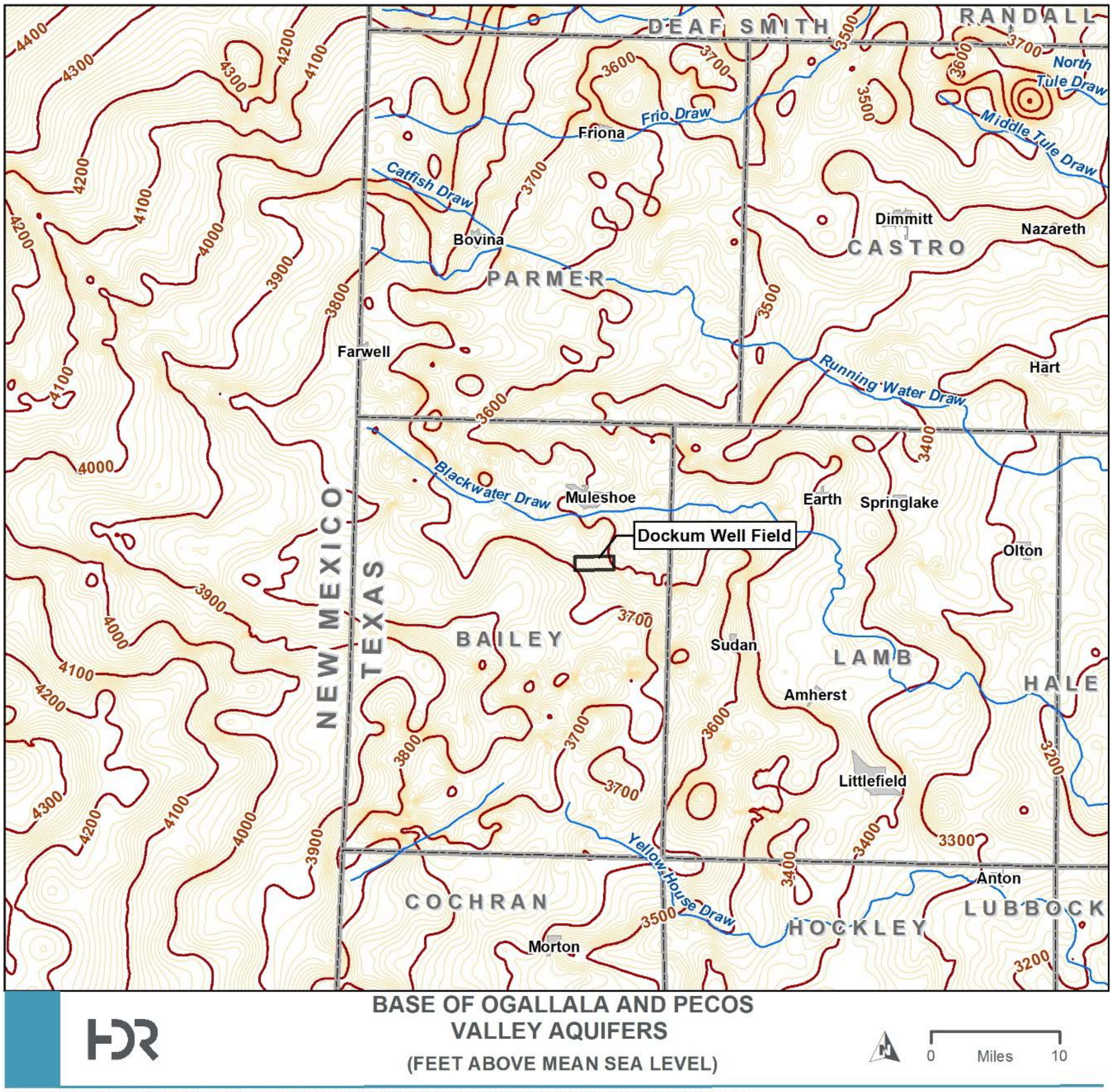

Figure 5.13. Base of the Ogallala Aquifer, which is approximate top of Dockum Aquifer in Project Area

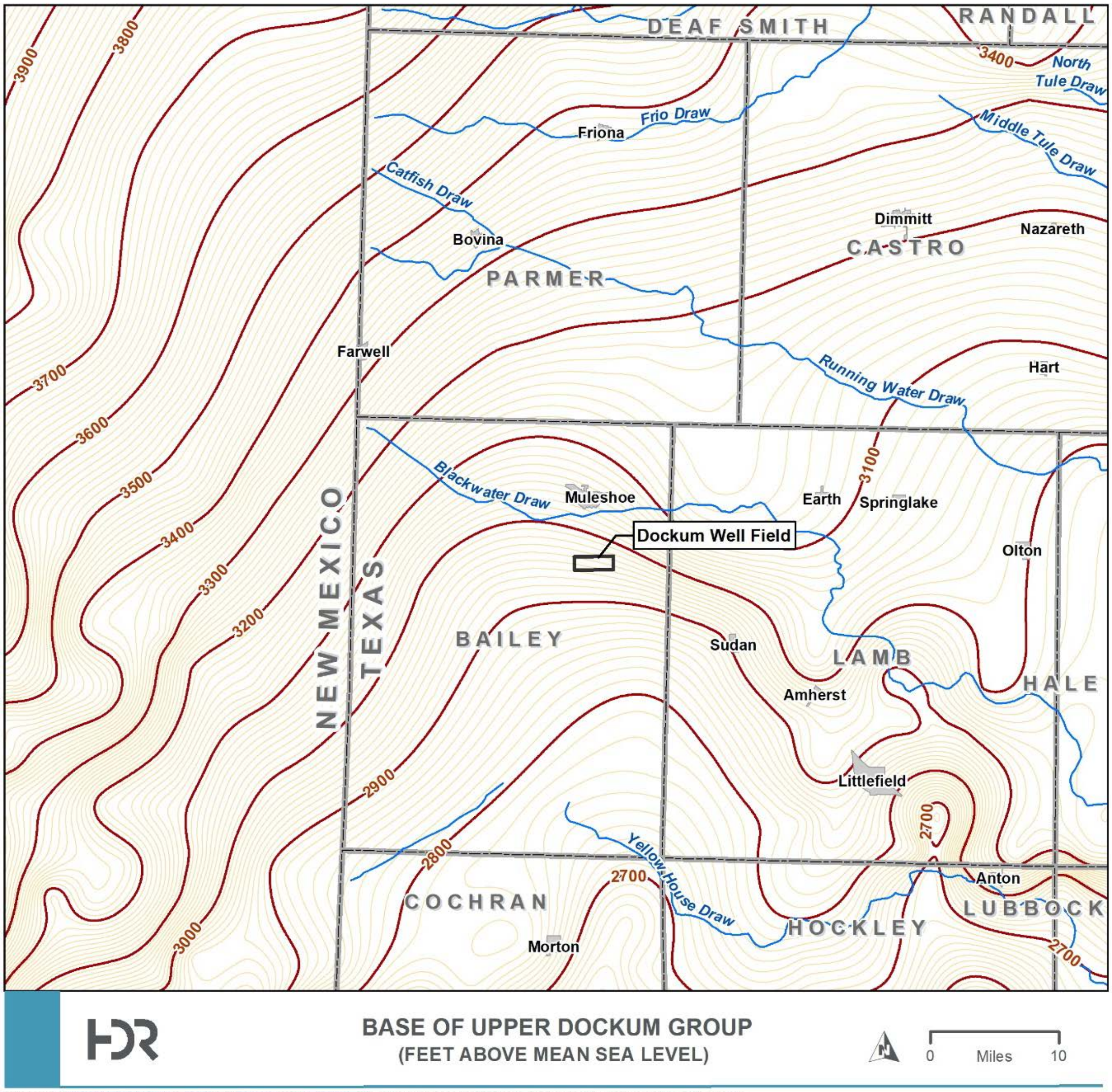

Figure 5.14. Base of the Upper Dockum Aquifer

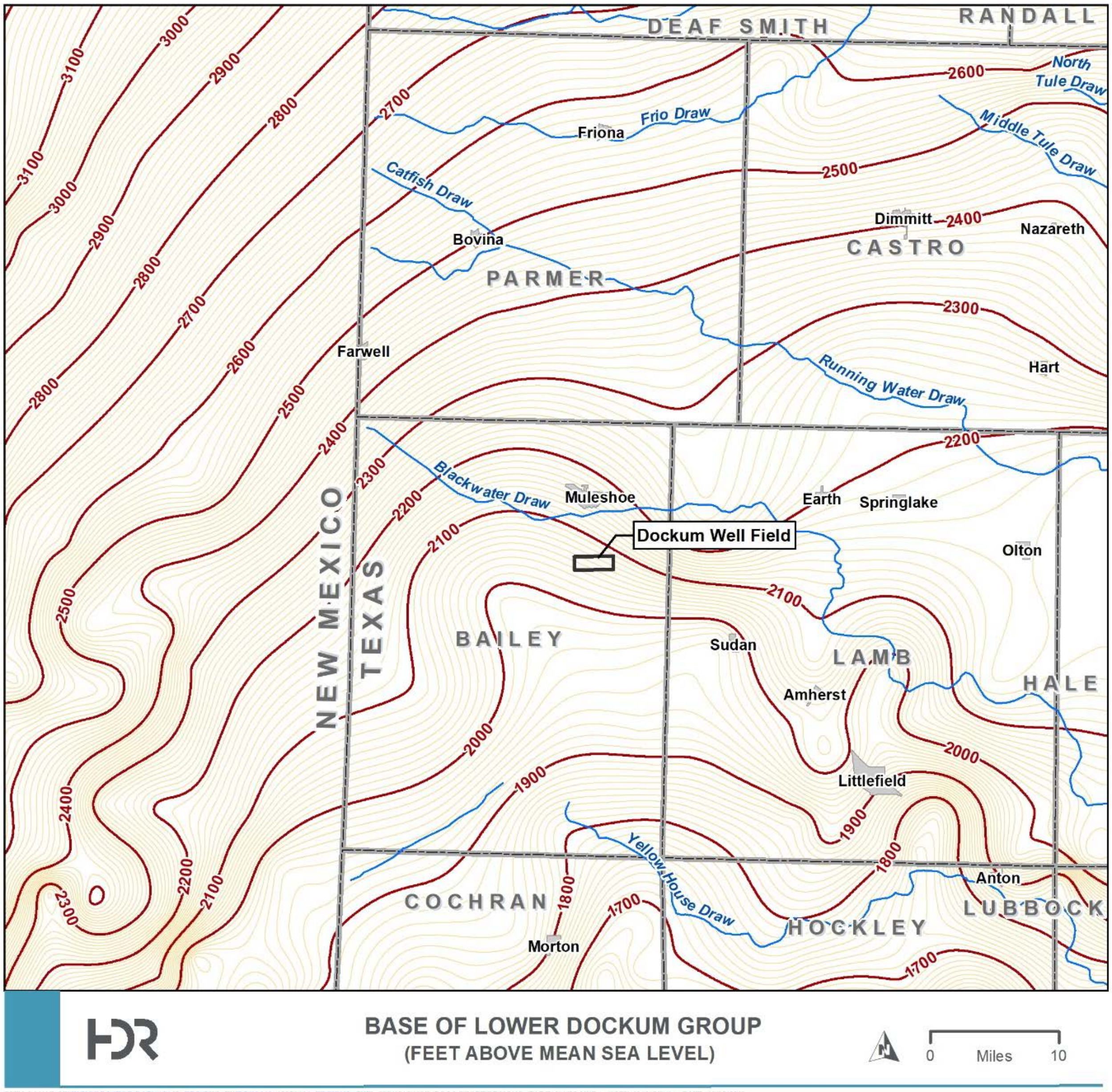

Figure 5.15. Base of the Dockum Aquifer

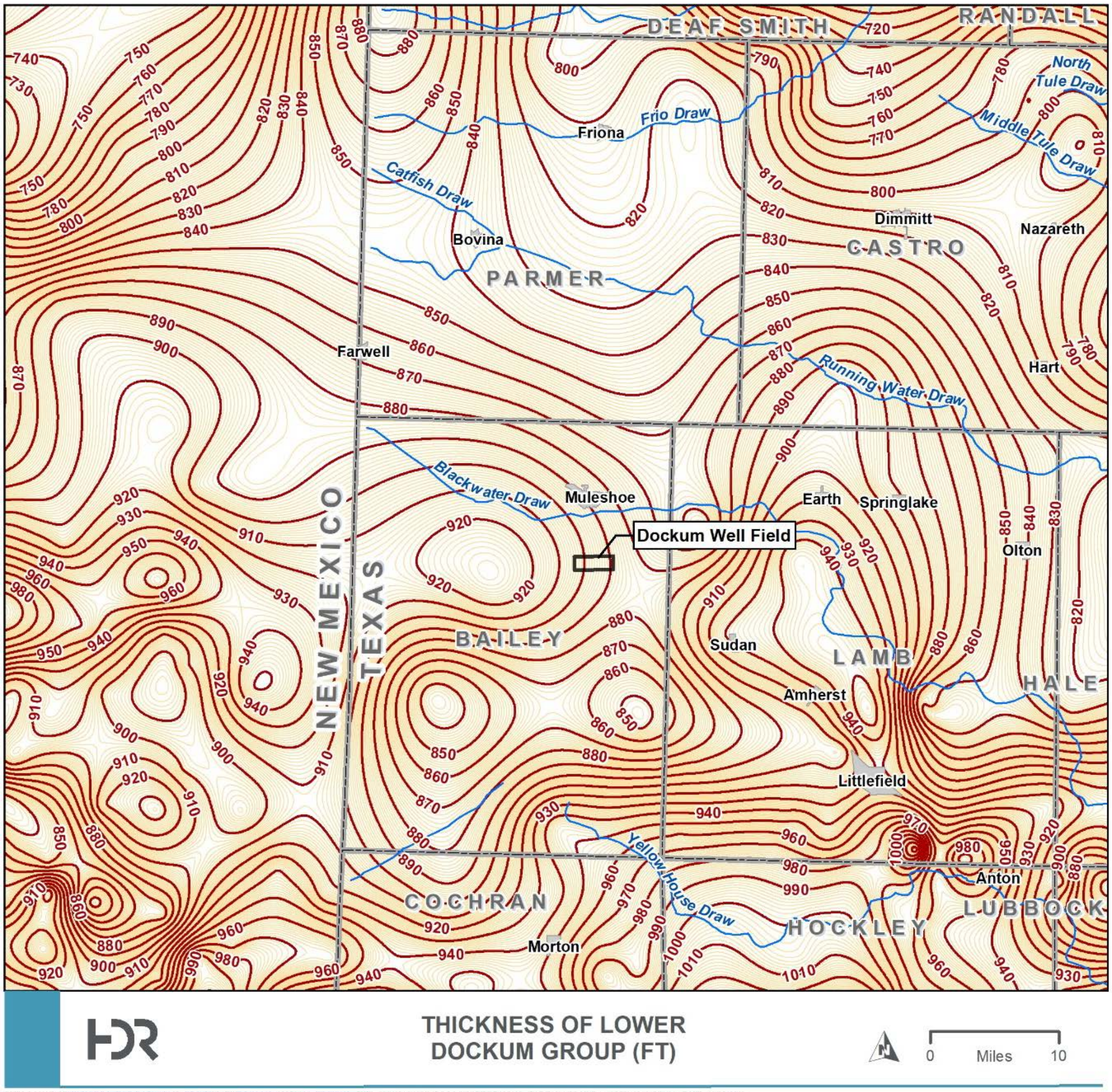

Figure 5.16. Thickness of Lower Dockum Aquifer

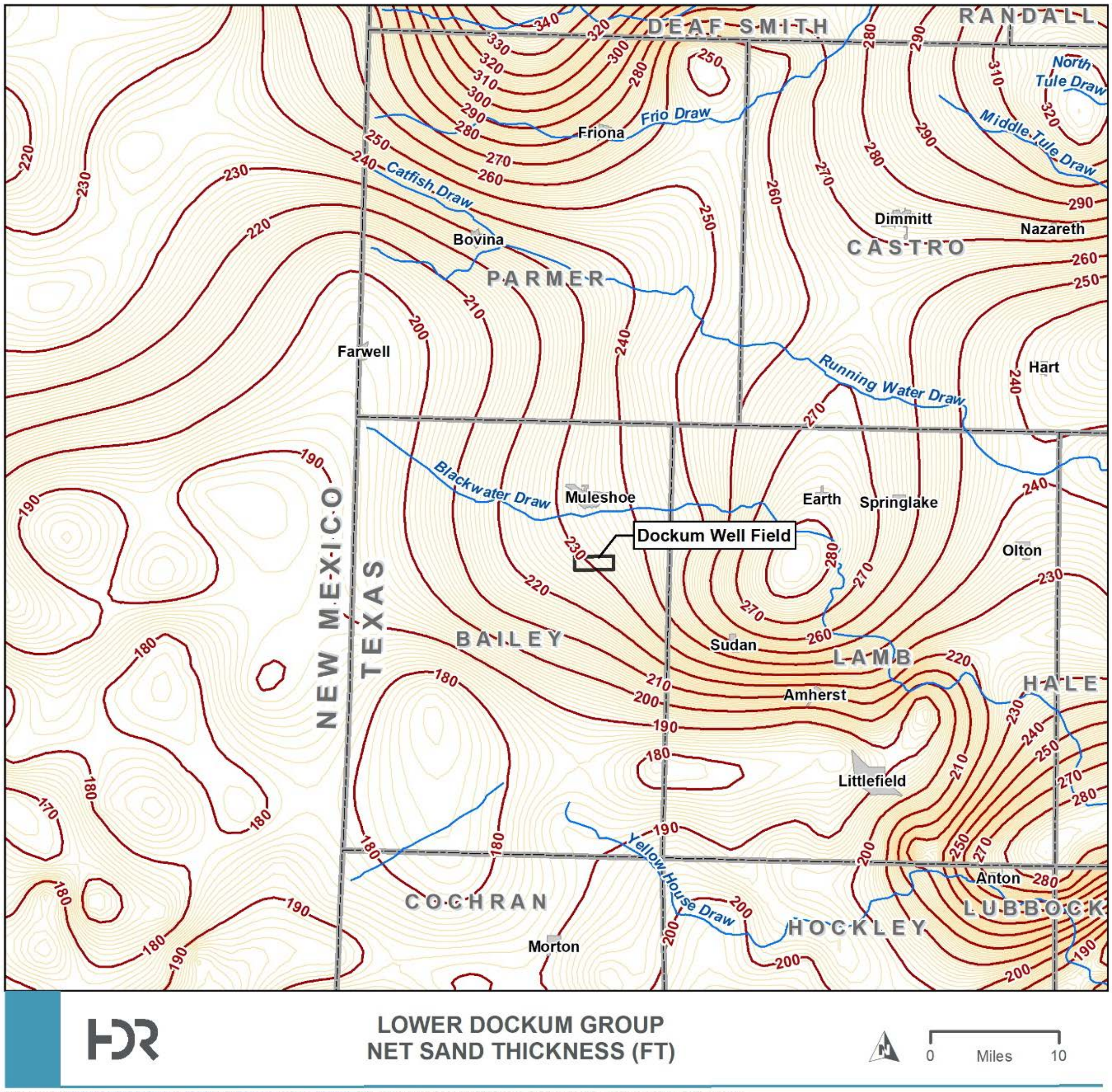

Figure 5.17. Net Sand Thickness of Lower Dockum Aquifer

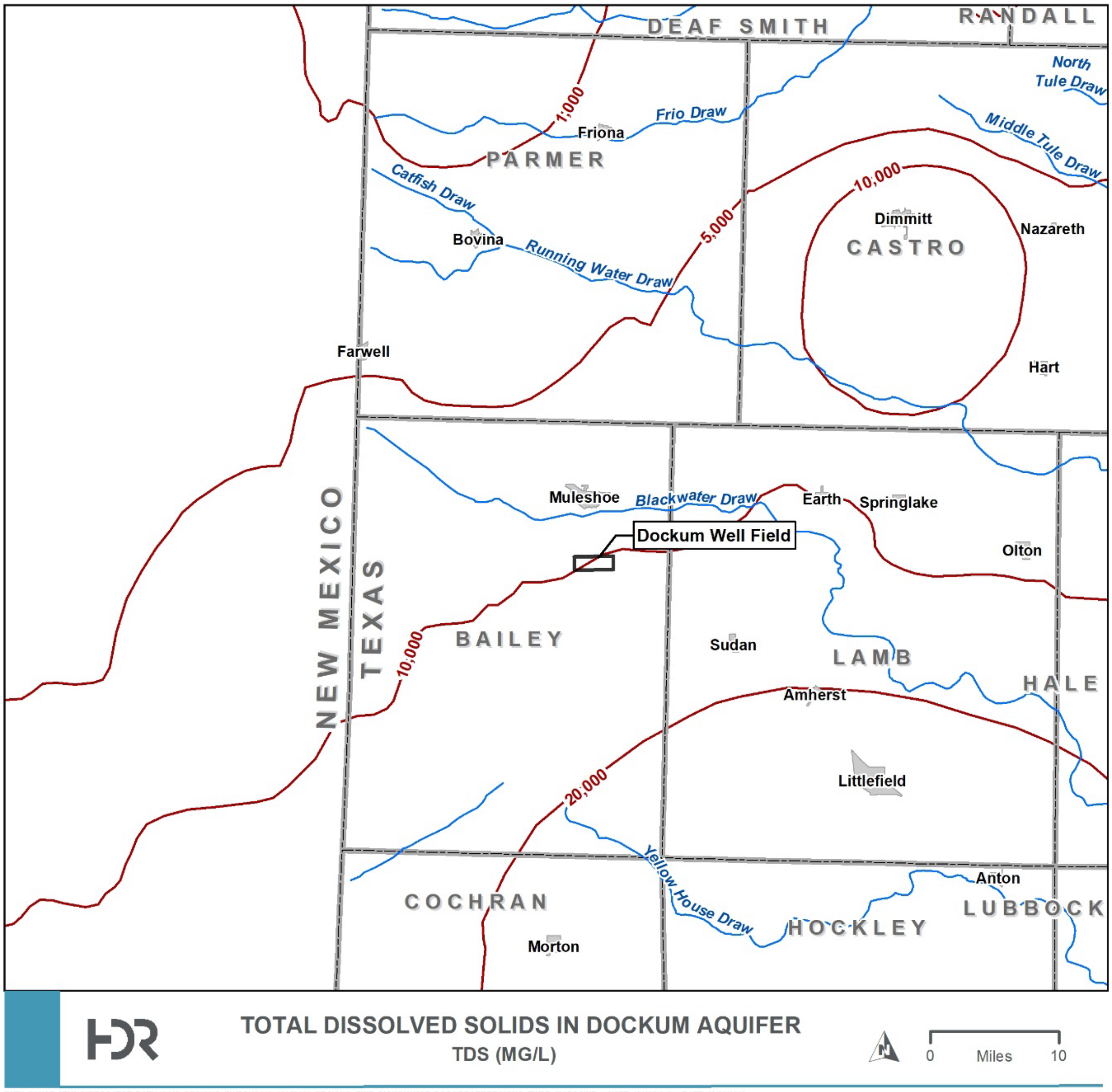

Figure 5.18. Approximate Salinity of Water in Dockum Aquifer

5.13.1 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 wells to maintain a target production during seasons of low demand and supplement Ogallala water during seasons of high demand.

5.13.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-13. 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 and Permian is included;
- Power is available at $0.08 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 5-13, the total project costs for the 50-year plan is estimated to be $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 5-13. BCWF Brackish Supplemental Water Supply Costs (September 2018 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	

Table 5-13. BCWF Brackish Supplemental Water Supply Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
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

5.13.3 Implementation Issues

Environmental Issues

The proposed project occurs within the High Plains physiographic region of Texas and is within the Kansan biotic province[155]. According to the EMST, the project components are within an area defined as Sandsage-Havard Shin oak brush vegetation type[156]. 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[157], 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 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.

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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. 2019. Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

FEMA has not mapped the project area for 100-year floodplains.[158] 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 12 for Utility Line Activities. The TCEQ Surface Water Quality Viewer[159] 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 4, 2019, the least tern and whooping crane are federal species that could potentially be in the project area; however, there are no critical habitats for these or any other species within the project area. The piping plover and red knot are also listed on the IPaC database for the project area, but only need to be considered for wind energy projects. TPWD's TXNDD showed the presence of two prairie dog towns, one approximately 0.5 mile northeast of the Dockum Well Field, the other on the southeast side of the Permian Well Field. No other occurrences of threatened, endangered, candidate or SGCN-listed species were documented within one mile of the proposed project area.

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

[158] FEMA. 2019. FEMA Flood Map Service Center: Search by Address. Accessed online https://msc.fema.gov/portal/search?AddressQuery=bailey%20county%2C%20tx#searchresultsanchor March 22, 2019.

[159] TCEQ. 2019. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed March 22, 2019.

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.).

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.

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.

5.14 Bailey County Well Field Capacity Maintenance

The BCWF produces water from the Ogallala Aquifer for the City of Lubbock. Production 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.[160] 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 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.[161] 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, 10 replacement wells would be required every 6 years to maintain the production capacity in the BCWF, while continually producing approximately 5,000 ac-ft/yr.

The major design features and assumptions of this strategy include the following.

- Construct 10 200-gpm wells every 6 years, for a total of 85 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 49 miles of 6- to 12-inch diameter well collection pipe and approximately 24 miles of 18- to 42-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 5.19 shows the relative locations of the well field and associated infrastructure needed.

[160] Daniel B. Stephens & Associates. 2012. Updated Bailey County Well Field Modeling Report, September 2012: 6.
[161] Daniel B. Stephens & Associates. 2012. Updated Bailey County Well Field Modeling Report, September 2012: 7.

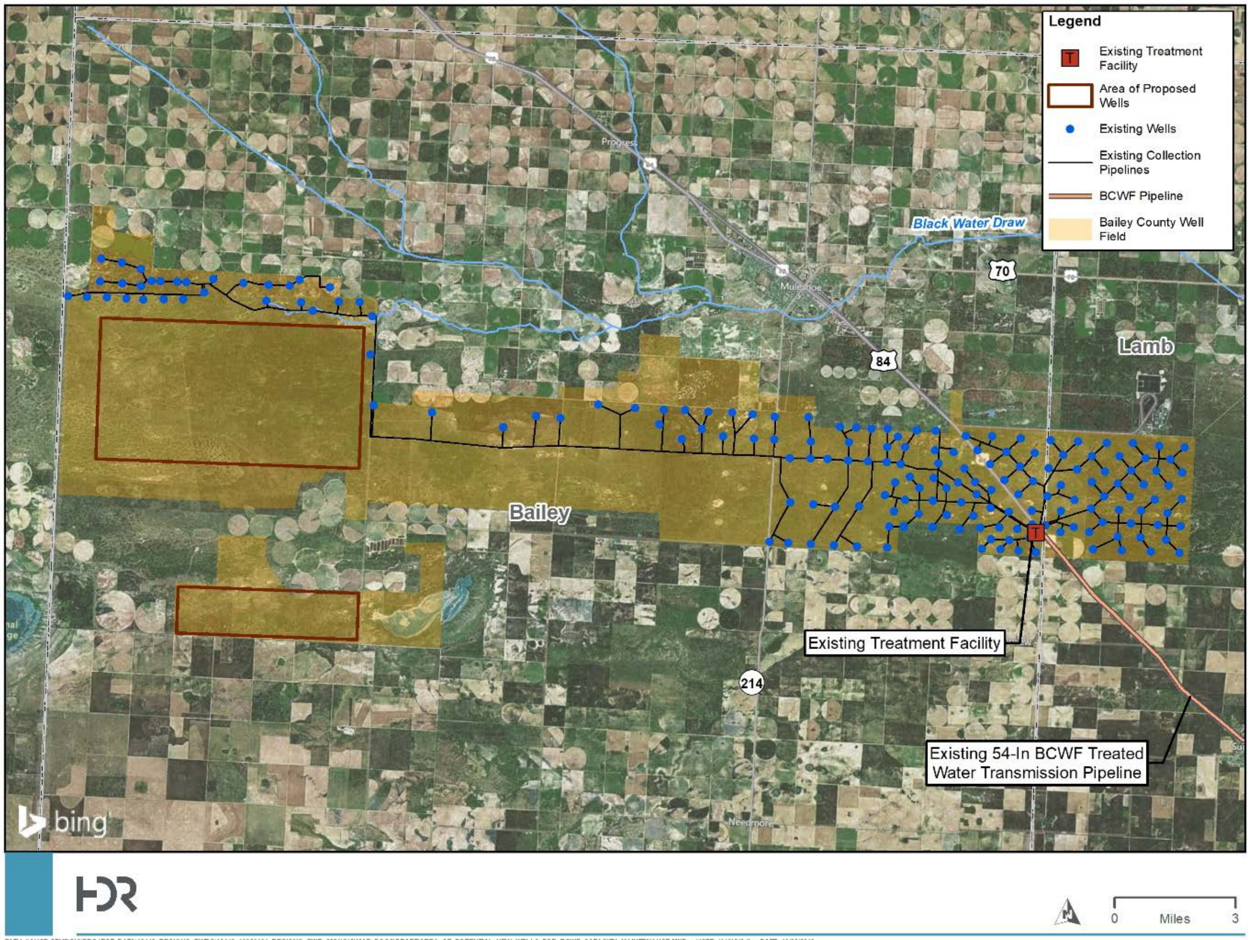

Figure 5.19. Area of Potential New Well Locations for BCWF Capacity Maintenance Strategy

5.14.1 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 10 new wells and associated pipeline every 6 years, providing 2.88 mgd (10 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.

5.14.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-14. 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 $0.08 per kW-hr;
- 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 5-14, the total construction costs for the 50-year plan is estimated to be $67,197,000. Annual debt service is $6,663,000; and, annual operational cost, including power, is $794,000, resulting in a total annual cost of $7,457,000. The unit cost for the 2.88 mgd peak capacity and 2,431 ac-ft/yr supply is estimated to be $3,067 per ac-ft, or $9.41 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 5-14. BCWF Capacity Maintenance Costs (September 2018 Prices)

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$67,197,000
TOTAL COST OF FACILITIES	**$67,197,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$23,519,000
Environmental & Archaeology Studies and Mitigation	$1,453,000
Interest During Construction (3% for 1 year with a 0.5% ROI)	$2,535,000
TOTAL COST OF PROJECT	**$94,704,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$6,663,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$672,000

Table 5-14. BCWF Capacity Maintenance Costs (September 2018 Prices)

Item	Estimated Costs for Facilities
Pumping Energy Costs (0.08 $/kW-hr)	$122,000
TOTAL ANNUAL COST	**$7,457,000**
Available Project Yield (ac-ft/yr)	2,431
Annual Cost of Water ($ per ac-ft), based on PF=1	$3,067
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$327
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$9.41
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.00

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.14.3 Implementation Issues

Environmental Issues

The proposed project occurs within the High Plains physiographic region of Texas and is within the Kansan biotic province[162]. The project components are within an area defined as Sandsage-Havard Shin oak brush vegetation type[163]. 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[164], 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 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

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

[163] 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.

[164] TPWD. 2019. Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

loss of less than 0.5 acres of waters of the U.S. could be covered under NWP 12 for utility line activities. TCEQ's Surface Water Quality Viewer[165] 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 4, 2019, the least tern and whooping crane are federal species that could potentially be in the project area; however, there are no critical habitats for these or any other species within the project area. The piping plover and red knot are also listed on the IPaC database for the project area, but only need to be considered for wind energy projects. TPWD's TxNDD showed the presence of a prairie dog town, part of which is on the northeastern corner of the proposed well field. 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 installed so that sensitive habitats, cultural resources, and other environmentally sensitive areas are avoided.

[165] TCEQ. 2019. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed February 25, 2019.

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.).

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.

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.

5.15 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.*[166] The strategy is also discussed in detail in the City of Lubbock's) 2015 *Aquifer Storage and Recovery (ASR) Evaluation*[167] report prepared by HDR.

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[166] CDM Smith. 2011. Canadian River Municipal Water Authority Aquifer Storage and Recovery Facility: Project Delivery Plan.

[167] HDR Engineering. 2015. Aquifer Storage and Recovery (ASR) Evaluation, Engineering Report for City of Lubbock.

The major design features and assumptions of this strategy include the following.

- Treat raw water from CRMWA sources at NWTP;
- 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;
- Concentrate 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 5.20 shows the relative locations of the ASR and production wells and associated infrastructure. Figure 5.21 shows a schematic of the ASR system.

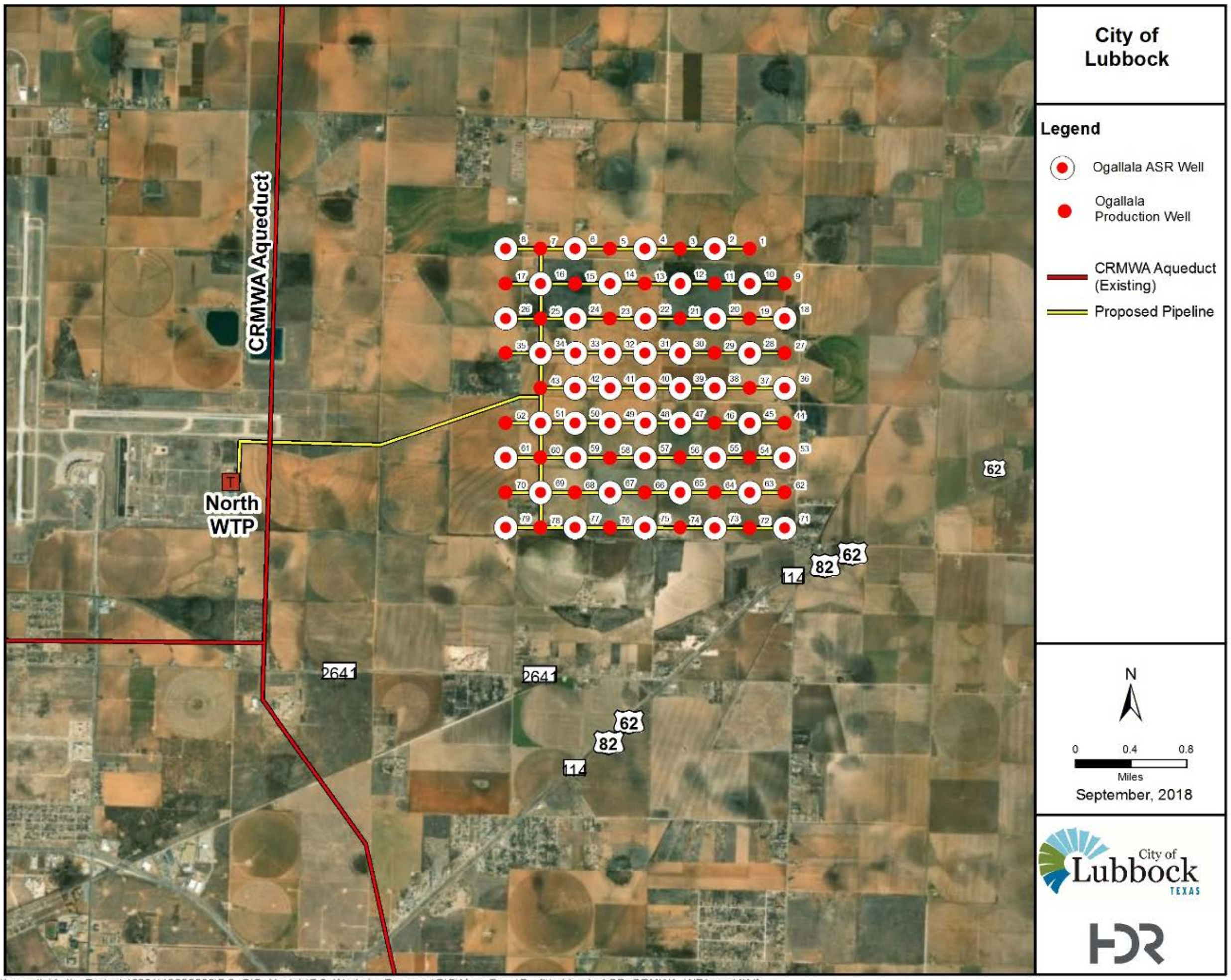

Figure 5.20. CRMWA to Aquifer Storage and Recovery Infrastructure

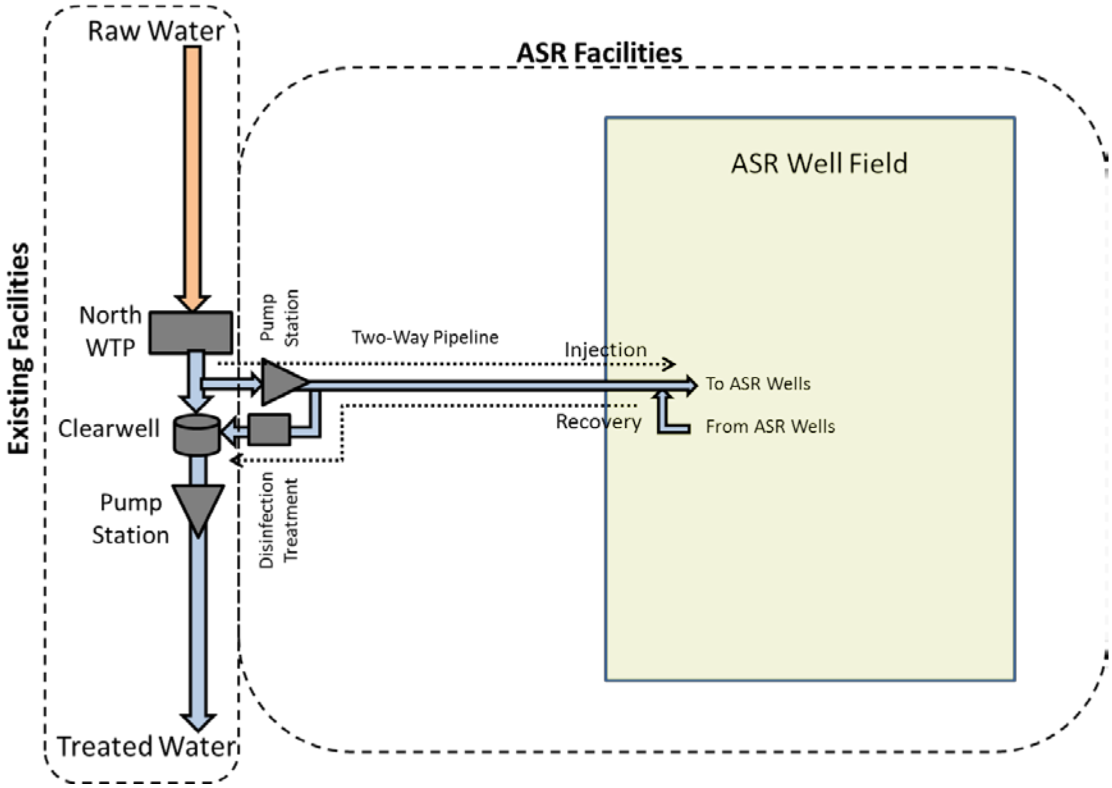

Figure 5.21. ASR System Schematic

5.15.1 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.

5.15.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-15. 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 can be purchased for $2,500 per acre (inclusive of water rights), which is twice the average of rural lands in this part of the state;
- Engineering, legal, and contingency costs is 30 percent of pipelines and 35 percent for other facilities;
- Power is available at $0.08 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 5-15. CRMWA to Aquifer Storage and Recovery Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Pump Station (19.5 mgd)	$1,274,000
Transmission Pipeline (54-in dia., 2 miles)	$4,592,000
Well Fields (Wells, Pumps, and Piping)	$53,500,000
Water Treatment Plant (49 mgd)	$2,777,000
TOTAL COST OF FACILITIES	**$62,143,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$21,521,000
Environmental & Archaeology Studies and Mitigation	$8,638,000
Land Acquisition and Surveying (3,212 acres)	$8,833,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$2,782,000
TOTAL COST OF PROJECT	**$103,917,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$7,312,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$581,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$32,000
Water Treatment Plant	$1,666,000
Pumping Energy Costs (0.08 $/kW-hr)	$307,000
TOTAL ANNUAL COST	**$9,898,000**
Available Project Yield (ac-ft/yr)	10,920
Annual Cost of Water ($ per ac-ft), based on PF=2	$906
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=2	$237
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$2.78
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.73

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 $103,917,000. Annual debt service is $7,312,000; and, annual operational cost, including power, is $2,586,000. This results in a total annual cost of $9,898,000. The unit cost for a 10,920 ac-ft/yr peaking supply is estimated to be $906 per ac-ft, or $2.78 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.

5.15.3 Implementation Issues

Environmental Issues

The proposed project occurs within the High Plains physiographic region of Texas and is within the Kansan biotic province[168]. The project components are within an area defined as crops vegetation type[169]. 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[170], 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 (without a base flood elevation Zone AE) are located in areas of playas within the proposed project area.[171] 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 two features identified as lakes, five freshwater emergent wetlands, one freshwater forested/shrub wetland, one freshwater pond, and three features identified in the NWI set as "other" wetland type. 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 12 for utility line activities. TCEQ's Surface Water Quality Viewer[172] shows proposed project components are within approximately 5 miles of North Fork (Segment 1241A), which is fully supporting of its designated uses and contains no water quality concerns.

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

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

[169] 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.

[170] TPWD. 2019. Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

[171] FEMA. 2019. 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 March 25, 2019.

[172] TCEQ. 2019. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed February 25, 2019.

Historic Preservation Act (P196-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets, there were no other 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 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.

According to IPaC, provided by USFWS for the project area on February 25, 2019, three threatened or endangered species, whooping crane, sharpnose shiner, and smalleye shiner, could potentially be affected by the project. The least tern, piping plover, and red knot are also mentioned, but only need to be considered for wind energy projects. The sharpnose and smalleye shiners only need to be considered for projects that may reduce the flow of water into major tributaries that eventually flow into occupied habitat. The whooping crane could be a migrant through the project area, but no adverse impacts to the whooping crane, or any other federally-listed threatened or endangered species are anticipated. 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. Within 5 miles, TXNDD shows documented occurrences of the Texas horned lizard (approximately 4 miles west of the existing NWTP), the Western burrowing owl (*Athene cunicularia hypugaea*) (approximately 5 miles west of the existing NWTP), a prairie dog town (approximately 5 miles west of the NWTP), and two areas where the swift fox has been documented (approximately one mile northwest of the existing NWTP, and approximately 4.8 miles south of the proposed well field). The black-tailed prairie dog (*Cynomys ludovicianus*) and swift fox are both SGCN-designated species.

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 sensitive areas are avoided.

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.

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.

5.16 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 5.22 shows the relative locations of the ASR and production wells and associated infrastructure.

Figure 5.22. CRMWA to Plainview Aquifer Storage and Recovery Infrastructure

5.16.1 Quantity of Water Available

This strategy assumes that CRMWA would maintain delivering water at a rate of 3,285 ac-ft/yr. It also assumes that CRMWA average unused water is 987 ac-ft/yr based on usage from 2016 through 2018. 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 987 ac-ft/yr of water available for ASR storage. To recover this same amount it would need to have a recovery rate of 700 gpm and a recharge rate of 500 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.

5.16.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-16. 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, and contingency costs is 30 percent of pipelines and 35 percent for other facilities;
- Power is available at $0.08 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 5-16. CRMWA to Plainview Aquifer Storage and Recovery Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Pump Station (3.5 MGD)	$991,000
Transmission Pipeline (14 in dia., 1 mile)	$1,226,000
Well Field (Wells, Pumps, and Piping)	$3,567,000
SCADA System	$563,000
TOTAL COST OF FACILITIES	**$6,347,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,160,000
Environmental & Archaeology Studies and Mitigation	$69,000
Land Acquisition and Surveying (22 acres)	$43,000
Interest During Construction (3% for 1 year with a 0.5% ROI)	$238,000
TOTAL COST OF PROJECT	**$8,857,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$623,000

Table 5-16. CRMWA to Plainview Aquifer Storage and Recovery Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$54,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$25,000
Pumping Energy Costs (0.08 $/kW-hr)	$709,000
TOTAL ANNUAL COST	**$1,411,000**
Available Project Yield (ac-ft/yr)	987
Annual Cost of Water ($ per ac-ft), based on PF=4	$1,430
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=4	$798
Annual Cost of Water ($ per 1,000 gallons), based on PF=4	$4.39
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=4	$2.45

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 $8,857,000. Annual debt service is $623,000 and annual operational cost, including power, is $788,000. This results in a total annual cost of $1,411,000. The unit cost for a 987 ac-ft/yr peaking supply is estimated to be $1,430 per ac-ft, or $4.39 per 1,000 gallons.

5.16.3 Implementation Issues

Environmental Issues

The proposed project occurs within the High Plains physiographic region of Texas and is within the Kansan biotic province[173]. The project components are within areas defined as mesquite shrub and crops vegetation types[174]. 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

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

[174] 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.

produced by TPWD[175], 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.[176] 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 adjacent to the potential ASR pipeline route. The NWI maps also identified freshwater emergent wetlands along Running Water Draw in the potential ASR well field. Ann 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[177] 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 the IPaC website[178] maintained by USFWS, the whooping crane could be a migrant through the project area, but no adverse impacts to the whooping crane, or any other federally-listed threatened or endangered species are anticipated. 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.

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[175] TPWD, Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

[176] FEMA. 2020. 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 January 13, 2020.

[177] TCEQ. 2019. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed January 13, 2020.

[178] USFWS. 2020. Information for Planning and Consultation. Accessed online https://ecos.fws.gov/ipac/location/2CDHNRFRWZBEFN2BCFV527IIXM/resources January 13, 2020.

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 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, cultural resources, and other sensitive areas are avoided.

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.

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.

5.17 South Lubbock Well Field

In the southern part of the City of Lubbock, groundwater levels in the Ogallala Aquifer are relatively high and saturated thickness is relatively large. The relatively high groundwater levels are mostly attributed to urban runoff into local playa lakes, which has caused unusually high recharge. The City of Lubbock conducted a *Groundwater Utilization Study* (2006) in this area (in the vicinity of pump station #10) which is at the intersection of Memphis and 84th Street. This WMS updates the utilization study.

Groundwater in the target area has a slightly elevated salinity (TDS), ranging up to more than 1,600 mg/L and is potentially "under the influence of surface water" according to

TCEQ. These two issues would require advanced treatment for the water to be used for drinking water.

The strategy uses a well field in the vicinity of pump station #10.

It is expected that, after advanced treatment, a composite raw water would have a TDS concentration comparable to current City of Lubbock potable water supplies. The treated water would be discharged into the existing ground storage tank at the pump station for blending and distribution into the City of Lubbock's system or to pump station #14 through a new jumper pipeline. Concentrate would be discharged into a new ground storage tank and discharged to new nearby Dockum wells for final disposal.

The project is designed for summer peaking supplies. As a result, the preliminary design is to operate the project from June to September.

Major assumptions include the following.

- A high-capacity Ogallala production well in the project area is expected to average approximately 340 gpm, or 0.49 mgd.
- The depth to the base of the Ogallala is approximately 135 feet.
- Based on a 2003 TWDB report[179], the depth to the base of the best Dockum sandstone is about 1,900 feet.
- Groundwater in the Dockum at this location has an estimated TDS concentration of approximately 25,000 to 50,000 mg/L.
- Sparse and relatively old data suggest TDS concentrations range from approximately 570 to over 1,600 mg/L. For preliminary strategy design, the estimated average TDS is 1,250 mg/L.
- This part of the Ogallala receives rather rapid and direct recharge from rainfall and runoff and possibly urban irrigation. Considering the likelihood of the water being slightly brackish and possibly "under the influence" of surface water, advanced water treatment is planned, which includes microfiltration for the direct use of well water and RO for raw groundwater going to desalination.
- Pump station #10 does not have sufficient capacity to incorporate the new supply into the distribution system. Thus, some of the water will be transported to pump station #14 for delivery to the distribution system.
- Preliminary plans for the disposal of the concentrate from the desalination process include (1) injecting the concentrate into Dockum Aquifer, (2) designing the ATWP to produce a TDS concentration that is less than or equal to the salinity of water in the Dockum Aquifer, and (3) the disposal wells would be near the ATWP.

[179] Bradley, R.G., and Kalaswad, S. 2003. The groundwater resources of the Dockum Aquifer in Texas: TWDB Report 359, December 2003. http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R359/Report%20359%20Dockum%20Final.pdf

- For an operational capacity of 7.0 mgd of potable water, 7.2 mgd of raw water is required. The balance of approximately 0.2 mgd becomes concentrate (50 percent bypass and 95 percent efficiency). The total capacity of the active production wells is almost 5,000 gpm.

Major design features include the following.

- Construct 17 Ogallala production wells, 2 of which would be considered contingency or standby wells, located on City of Lubbock-owned property.
- Site wells to meet TCEQ sanitary distance requirements.
- Construct 2 concentrate disposal wells that discharge into the Dockum, of which 1 is considered a contingency well. Locate both wells on City of Lubbock property.
- Install approximately 7 miles of 6- to 18-inch diameter raw water collection pipeline.
- Size well pumps to deliver the raw water directly to the advanced water treatment plant at pump station #10.
- Design the advanced water treatment plant to provide microfiltration and RO for desalination and produce finished water with salinity near the concentration of current potable water supplies.
- Deliver treated water to the existing ground storage tank at pump station #10 for blending. Some of the water will be integrated into the distribution system at pump station #10 and the remainder will be transported to pump station #14 for delivery.
- Discharge concentrate into a ground storage tank, then pump into the Dockum disposal well.

Figure 5.23 shows the potential locations of the well field and associated infrastructure.

Figure 5.23. **Location of Potential New Wells and Infrastructure for South Lubbock Well Field**

5.17.1 Quantity of Available Water

This strategy is designed to help the City of Lubbock meet its summer (June through September) peak demands. The well field is estimated to produce 7.0 mgd (2,613 ac-ft) over the 4 months.

5.17.2 Strategy Costs

A cost summary is provided in Table 5-17. Assumptions and conditions associated with these costs include the following.

- Engineering, legal, and contingency costs is 35 percent for facilities required by this strategy.
- Power is available at $0.08 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 in Table 5-17, the total project cost is estimated to be $66,242,000. Costs estimates include adjustment for construction in an urban setting. Annual debt service is $4,661,000; and, annual operational cost, including power, is $4,046,000. This results in a total annual cost of $8,707,000. The unit cost for a 2,613 ac-ft/yr supply is estimated to be $3,332 per acre-foot, or $10.22 per 1,000 gallons.

Table 5-17. South Lubbock Well Field Costs (September 2018 Prices)

Item	Estimated Costs for Facilities
Transmission Pipeline (Jumper Pipeline to PS#14)	$8,000,000
Well Field (Wells, Pumps, and Piping)	$9,795,000
Storage Tanks (Concentrate Holding Tanks)	$791,000
Two Water Treatment Plants (3.7 mgd and 3.5 mgd)	$29,283,000
System Integration	$50,000
TOTAL COST OF FACILITIES	**$47,919,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$16,372,000
Environmental & Archaeology Studies and Mitigation	$178,000
Interest During Construction (3% for 1 year with a 0.5% ROI)	$1,773,000
TOTAL COST OF PROJECT	**$66,242,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$4,661,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$186,000
Water Treatment Plant	$3,700,000
Pumping Energy Costs (0.08 $/kW-hr)	$160,000
TOTAL ANNUAL COST	**$8,707,000**
Available Project Yield (ac-ft/yr)	2,613
Annual Cost of Water ($ per ac-ft), based on PF=2	$3,332
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=2	$1,548
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$10.22
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$4.75

Notes: mgd = million gallons per day; ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.17.3 Implementation Issues

Environmental Issues

The proposed project occurs within the High Plains physiographic region of Texas, and is within the Kansan biotic province[180.] TPWD has defined the vegetation community within the project area as urban[181]. Urban vegetation generally includes maintained right-of-way, lawns, shade and ornamental trees, and planted species. Vegetation impacts would include clearing of areas for the installation of wells and pipelines in an already maintained low density urban area that has been previously disturbed.

The proposed wells and much of the associated infrastructure are located in special flood hazard areas (Zone AE – 1 percent annual chance flood hazard, and areas with 0.2 percent annual chance flood hazard)[182]. The wells are being installed to take advantage of groundwater infiltration from playas. These playas are identified on the NWI dataset as freshwater ponds[183]. Coordination with USACE would be required for construction within jurisdictional 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 12 for utility line activities. TCEQ's Surface Water Quality Viewer[184] shows there are no impaired stream segments within 5 miles of proposed project components. Segment 1241A, North Fork, is located within 5 miles of the proposed project, but is not an impaired segment.

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, one historical marker for Miss Mae Murfee was located within a one-mile buffer of the proposed project components. 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. 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.

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

[181] 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.

[182] FEMA. 2019. FEMA's National Flood Hazard Layer (NFHL) Viewer. Accessed online https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd&extent=-101.98319740844704,33.48730913182306,-101.81702919555664,33.558863023536894 March 27, 2019.

[183] USFWS. 2019. National Wetlands Inventory – Surface Waters and Wetlands. Available online https://www.fws.gov/wetlands/Data/Mapper.html March 27, 2019.

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

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 shown in Appendix D under Lubbock County, Texas.

According to IPaC, provided by USFWS on April 1, 2019, the whooping crane, sharpnose shiner, and smalleye shiner are federally-listed species that should be considered during project development. The IPaC recommended contacting the local field office to determine whether critical habitat for the whooping crane should also be considered. 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 survey of the project area may be required prior to construction to determine whether populations threatened or endangered species, or potential habitats used by listed species occur in the area to be affected and to determine if impacts or effects to listed species may occur. 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, collection pipelines, storage tank, and water treatment plant would be installed in highly disturbed urban areas. Thus, no issues are expected. Concentrate will be discharged into a saline aquifer with a dissolved solids concentration equal to or greater than the concentrate.

Summary

The project is proposed to increase supply during summer peak periods. The preliminary design is to operate the project June through September. Expanding this capacity would allow for development change to occur in accordance with proposed local area plans. Permanent land use impacts in the project area would be limited to the new wells, collector lines, water treatment plant. Disturbance to area land use would depend upon the type of construction used to install the pipelines (open cut, boring, etc.).

Permitting Issues

The City of Lubbock would need to acquire permits from the HPWD. The TCEQ must approve the design and construction of water supply wells and water transmission facilities and disposal of concentrate.

Other

Wells will be placed on properties owned by the City of Lubbock.

5.18 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.

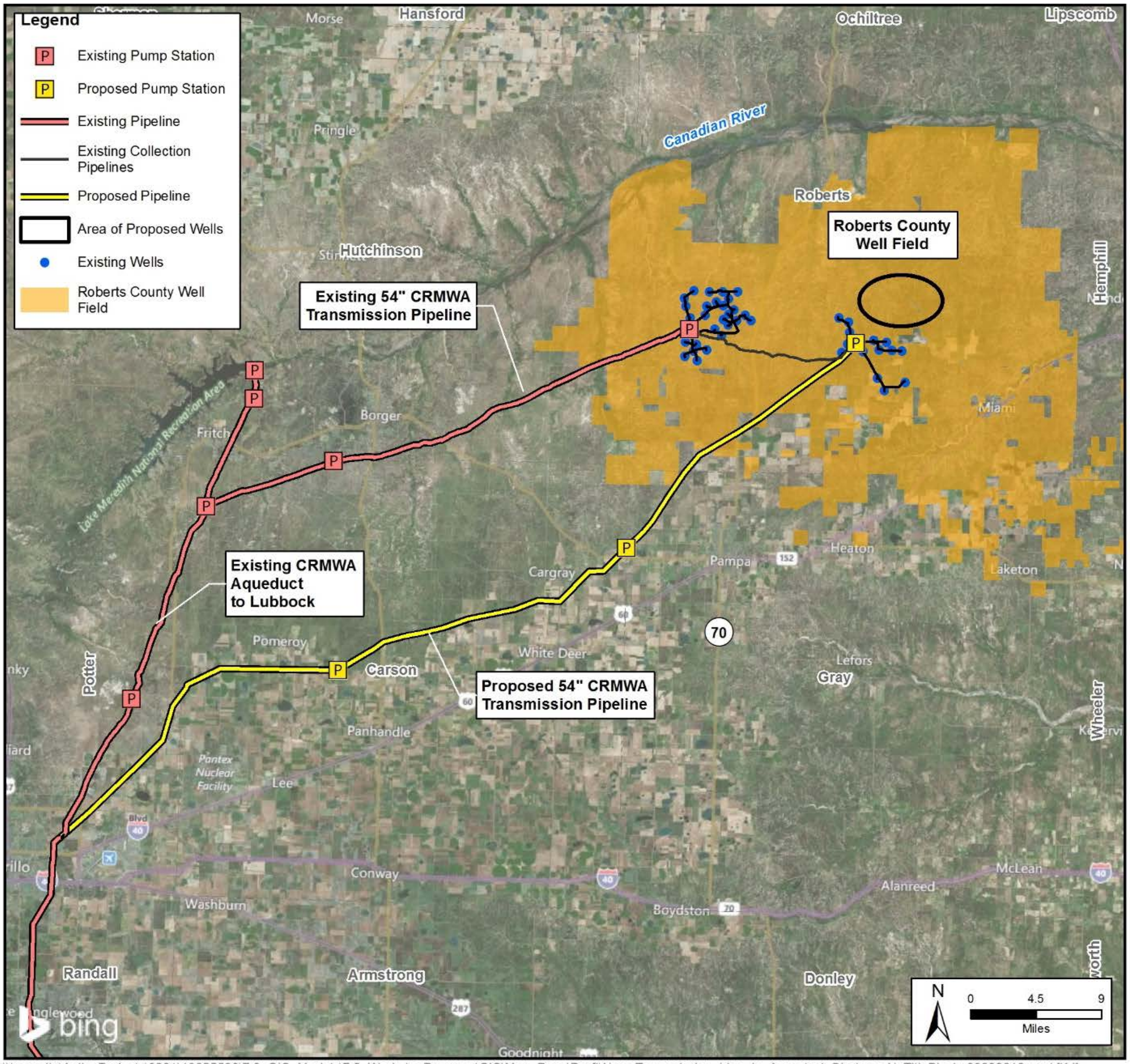
Two 54-inch diameter transmission lines (one existing and one planned) delivering water from the RCWF could deliver a peak supply of 130 mgd to the CRMWA Aqueduct (65 mgd from each pipeline). The City of Lubbock's portion would be 48.2 mgd (37.058 percent of the total CRMWA-produced water available). 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 be 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 72 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 5.24 depicts the relative locations of the well field, new wells, transmission lines, and associated infrastructure.



\\tx-austin\ActiveProjects\3291\10055566\7.0_GIS_Models\7.2_Work_In_Progress\GIS\Map_Docs\Draft\New_Transmission_Line_to_Aqueduct_Strategy_NoTitleBlock_08082018.mxd [KJ]

Figure 5.24. RCWF – New Transmission Line to Aqueduct Strategy

5.18.1 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 will 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.

5.18.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-18. 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 $0.08 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 $584,951,000 for facilities to provide the full capacity of 65 mgd. Annual debt service is $41,158,000, and annual operational cost, including power, is $22,030,000. This results in a total annual cost of $63,188,000. The unit cost for the average annual supply is $1,085/ac-ft or $3.33 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 $23,416,000, which is 37.058 percent of $63,188,000.

Table 5-18. RCWF New Transmission Line to Aqueduct Costs (Sept 2018 Prices)

Item	Estimated Costs for Facilities
Pump Station (65 mgd)	$45,662,000
Transmission Pipeline (54-in dia., 72 miles)	$168,550,000
Transmission Pump Stations (65 mgd)	$78,025,000
Well Field (Wells, Pumps, and Piping)	$132,195,000
TOTAL COST OF FACILITIES	**$424,432,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$140,124,000
Environmental & Archaeology Studies and Mitigation	$3,407,000
Land Acquisition and Surveying (850 acres)	$1,332,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$15,656,000
TOTAL COST OF PROJECT	**$584,951,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$41,158,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,082,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$2,907,000
Pumping Energy Costs (0.08 $/kW-hr)	$16,041,000
TOTAL ANNUAL COST	**$63,188,000**
Available Project Yield (ac-ft/yr)	58,240
Annual Cost of Water ($ per ac-ft), based on PF=1	$1,085
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$378
Annual Cost of Water ($ 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	$1.16

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

5.18.3 Implementation Issues

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[185]. TPWD has defined four vegetation associations within the project area: mesquite shrub, mesquite-juniper brush, cottonwood-hackberry-saltcedar brush/woods, and crops.[186] 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. 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[187]. 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 12 for utility line activities. TCEQ's Surface Water Quality Viewer[188] 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

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

[186] 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.

[187] FEMA. 2019. FEMA Flood Map Service Center. Accessed online https://msc.fema.gov/portal/home April 1, 2019.

[188] TCEQ. 2019. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed February 26, 2019.

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 April 1, 2019, the least tern, whooping crane, and Arkansas River shiner (*Notropis girardi*) are federally-listed species that could potentially be in the project area. The IPaC data recommended contacting the USFWS local field office, during project planning, to determine whether critical habitat for the whooping crane needs to be considered. Critical habitats for the least tern and Arkansas River shiner have not been established. TPWD's TxNDD documents the occurrences of rare species in Texas. This information has been requested for the project counties.

A biological survey of the project area may be required prior to construction to determine whether populations of or potential habitats used by listed species occur in the area to be affected and to determine if impacts or effects to listed species may occur. 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.).

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.

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.

5.19 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; and
- No additional treatment is included in the costs.

Figure 5.25 shows the relative locations of well field and associated infrastructure.

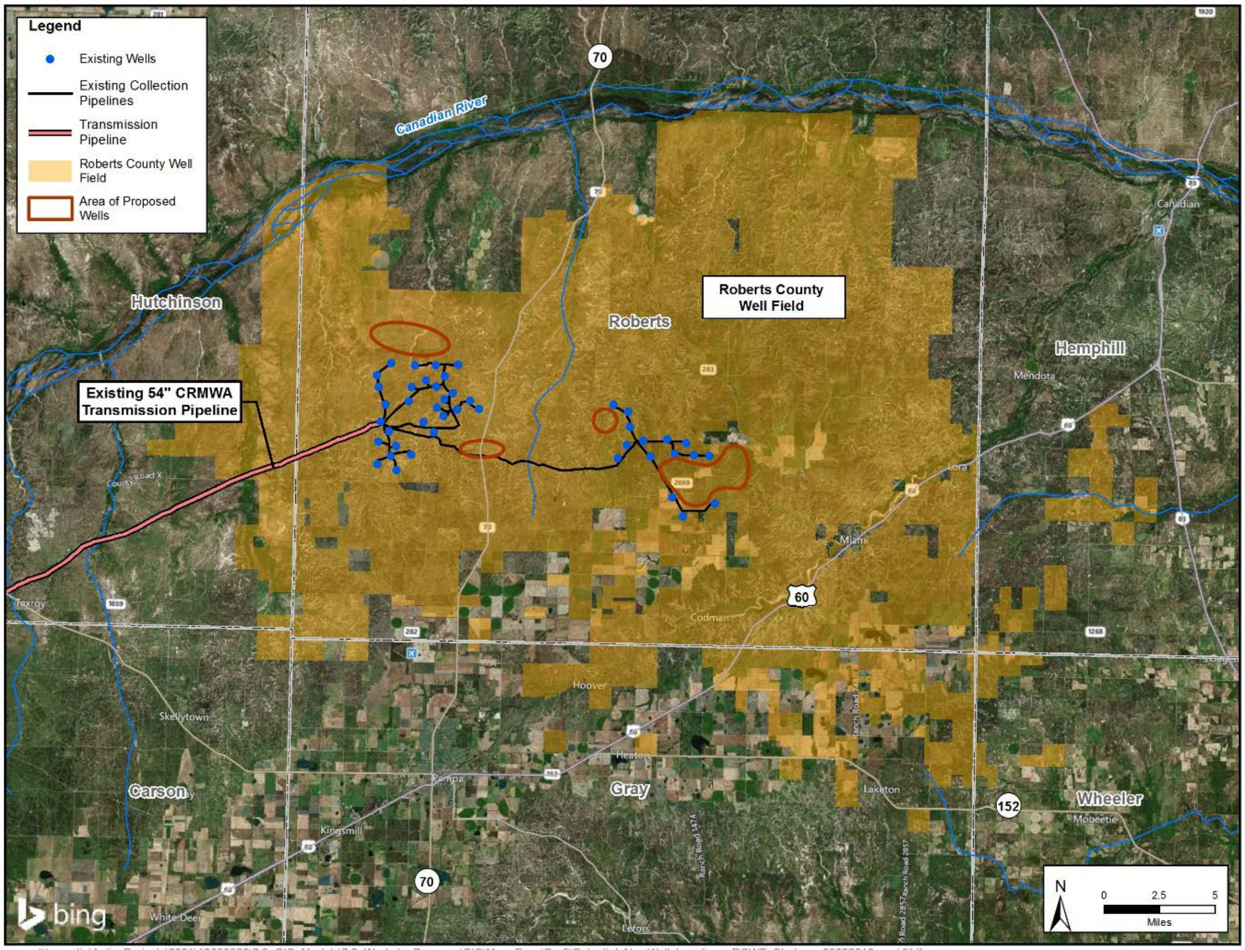


Figure 5.25. Potential New Well Locations for the RCWF Capacity Maintenance Strategy

5.19.1 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.

5.19.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-19. 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 $0.08 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; and
- 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 $120,356,000. Annual debt service is $8,468,000 and annual operational cost, including power, is $10,492,000. This results in a total annual cost of $5,141,000. 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 $5,043,000 and 19,380 ac-ft/yr. This results in a unit cost of $260 per ac-ft, or $0.80 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 5-19. RCWF Capacity Maintenance Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Well Field (Wells, Pumps, and Piping)	$86,179,000
TOTAL COST OF FACILITIES	**$86,179,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$30,163,000
Environmental & Archaeology Studies and Mitigation	$792,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$3,222,000
TOTAL COST OF PROJECT	**$120,356,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$8,468,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$862,000
Pumping Energy Costs (0.08 $/kW-hr)	$4,279,000
TOTAL ANNUAL COST	**$13,609,000**
Available Project Yield (ac-ft/yr)	52,300
Annual Cost of Water ($ per ac-ft), based on PF=1	$260
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$98
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.80

Table 5-19. RCWF Capacity Maintenance Costs (September 2018 Dollars)

Item	Estimated Costs for Facilities
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.30

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

5.19.3 Implementation Issues

Environmental Issues

The proposed project occurs within the High Plains and Southwestern Tablelands physiographic regions of Texas and is within the Kansan biotic province189. The project components are within an area defined as mesquite shrub and crops vegetation types[190]. 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[191], identify several different habitat types within the proposed well field areas including canyon breaks, deciduous shrubland, short and mixed grass prairie, herbaceous vegetation, and urban low intensity. Vegetation impacts would include clearing areas for construction of approximately 19 new wells and collection pipelines.

FEMA has not mapped the project area for 100-year floodplains[192]. 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 12 for utility line activities. TCEQ's Surface Water Quality Viewer[193] identifies no impaired stream or reservoir segments within 5 miles of the proposed well fields.

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[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/ March 22, 2019.

[191] TPWD. 2019. Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

[192] FEMA. 2019. FEMA Flood Map Service Center: Search by Address. Accessed online https://msc.fema.gov/portal/search?AddressQuery=roberts%20county%20texas#searchresultsanchor March 26, 2019.

[193] TCEQ. 2019. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed March 26, 2019.

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 publically-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 March 26, 2019, the least tern and Arkansas River shiner are federally-listed species that could potentially be in the project area; however, there are no critical habitats for these or any other species within the project area. 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 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 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.).

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.

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.

5.20 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 expense 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 woud be implemented in two phases with 8 active and 2 contigency 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.

5.20.1 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).

5.20.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-20.

Table 5-20. Seminole Groundwater Development Costs (September 2018 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

5.20.3 Implementation Issues

Environmental Issues

The proposed project occurs within the High Plains physiographic region of Texas and is within the Kansan biotic province[194]. The project components are within an area defined as crops vegetation type[195]. Crops include a variety of cultivated row or cover crops. EMST data and TPWD's more detailed and recently produced vegetation data[196], identify several primarily row crops and shortgrass prairie within the proposed well field area. Vegetation impacts would include clearing areas for construction of new wells and pipelines.

FEMA has not mapped the project area for 100-year floodplains[197]. 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. An NWP 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 12 for utility line activities. TCEQ's Surface Water Quality Viewer[198] identifies 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 north east 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 publically-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.

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

[195] 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.

[196] TPWD. 2019. Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

[197] 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.

[198] TCEQ. 2020. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed February 3, 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 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 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.

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.).

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.

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.

5.21 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 6,000 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 5.25 shows the relative well field location.

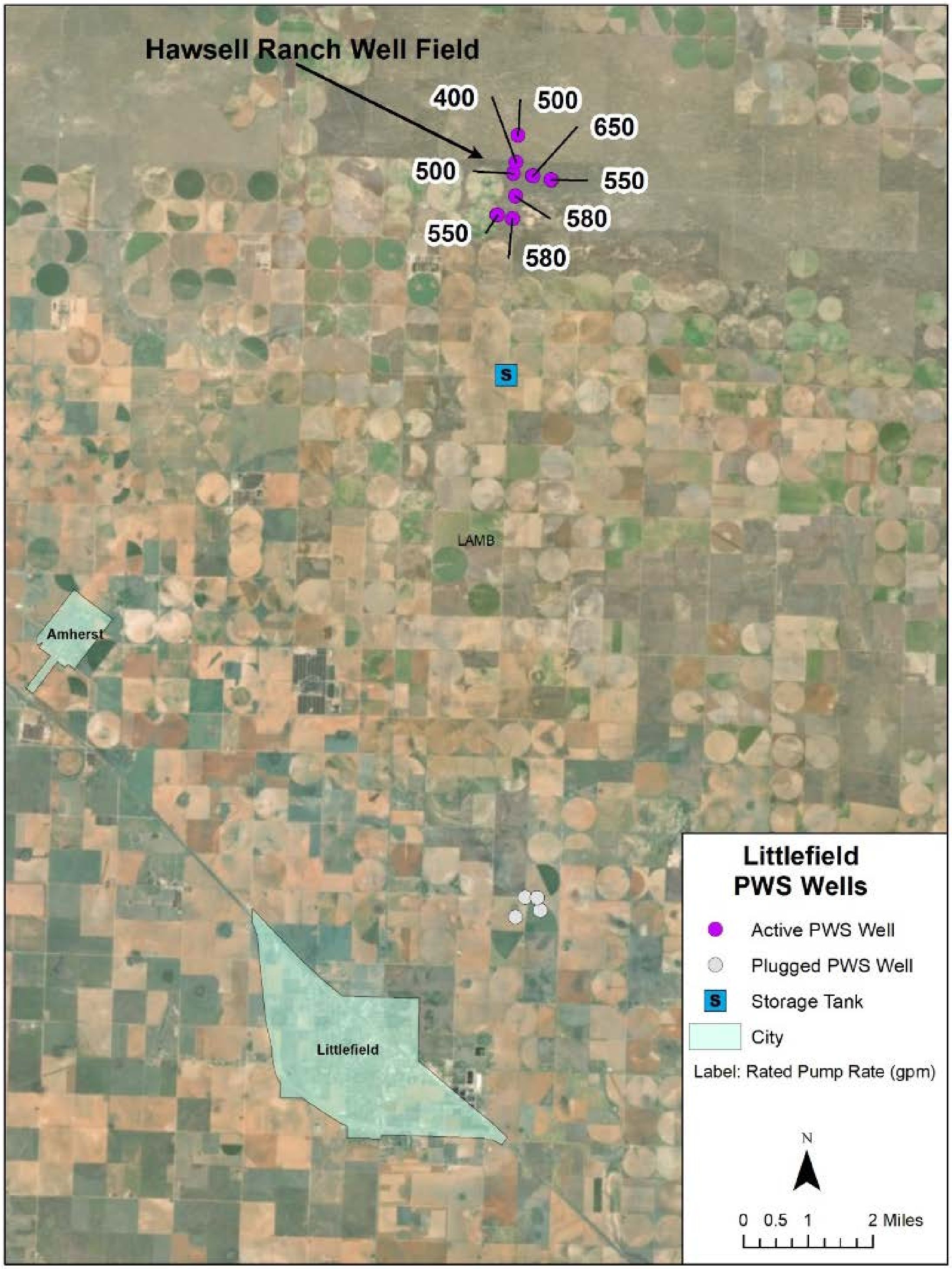

Figure 5.26. Location of Hawsell Ranch Well Field

5.21.1 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.

5.21.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-21. 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 $0.08 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 $902,000. Annual debt service is $63,000, and annual operational cost, including power is $16,000. The unit cost for 240 ac-ft/yr supply is estimated to be $329 per ac-ft or $1.01 per 1,000 gallons. This cost does not include the cost of water treatment prior to storage.

Table 5-21. City of Littlefield Additional Well Cost (September 2018 Dollars)*

Item	*Estimated Costs for Facilities*
Public Supply Well (Well, Pumps, and Piping)	$628,000
TOTAL COST OF FACILITIES	**$628,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$220,000
Environmental & Archaeology Studies and Mitigation	$29,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$25,000
TOTAL COST OF PROJECT	**$902,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$63,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$6,000
Pumping Energy Costs (0.08 $/kW-hr)	$10,000
TOTAL ANNUAL COST	**$79,000**
Available Project Yield (ac-ft/yr)	240
Annual Cost of Water ($ per ac-ft), based on PF=1.5	$329
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.5	$67
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$1.01
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.20

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.21.3 Implementation Issues

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 consideratons for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

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.

5.22 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 5.27 shows the relative well field location.

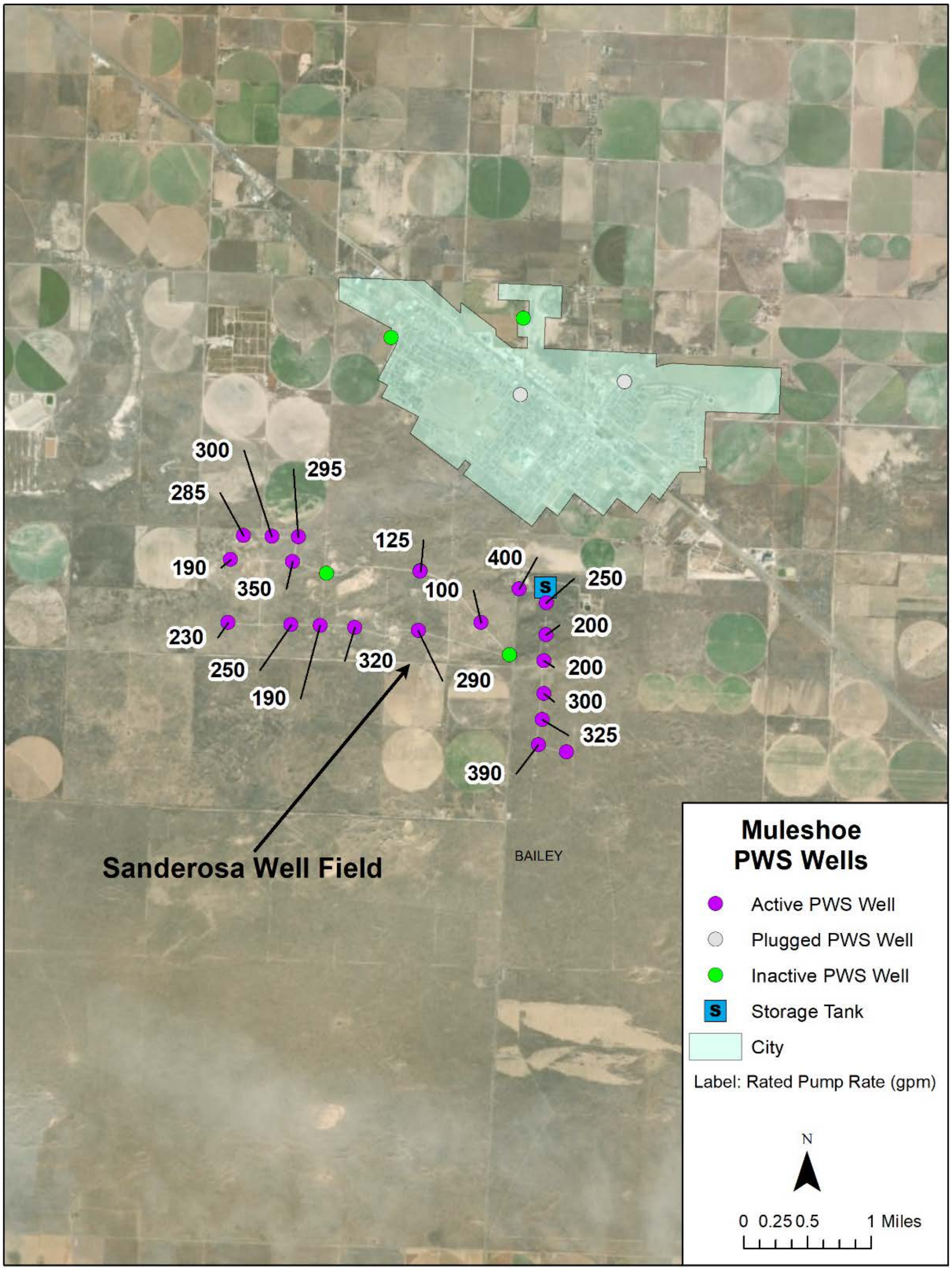

Figure 5.27. Location of Sanderosa Well Field

5.22.1 Quantity of Available Water

The strategy is intended to keep pace with the growing demand and peak need of the city. The city plans to submit another well application in 2021. The strategy is designed to add a new well that will add 240 acre-ft per year into the system.

5.22.2 Strategy Costs

Costs associated with this strategy are presented in Table 5-22. 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 $0.08 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 $631,000. Annual debt service is $44,000, and annual operational cost, including power, is $6,000. The unit cost for 240 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 5-22. City of Muleshoe Additional Well Cost (September 2018 Dollars)

Item	*Estimated Costs for Facilities*
Public Supply Well (Well, Pumps, and Piping)	$455,000
TOTAL COST OF FACILITIES	**$455,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$159,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$17,000
TOTAL COST OF PROJECT	**$631,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$44,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$5,000
Pumping Energy Costs (0.08 $/kW-hr)	$1,000
TOTAL ANNUAL COST	**$50,000**
Available Project Yield (ac-ft/yr)	240
Annual Cost of Water ($ per ac-ft), based on PF=1.2	$208
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.2	$25
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.2	$0.64
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.2	$0.08

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.22.3 Implementation Issues

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 consideratons for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

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.

5.23 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 six new wells, five active and one 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 between 100 to 150 gpm (0.14 to 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 10 inches in diameter and will be 6,000 feet in length. The pumped water will be transported via a new 5.5-mile transmission pipeline, 10 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 3 mgd is expected to start in 2020. At 3 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 100 gpm (0.14 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 six new wells, five active and one contingent, drilled to approximately 300 feet and screened in the Edwards-Trinity Aquifer.
- Locate wells on city-owned property.
- Plumb the wells with six 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 3 mgd to handle the additional produced water.
- Install new primary pump station capable of pumping 1.1 mgd of raw water to the city's treatment plant.
- Install new 10-inch transmission pipeline spanning 5.5 miles from the well field to the city treatment plant.

Figure 5.28 shows the relative location of the well field.

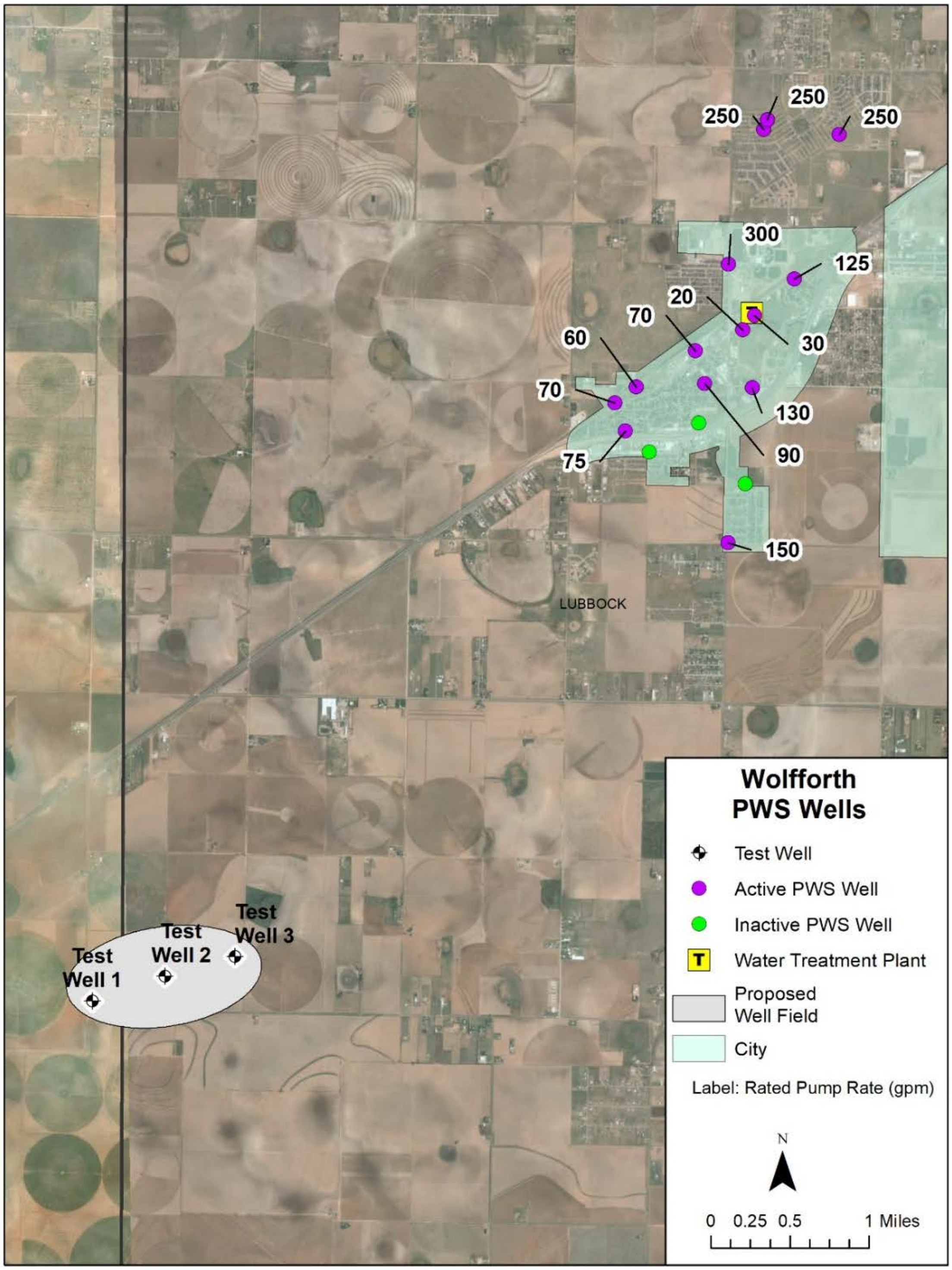

Figure 5.28. Location of Wolfforth Proposed Well Field

5.23.1 Quantity of Available Water

This strategy is designed with a primary pump station capable of pumping 1.1 mgd from the well field to the city. The well field is expected to produce an average of 800 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.

5.23.2 Strategy Costs

A cost summary is provided in Table 5-23. Assumptions and conditions associated with these costs include the following.

- Engineering, legal, and contingency costs are 30 percent for the transmission pipeline and 35 percent for facilities required by this strategy.
- Power is available at $0.08 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 $13,961,000. Annual debt service is $982,000 and annual operational cost, including power is $635,000. The unit cost for 800 ac-ft/yr supply is estimated to be $2,021 per ac-ft or $6.20 per 1,000 gallons. This cost does not include the cost of water treatment prior to storage.

Table 5-23. City of Wolfforth Additional Well Field Cost (September 2018 Dollars)

Item	*Estimated Costs for Facilities*
Primary Pump Station (1.1 MGD)	$974,000
Transmission Pipeline (10-in dia., 5.5 miles)	$1,889,000
Well Field (Wells, Pumps, and Piping)	$2,005,000
Water Treatment Plant Expansion (1.5 MGD)	$5,100,000
TOTAL COST OF FACILITIES	**$9,968,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,395,000
Environmental & Archaeology Studies and Mitigation	$201,000
Land Acquisition and Surveying (38 acres)	$23,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$374,000
TOTAL COST OF PROJECT	**$13,961,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$982,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$39,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$24,000
Water Treatment Plant	$534,000
Pumping Energy Costs (0.08 $/kW-hr)	$38,000
TOTAL ANNUAL COST	**$1,617,000**
Available Project Yield (ac-ft/yr)	800
Annual Cost of Water ($ per ac-ft), based on PF=1.5	$2,021
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.5	$794
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$6.20
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$2.44

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.23.3 Implementation Issues

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 consideratons for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

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.

5.24 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 well 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 5.29 shows the relative location of the well field.

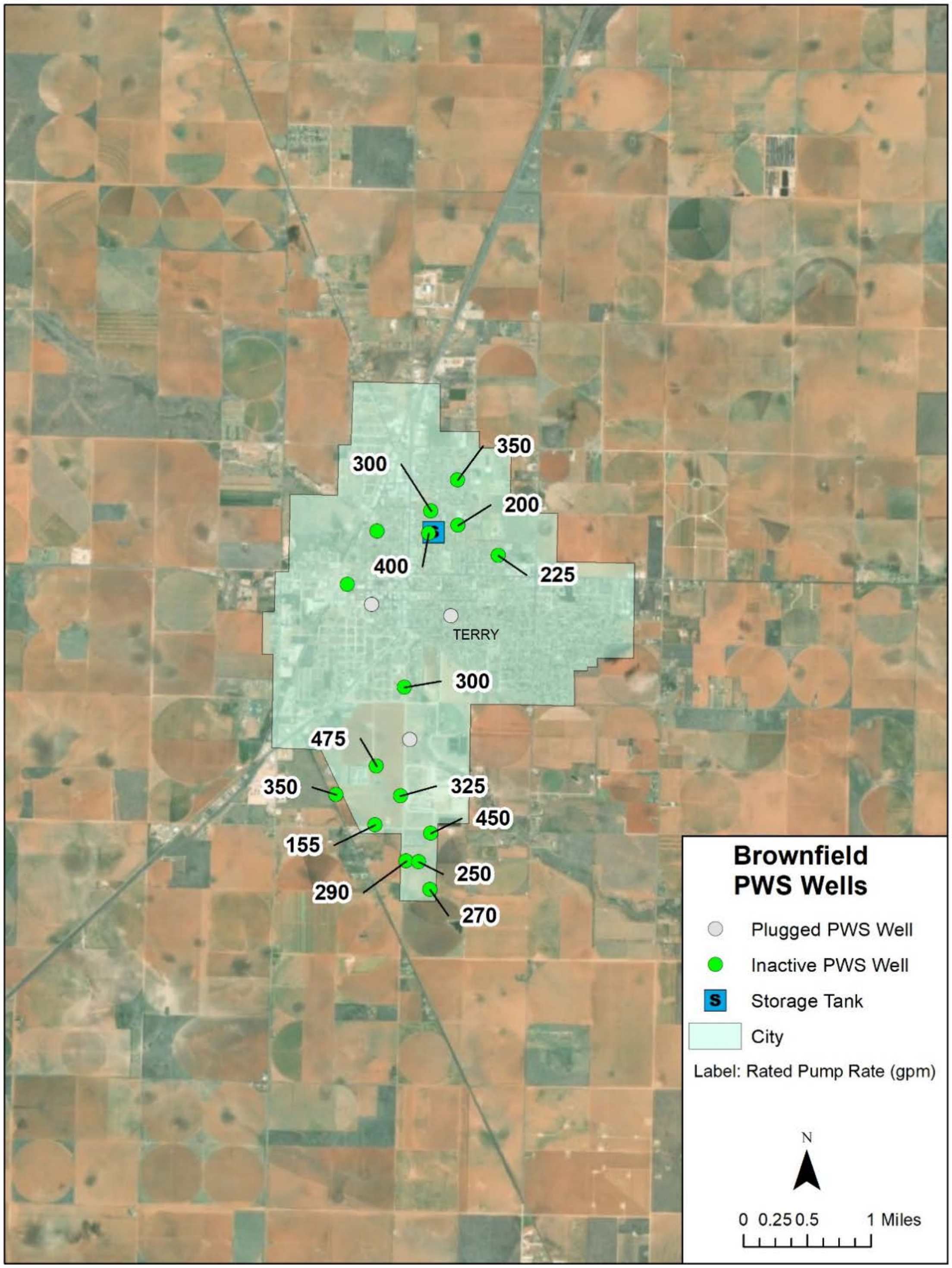

Figure 5.29. City of Brownfield Public Water Supply Wells

5.24.1 Quantity of Available Water

The City of Brownfield is expected to have a water deficit starting in the year 2050 of 49 ac-ft per year. By 2070, the deficit is expected to increase to 291 ac-ft per year. The strategy is designed to add a new well that will add 160 ac-ft per year into the system. The remaining deficit of 131 ac-ft per year will be covered by water purchased from CRMWA.

5.24.2 Strategy Costs

A cost summary is provided in Table 5-24. 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 $0.08 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 $633,000. Annual debt service is $44,000, and annual operational cost, including power is $9,000. The unit cost for 160 ac-ft/yr supply is estimated to be $331 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 Brownfield Additional Well Cost (September 2018 Dollars)

Item	Estimated Costs for Facilities
Public Supply Well (Well, Pumps, and Piping)	$446,000
TOTAL COST OF FACILITIES	**$446,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$156,000
Environmental & Archaeology Studies and Mitigation	$12,000
Land Acquisition and Surveying (2 acres)	$2,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$17,000
TOTAL COST OF PROJECT	**$633,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$44,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$4,000
Pumping Energy Costs (0.08 $/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	$331
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.5	$56
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$1.02
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.17

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.24.3 Implementation Issues

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 consideratons for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

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.

5.25 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 5.30 shows the relative location of the well field.

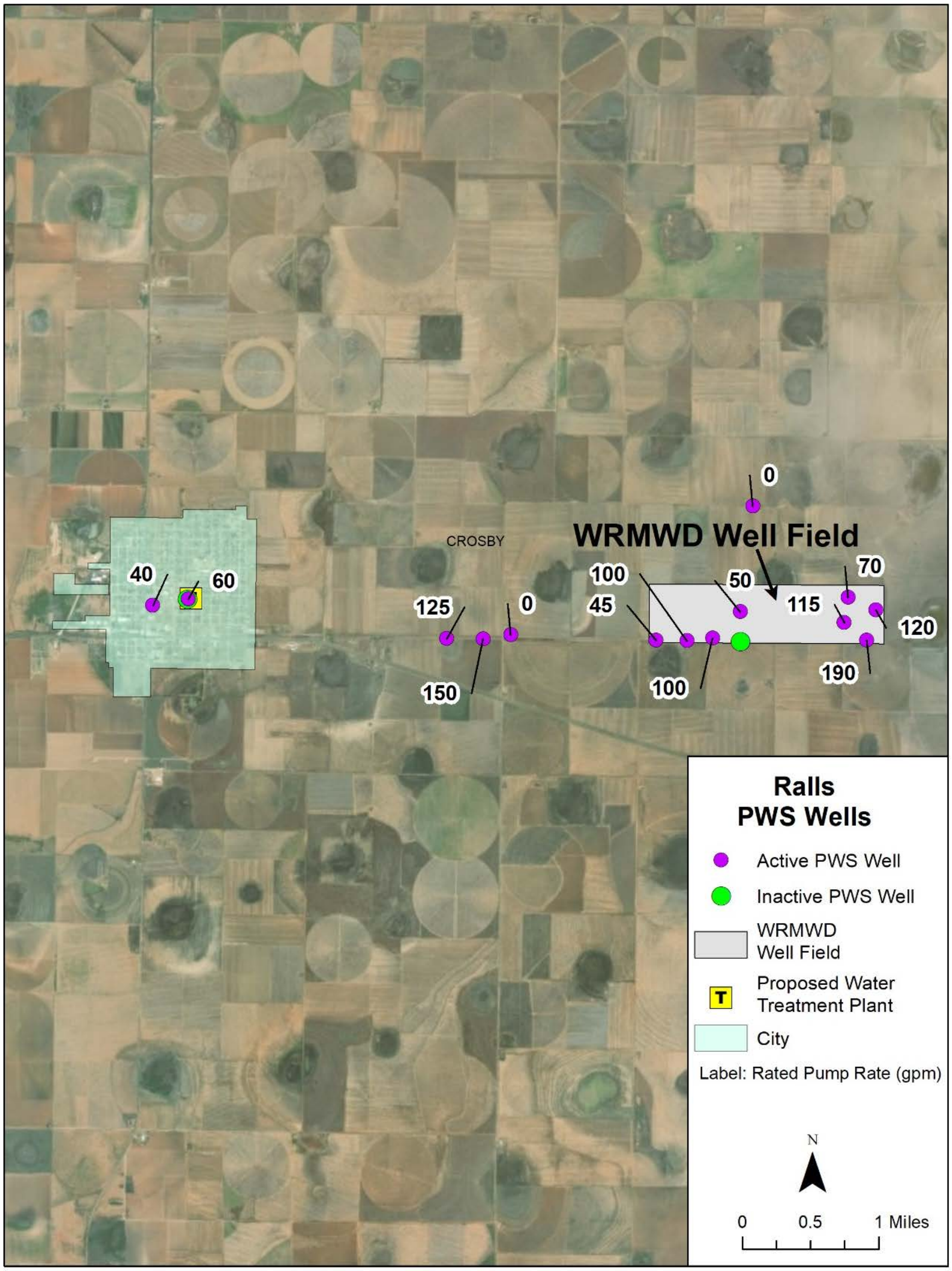

Figure 5.30. Location of WRMWD Well Field

5.25.1 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.

5.25.2 Strategy Costs

A cost summary is provided in Table 5-25. 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 $0.08 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 5-25. City of Ralls Additional Well Cost (September 2018 Prices)

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

Table 5-25. City of Ralls Additional Well Cost (September 2018 Prices)

Item	Estimated Costs for Facilities
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

5.25.3 Implementation Issues

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 consideratons for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

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.

5.26 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; and,
- 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 5.31 shows the location of the City of New Deal's existing well field and the location of the new well.

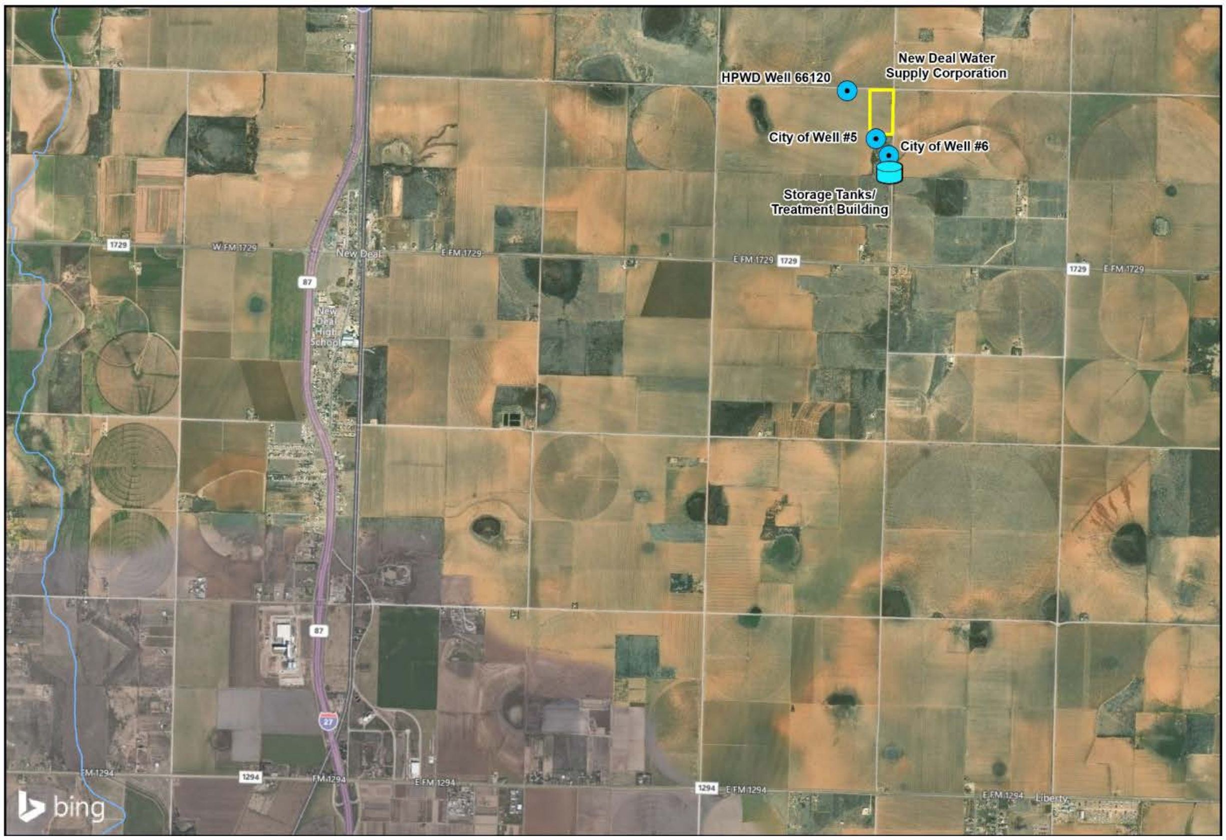

Figure 5.31. Location Map of City of New Deal New Well

5.26.1 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.

5.26.2 Strategy Costs

A cost summary is provided in Table 5-26. 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 $0.08 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 $398,000. Annual debt service is $28,000, and annual operational cost, including power, is $12,000. The unit cost for 242 ac-ft/yr supply is estimated to be $165 per ac-ft or $0.51 per 1,000 gallons.

Table 5-26. City of New Deal Additional Well Cost (September 2018 Dollars)

Item	Estimated Costs for Facilities
Public Supply Well (1 Wells, Pumps, and Piping)	$283,000
TOTAL COST OF FACILITIES	**$283,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$99,000
Environmental & Archaeology Studies and Mitigation	$5,000
Land Acquisition and Surveying (0 acres)	$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	$11,000
TOTAL COST OF PROJECT	**$398,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$28,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,000
Pumping Energy Costs (0.08 $/kW-hr)	$9,000
TOTAL ANNUAL COST	**$40,000**
Available Project Yield (ac-ft/yr)	242
Annual Cost of Water ($ per ac-ft), based on PF=1	$165
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$50
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.51
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.15

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.26.3 Implementation Issues

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 consideratons for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

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 TCEQ. The city would need to coordinate with WRMWD on the placement of the new wells.

5.27 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; and
- 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 5.32 shows the location of the City of Lockney's existing well field and the location of the potential well field.

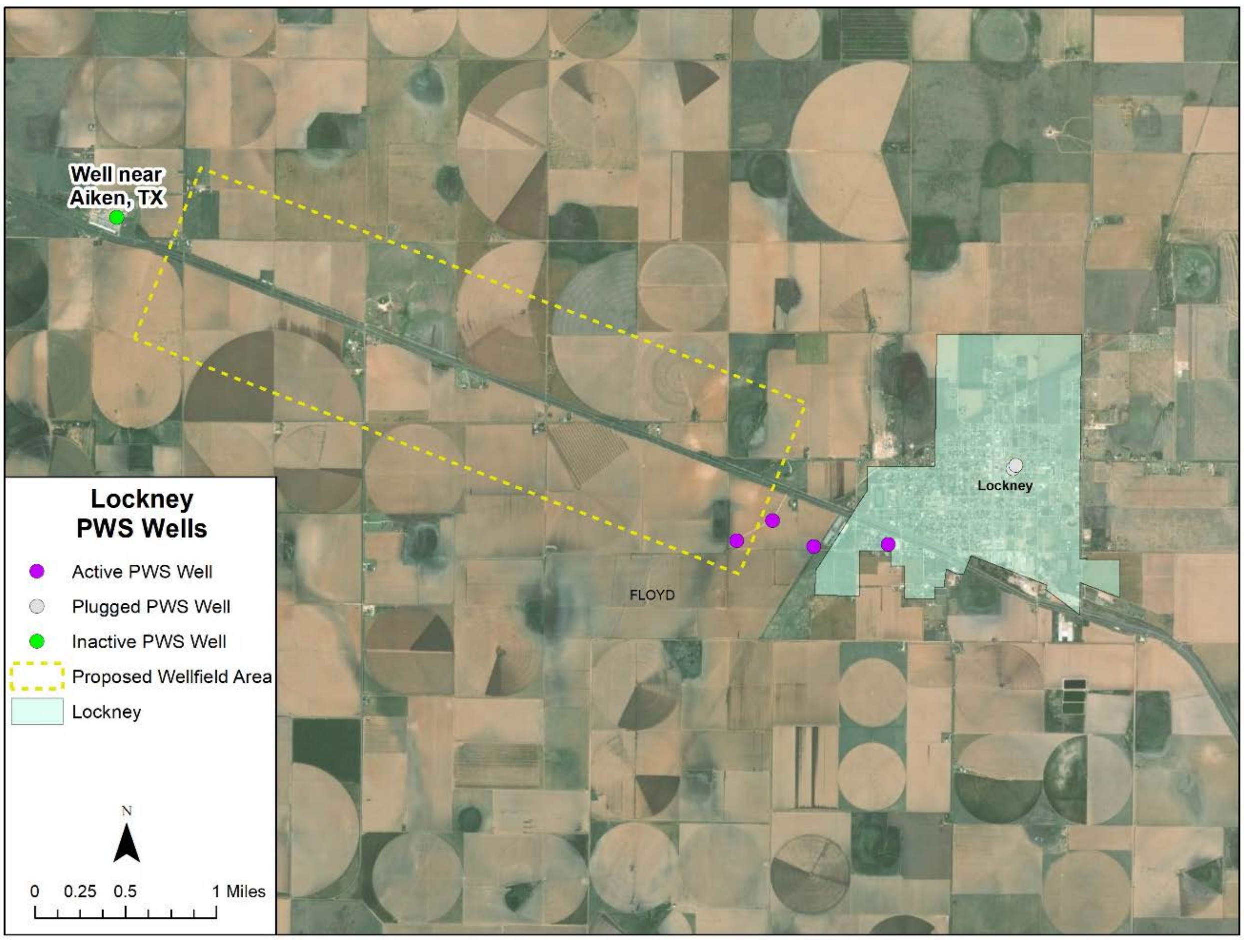

Figure 5.32. Location Map of City of Lockney Proposed Wellfield

5.27.1 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.

5.27.2 Strategy Costs

A cost summary is provided in Table 5-27. 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 $0.08 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 $1,750,000. Annual debt service is $123,000, and annual operating cost, including power, is $24,000. The unit cost for 320 ac-ft/yr of supply is estimated to be $459 per ac-ft or $1.41 per 1,000 gallons.

Table 5-27. City of Lockney Additional Well Cost (September 2018 Dollars)

Item	*Estimated Costs for Facilities*
Public Supply Well (4 Wells, Pumps, and Piping)	$1,181,000
TOTAL COST OF FACILITIES	**$1,181,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$414,000
Environmental & Archaeology Studies and Mitigation	$86,000
Land Acquisition and Surveying (18 acres)	$22,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$47,000
TOTAL COST OF PROJECT	**$1,750,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$123,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$12,000
Pumping Energy Costs (0.08 $/kW-hr)	$12,000
TOTAL ANNUAL COST	**$147,000**
Available Project Yield (ac-ft/yr)	320

Table 5-27. City of Lockney Additional Well Cost (September 2018 Dollars)

Item	Estimated Costs for Facilities
Annual Cost of Water ($ per ac-ft), based on PF=1.2	$459
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.2	$75
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.2	$1.41
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.2	$0.23
Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor	

5.27.3 Implementation Issues

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 consideratons for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

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 TCEQ.

5.28 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.

5.28.1 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.

5.28.2 Strategy Costs

A cost summary is provided in Table 5-28. 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 $0.08 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 5-28. Gaines County Other Additional Well Cost (September 2018 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

Table 5-28. Gaines County Other Additional Well Cost (September 2018 Dollars)

Item	Estimated Costs for Facilities
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

5.28.3 Implementation Issues

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 consideratons for this strategy are summarized in Appendix E: Water Management Strategy Evaluation - Agricultural Resources and Environmental Factors.

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.

5.29 Regional Manufacturing Groundwater

Four counties in the Llano Estacado Region have projected manufacturing water needs: Deaf Smith, Gaines, Hale, and Lubbock. Within the four counties, the manufacturing water demands are projected to be 5,454 ac-ft/yr in 2020 and are projected to increase to 6,482 ac-ft/yr in 2070.

The strategy would add additional water wells in each of the four counties to meet the projected needs on a county-by-county basis. The wells are expected to be within 3.5 miles of a municipality. 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 maximum projected needs. The well specifications such as yield, depth, and elevation are estimated based on existing wells within the area of interest in each county. The wells are expected to have an average production rate between 100 to 250 gpm (0.14 to 0.36 mgd). The gathering line for each well will range from 6 to 8 inches in diameter and be 1,000 feet in length. The gathering lines will be plumbed into the main trunkline that ranges from 6 to 18 inches in diameter. Differences in elevation were not considered during the design of the well fields.

Major assumptions include the following.

- The Ogallala production wells are expected to range from about 100 to 250 gpm (0.14 to 0.36 mgd).
- All production wells would produce from the Ogallala Aquifer.
- All production wells would be within 3.5 miles of a municipality.
- Wells are priced as if they were public water supply wells.
- A peaking factor of 1.1 to 1.5 is applied to pipe sizing based on the range of yields in the county's area of interest.
- For each county, approximately 15 percent of the added wells are considered contingency wells. At least one contingency well was added in each county.

Major design features include the following.

- 1,000-foot segments of 6-inch raw water collection pipeline.
- 2,000-foot segments of 6 to 18-inch raw water main pipeline.

5.29.1 Strategy Costs

A cost summary for Deaf Smith County is provided in Table 5-29. A cost summary for Gaines County is provided in Table 5-30. A cost summary for Hale County is provided in Table 5-31. A cost summary for Lubbock County is provided in Table 5-32. 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 $0.08 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.

Table 5-29. Deaf Smith County Manufacturing Additional Well Cost (September 2018 Prices)*

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$2,275,000
TOTAL COST OF FACILITIES	$2,275,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$796,000
Environmental & Archaeology Studies and Mitigation	$53,000
Land Acquisition and Surveying (9 acres)	$11,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$87,000
TOTAL COST OF PROJECT	$3,222,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$227,000
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$23,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (416087 kW-hr @ 0.08 $/kW-hr)	$33,000
Purchase of Water (ac-ft/yr @ $/ac-ft)	$0
TOTAL ANNUAL COST	$283,000
Available Project Yield (ac-ft/yr)	1,250
Annual Cost of Water ($ per ac-ft), based on PF=1.25	$226
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.25	$45
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.25	$0.69
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.25	$0.14

*Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018
Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

Table 5-30. Gaines County Manufacturing Additional Well Cost (September 2018 Prices)*

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$2,152,000
TOTAL COST OF FACILITIES	$2,152,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$753,000
Environmental & Archaeology Studies and Mitigation	$67,000
Land Acquisition and Surveying (11 acres)	$11,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$83,000
TOTAL COST OF PROJECT	$3,066,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$216,000
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$22,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (490932 kW-hr @ 0.08 $/kW-hr)	$39,000
Purchase of Water (ac-ft/yr @ $/ac-ft)	$0
TOTAL ANNUAL COST	$277,000
Available Project Yield (ac-ft/yr)	1,200
Annual Cost of Water ($ per ac-ft), based on PF=1.33	$231
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.33	$51
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.33	$0.71
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.33	$0.16

*Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018
Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

Table 5-31. Hale County Manufacturing Additional Well Cost (September 2018 Prices)*

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$6,316,000
TOTAL COST OF FACILITIES	$6,316,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,211,000
Environmental & Archaeology Studies and Mitigation	$138,000
Land Acquisition and Surveying (23 acres)	$27,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$240,000
TOTAL COST OF PROJECT	$8,932,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$628,000
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$63,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (1727673 kW-hr @ 0.08 $/kW-hr)	$138,000
Purchase of Water (ac-ft/yr @ $/ac-ft)	$0
TOTAL ANNUAL COST	$829,000
Available Project Yield (ac-ft/yr)	4,000
Annual Cost of Water ($ per ac-ft), based on PF=1.2	$207
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.2	$50
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.2	$0.64
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.2	$0.15

*Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018
Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

Table 5-32. Lubbock County Manufacturing Additional Well Cost (September 2018 Prices)*

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$1,915,000
TOTAL COST OF FACILITIES	$1,915,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$670,000
Environmental & Archaeology Studies and Mitigation	$69,000
Land Acquisition and Surveying (11 acres)	$14,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$74,000
TOTAL COST OF PROJECT	$2,742,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$193,000
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$19,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (259223 kW-hr @ 0.08 $/kW-hr)	$21,000
Purchase of Water (ac-ft/yr @ $/ac-ft)	$0
TOTAL ANNUAL COST	$233,000
Available Project Yield (ac-ft/yr)	800
Annual Cost of Water ($ per ac-ft), based on PF=1.5	$291
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.5	$50
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$0.89
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.15

*Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018
Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.30 Regional Mining Groundwater

Eight counties in the Llano Estacado Region have projected mining water needs: Crosby, Dawson, Hale, Lamb, Lubbock, Lynn, Terry, and Yoakum. Within these counties, the mining water demands are projected to be 10,118 ac-ft/yr in 2020 and are projected to decrease to 5,893 ac-ft/yr in 2070.

The strategy would add water wells in each of the eight counties to meet the projected mining needs on a county by county basis. 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 each county. The wells are expected to have an average production rate between 100 to 300 gpm (0.14 to 0.43 mgd). The gathering line for each well will range from 6 to 8 inches in diameter and be 1,000 feet in length.

Major assumptions include the following.

- The Ogallala production wells are expected to range from about 100 to 250 gpm (0.14 to 0.36 mgd).
- All production wells would produce from the Ogallala Aquifer.
- Wells are priced as if they were irrigation wells.
- A peaking factor of 1.1 to 1.5 is applied for pipe sizing based on the range of yields in the county's area of interest.
- For each county approximately 15 percent of the added wells are considered contingency wells. At least one contingency well was added in each county.

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 18-inch raw water main pipeline.

5.30.1 Strategy Costs

A cost summary for Crosby County is provided in Table 5-33. A cost summary for Dawson County is provided in Table 5-34. A cost summary for Hale County is provided in Table 5-35. A cost summary for Lamb County is provided in Table 5-36. A cost summary for Lubbock County is provided in Table 5-37. A cost summary for Lynn County is provided in Table 5-38. A cost summary for Terry County is provided in Table 5-39. A cost summary for Yoakum County is provided in Table 5-40. 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 $0.08 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.

Table 5-33. Crosby County Mining Additional Well Cost (September 2018 Dollars)

Item	Estimated Costs for Facilities
Mining Supply Wells (4 Wells, Pumps, and Piping)	$895,000
TOTAL COST OF FACILITIES	**$895,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$313,000
Environmental & Archaeology Studies and Mitigation	$46,000
Land Acquisition and Surveying (8 acres)	$9,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$35,000
TOTAL COST OF PROJECT	**$1,298,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$91,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$9,000
Pumping Energy Costs (0.08 $/kW-hr)	$17,000
TOTAL ANNUAL COST	**$117,000**
Available Project Yield (ac-ft/yr)	480
Annual Cost of Water ($ per ac-ft), based on PF=1.5	$244
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.5	$54
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$0.75
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.17

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

Table 5-34. Dawson County Mining Additional Well Cost (September 2018 Prices)*

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$1,364,000
TOTAL COST OF FACILITIES	$1,364,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$477,000
Environmental & Archaeology Studies and Mitigation	$69,000
Land Acquisition and Surveying (11 acres)	$13,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$53,000
TOTAL COST OF PROJECT	$1,976,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$139,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$14,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (500954 kW-hr @ 0.08 $/kW-hr)	$40,000
Purchase of Water (ac-ft/yr @ $/ac-ft)	$0
TOTAL ANNUAL COST	$193,000
Available Project Yield (ac-ft/yr)	1,600
Annual Cost of Water ($ per ac-ft), based on PF=1.25	$121
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.25	$34
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.25	$0.37
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.25	$0.10

*Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018
Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

Table 5-35. Hale County Mining Additional Well Cost (September 2018 Prices)*

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$1,100,000
TOTAL COST OF FACILITIES	$1,100,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$385,000
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)	$42,000
TOTAL COST OF PROJECT	$1,562,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$110,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$11,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (489287 kW-hr @ 0.08 $/kW-hr)	$39,000
Purchase of Water (ac-ft/yr @ $/ac-ft)	$0
TOTAL ANNUAL COST	$160,000
Available Project Yield (ac-ft/yr)	965
Annual Cost of Water ($ per ac-ft), based on PF=1	$166
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$52
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.51
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.16

*Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018
Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

Table 5-36. Lamb County Mining Additional Well Cost (September 2018 Prices)*

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$715,000
TOTAL COST OF FACILITIES	$715,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$250,000
Environmental & Archaeology Studies and Mitigation	$22,000
Land Acquisition and Surveying (4 acres)	$4,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$28,000
TOTAL COST OF PROJECT	$1,019,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$72,000
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)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (226062 kW-hr @ 0.08 $/kW-hr)	$18,000
Purchase of Water (ac-ft/yr @ $/ac-ft)	$0
TOTAL ANNUAL COST	$97,000
Available Project Yield (ac-ft/yr)	480
Annual Cost of Water ($ per ac-ft), based on PF=1	$202
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$52
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.62
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.16

*Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018
Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

Table 5-37. Lubbock County Mining Additional Well Cost (September 2018 Prices)*

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$13,019,000
TOTAL COST OF FACILITIES	$13,019,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$4,557,000
Environmental & Archaeology Studies and Mitigation	$505,000
Land Acquisition and Surveying (81 acres)	$97,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$500,000
TOTAL COST OF PROJECT	$18,678,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,314,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$130,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (332442 kW-hr @ 0.08 $/kW-hr)	$27,000
Purchase of Water (ac-ft/yr @ $/ac-ft)	$0
TOTAL ANNUAL COST	$1,471,000
Available Project Yield (ac-ft/yr)	5,560
Annual Cost of Water ($ per ac-ft), based on PF=1.5	$265
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.5	$28
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$0.81
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.09

*Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018
Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

Table 5-38. Lynn County Mining Additional Well Cost (September 2018 Prices)

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$906,000
TOTAL COST OF FACILITIES	$906,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$317,000
Environmental & Archaeology Studies and Mitigation	$69,000
Land Acquisition and Surveying (11 acres)	$14,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$36,000
TOTAL COST OF PROJECT	$1,342,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$94,000
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$9,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (141936 kW-hr @ 0.08 $/kW-hr)	$11,000
Purchase of Water (ac-ft/yr @ $/ac-ft)	$0
TOTAL ANNUAL COST	$114,000
Available Project Yield (ac-ft/yr)	800
Annual Cost of Water ($ per ac-ft), based on PF=1	$143
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$25
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.44
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.08
J. Pinkard	*1/28/2020*

*Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018
Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

Table 5-39. Terry County Mining Additional Well Cost (September 2018 Prices)*

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$691,000
TOTAL COST OF FACILITIES	$691,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$242,000
Environmental & Archaeology Studies and Mitigation	$28,000
Land Acquisition and Surveying (5 acres)	$5,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$27,000
TOTAL COST OF PROJECT	$993,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$70,000
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)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (228203 kW-hr @ 0.08 $/kW-hr)	$18,000
Purchase of Water (ac-ft/yr @ $/ac-ft)	$0
TOTAL ANNUAL COST	$95,000
Available Project Yield (ac-ft/yr)	640
Annual Cost of Water ($ per ac-ft), based on PF=1	$148
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$39
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.46
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.12

*Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018
Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

Table 5-40. Yoakum County Mining Additional Well Cost (September 2018 Prices)

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$894,000
TOTAL COST OF FACILITIES	$894,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$313,000
Environmental & Archaeology Studies and Mitigation	$50,000
Land Acquisition and Surveying (9 acres)	$8,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$35,000
TOTAL COST OF PROJECT	$1,300,000
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
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (276010 kW-hr @ 0.08 $/kW-hr)	$22,000
Purchase of Water (ac-ft/yr @ $/ac-ft)	$0
TOTAL ANNUAL COST	$123,000
Available Project Yield (ac-ft/yr)	640
Annual Cost of Water ($ per ac-ft), based on PF=1	$192
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1	$48
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.59
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.15

*Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018
Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

C. Water Conservation

5.31 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 5-45) 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 with regard to 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.

5.32 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 5-41.

Table 5-41. 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 5-42. 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 5-42. 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

5.32.1 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 was projected for per capita water use in 2020, 2030, 2040, 2050, 2060, and 2070, and includes expected effects of low-flow plumbing fixtures upon per capita water use (Table 5-43). The 74 WUGs of the Llano Estacado Region are listed in Table 5-43, in order from low to high per capita water use, in year 2011. Year 2011 is the base year for per capita water use because it is representative of drought conditions for much of the state. The projected savings attributed to plumbing fixture requirements are shown in Table 5-42, and these savings are included in the per capita rates shown in Table 5-43.

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 2021 Llano Estacado Regional Water Plan (LERWP).

Table 5-43. Municipal Water User Groups Projected Per Capital Water Use (TWDB Projections)

No.	County	Water User	Year 2011 gpcd	Per Capita Goal with Conservation (gpcd)					
				2020	2030	2040	2050	2060	2070
1	LYNN	COUNTY-OTHER, LYNN	113	111	111	111	111	111	111
2	DEAF SMITH	COUNTY-OTHER, DEAF SMITH	116	114	114	114	114	114	114
3	CROSBY	COUNTY-OTHER, CROSBY	117	115	115	115	115	115	115
4	GAINES	COUNTY-OTHER, GAINES	117	115	115	115	115	115	115
5	LUBBOCK	SLATON	117	115	115	115	115	115	115
6	FLOYD	COUNTY-OTHER, FLOYD	118	116	116	116	116	116	116
7	HOCKLEY	COUNTY-OTHER, HOCKLEY	119	117	117	117	117	117	117
8	YOAKUM	COUNTY-OTHER, YOAKUM	119	117	117	117	117	117	117
9	DAWSON	COUNTY-OTHER, DAWSON	120	118	118	118	118	118	118
10	BAILEY	COUNTY-OTHER, BAILEY	121	119	119	119	119	119	119
11	HALE	HALE CENTER	121	119	119	119	119	119	119
12	TERRY	COUNTY-OTHER, TERRY	121	119	119	119	119	119	119
13	GARZA	COUNTY-OTHER, GARZA	123	121	121	121	121	121	121
14	LAMB	AMHERST	124	122	122	122	122	122	122
15	LUBBOCK	COUNTY-OTHER, LUBBOCK	125	123	123	123	123	123	123
16	LUBBOCK	NEW DEAL	125	123	123	123	123	123	123
17	GARZA	POST	126	124	124	124	124	124	124
18	HALE	COUNTY-OTHER, HALE	126	124	124	124	124	124	124
19	HOCKLEY	ANTON	126	124	124	124	124	124	124
20	SWISHER	COUNTY-OTHER, SWISHER	127	124	124	124	124	124	124
21	DICKENS	COUNTY-OTHER, DICKENS	130	127	127	127	127	127	127
22	FLOYD	LOCKNEY	132	129	129	129	129	129	129
23	DAWSON	ODONNELL	134	131	131	131	131	131	131
24	LYNN	ODONNELL	134	131	131	131	131	131	131
25	LAMB	COUNTY-OTHER, LAMB	140	137	137	137	137	137	137
26	CASTRO	COUNTY-OTHER, CASTRO	141	137	137	137	137	137	137
27	CASTRO	HART MUNICIPAL WATER SYSTEM	141	137	137	137	137	137	137
28	LAMB	LITTLEFIELD	142	137	137	137	137	137	137

Table 5-43. Municipal Water User Groups Projected Per Capital Water Use (TWDB Projections)

No.	County	Water User	Year 2011 gpcd	Per Capita Goal with Conservation (gpcd)					
				2020	2030	2040	2050	2060	2070
29	LUBBOCK	SHALLOWATER	143	137	137	137	137	137	137
30	CROSBY	RALLS	144	138	138	138	138	138	138
31	SWISHER	HAPPY	145	138	138	138	138	138	138
32	CROSBY	CROSBYTON	150	139	139	139	139	139	139
33	TERRY	BROWNFIELD	153	140	140	140	140	140	140
34	GAINES	SEAGRAVES	157	144	140	140	140	140	140
35	HOCKLEY	LEVELLAND	157	144	140	140	140	140	140
36	LUBBOCK	WOLFFORTH	158	145	139	139	139	139	139
37	LYNN	TAHOKA PUBLIC WATER SYSTEM	160	147	140	140	140	140	140
38	BRISCOE	SILVERTON	161	148	141	140	140	140	140
39	DICKENS	SPUR	165	151	144	140	140	140	140
40	LAMB	EARTH	165	151	144	140	140	140	140
41	FLOYD	FLOYDADA	168	154	147	140	140	140	140
42	SWISHER	TULIA	168	154	147	140	140	140	140
43	LUBBOCK	IDALOU	169	155	148	140	140	140	140
44	LUBBOCK	LUBBOCK	169	155	148	140	140	140	140
45	MOTLEY	COUNTY-OTHER, MOTLEY	170	156	148	141	140	140	140
46	PARMER	BOVINA	170	156	148	141	140	140	140
47	PARMER	FRIONA	171	157	149	142	140	140	140
48	CROSBY	LORENZO	174	160	152	145	140	140	140
49	HALE	PLAINVIEW	176	162	154	146	140	140	140
50	PARMER	COUNTY-OTHER, PARMER	184	169	161	153	145	140	140
51	BAILEY	MULESHOE	191	175	167	159	151	144	140
52	LAMB	OLTON	194	178	169	161	153	146	139
53	COCHRAN	MORTON PUBLIC WATER SYSTEM (PWS)	207	190	181	172	164	156	148
54	DEAF SMITH	HEREFORD	211	194	184	175	167	159	151
55	CASTRO	DIMMITT	212	195	185	176	167	159	151
56	DAWSON	LAMESA	215	197	188	179	170	162	154

Table 5-43. Municipal Water User Groups Projected Per Capital Water Use (TWDB Projections)

No.	County	Water User	Year 2011 gpcd	Per Capita Goal with Conservation (gpcd)					
				2020	2030	2040	2050	2060	2070
57	COCHRAN	WHITEFACE	221	203	193	184	175	166	158
58	HALE	ABERNATHY	221	203	193	184	175	166	158
59	LUBBOCK	ABERNATHY	221	203	193	184	175	166	158
60	LAMB	SUDAN	224	206	196	186	177	168	160
61	DICKENS	RED RIVER AUTHORITY OF TEXAS	229	210	200	190	181	172	164
62	MOTLEY	RED RIVER AUTHORITY OF TEXAS	229	210	200	190	181	172	164
63	BRISCOE	QUITAQUE	234	215	204	194	185	176	167
64	HALE	PETERSBURG MUNICIPAL WATER SYSTEM	239	219	209	199	189	180	171
65	YOAKUM	PLAINS	240	220	210	199	190	180	172
66	PARMER	FARWELL	243	223	212	202	192	183	174
67	HOCKLEY	SUNDOWN	253	232	221	210	200	190	181
68	YOAKUM	DENVER CITY	261	240	228	217	206	196	187
69	LUBBOCK	RANSOM CANYON	265	243	231	220	209	199	189
70	BRISCOE	COUNTY-OTHER, BRISCOE	294	270	257	244	232	221	210
71	GAINES	SEMINOLE	305	280	266	253	241	229	218
72	MOTLEY	MATADOR	321	295	280	267	254	241	229
73	COCHRAN	COUNTY-OTHER, COCHRAN	344	316	300	286	272	258	246
74	CASTRO	NAZARETH	350	321	306	291	276	263	250

gpcd = gallons per capita per day

The 2021 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 4.1 percent of water demands and approximately 2.5 percent of water needs in 2070.

Of the 74 WUGs in the Llano Estacado Region, 25 had per capita water use rates in year 2011 equal to or higher than 140 gpcd. The LERWP recommends a 0.5 percent reduction per year in water use for those WUGs with per capita use greater than 140 gpcd until a gpcd of 140 is reached. 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 5-44). Many WUGs have also set 5- and 10-year water conservation goals as part of their ongoing water conservation planning program (Table 5-45). 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

TWDB water demand and per capita projections already include water savings through mandated plumbing fixture replacement programs. 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 5-44. 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 Seagraves	City of Wilson	Valley WSC	White River MWD
1. Conservation coordinator				X		X	X	
2. Cost effective analysis				X				
3. Water survey for single-family and multi-family customers				X				
4. Wholesale agency assistance programs				X				
5. Water conservation pricing				X	X			
6. Metering of all new connections and retrofit of existing connections	X		X	X	X	X	X	X
7. System water audit and water loss control	X	X	X					X
8. Landscape irrigation conservation and incentives					X			
9. Athletic field conservation				X				
10. Golf course conservation				X				
11. Park conservation		X		X	X			
12. Residential landscape irrigation evaluation				X				
13. School education		X		X				
14. Public information	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						

Table 5-44. 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 Seagraves	City of Wilson	Valley WSC	White River MWD
19. New construction gray water				X				
20. Prohibitions on wasting water				X	X			

MWD = municipal water district; WSC = water supply corporation

Table 5-45. 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	132	Will be accomplished with conservation programs	128	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
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

gpcd = gallons per capita per day

5.32.2 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 2018 Water Loss Survey are included in and Table 5-49.

5.32.3 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 5-46 lists municipal WUGs' projected needs (shortages) and additional water saved after conservation.

Table 5-46. Estimated Water Savings for WUGs with Recommended Conservation

County Name	Water User Group	Projected Water Needs						Additional Water Saved With Conservation (ac-ft/yr)					
		2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
LYNN	COUNTY-OTHER, LYNN	-	-	-	-	-	-	-	-	-	-	-	-
DEAF SMITH	COUNTY-OTHER, DEAF SMITH	-	-	-	-	-	-	-	-	-	-	-	-
CROSBY	COUNTY-OTHER, CROSBY	-	-	-	-	-	-	-	-	-	-	-	-
GAINES	COUNTY-OTHER, GAINES	-	10	452	938	1,398	1,880	-	-	-	-	-	-
LUBBOCK	SLATON	-	-	-	-	-	-	-	-	-	-	-	-
FLOYD	COUNTY-OTHER, FLOYD	-	-	-	-	-	-	-	-	-	-	-	-
HOCKLEY	COUNTY-OTHER, HOCKLEY	-	-	-	-	-	-	-	-	-	-	-	-
YOAKUM	COUNTY-OTHER, YOAKUM	-	-	-	-	-	-	-	-	-	-	-	-
DAWSON	COUNTY-OTHER, DAWSON	-	-	-	-	-	-	-	-	-	-	-	-
BAILEY	COUNTY-OTHER, BAILEY	-	-	-	-	-	-	-	-	-	-	-	-
HALE	HALE CENTER	-	-	-	-	-	-	-	-	-	-	-	-
TERRY	COUNTY-OTHER, TERRY	-	-	-	-	-	-	-	-	-	-	-	-
GARZA	COUNTY-OTHER, GARZA	-	-	-	-	-	-	-	-	-	-	-	-
LAMB	AMHERST	-	-	-	-	-	-	-	-	-	-	-	-
LUBBOCK	COUNTY-OTHER, LUBBOCK	-	-	-	-	-	-	-	-	-	-	-	-
LUBBOCK	NEW DEAL	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-46. Estimated Water Savings for WUGs with Recommended Conservation

County Name	Water User Group	Projected Water Needs						Additional Water Saved With Conservation (ac-ft/yr)					
		2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
GARZA	POST	-	-	-	-	-	-	-	-	-	-	-	-
HALE	COUNTY-OTHER, HALE	-	-	-	-	-	-	-	-	-	-	-	-
HOCKLEY	ANTON	-	-	-	-	-	-	-	-	-	-	-	-
SWISHER	COUNTY-OTHER, SWISHER	-	-	-	-	-	-	-	-	-	-	-	-
DICKENS	COUNTY-OTHER, DICKENS	-	-	-	-	-	-	-	-	-	-	-	-
FLOYD	LOCKNEY	-	-	-	-	-	-	-	-	-	-	-	-
DAWSON	ODONNELL	-	-	-	-	-	-	-	-	-	-	-	-
LYNN	ODONNELL	-	-	-	-	-	-	-	-	-	-	-	-
LAMB	COUNTY-OTHER, LAMB	-	-	-	-	-	-	-	-	-	-	-	-
CASTRO	COUNTY-OTHER, CASTRO	-	-	-	-	-	-	-	-	-	-	-	-
CASTRO	HART MUNICIPAL WATER SYSTEM	-	-	-	-	-	-	-	-	-	-	-	-
LAMB	LITTLEFIELD	-	-	-	-	-	-	-	-	-	-	-	-
LUBBOCK	SHALLOWATER	-	-	-	-	-	-	-	-	-	-	-	-
CROSBY	RALLS	78	89	98	112	129	146	-	-	-	-	-	-
SWISHER	HAPPY	-	-	-	-	-	-	-	-	-	-	-	-
CROSBY	CROSBYTON	-	-	-	-	-	-	1	-	-	-	-	-
TERRY	BROWNFIELD	-	-	-	49	216	291	30	-	-	-	-	-

Table 5-46. Estimated Water Savings for WUGs with Recommended Conservation

County Name	Water User Group	Projected Water Needs						Additional Water Saved With Conservation (ac-ft/yr)					
		2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
GAINES	SEAGRAVES	-	-	-	-	-	-	10	-	-	-	-	-
HOCKLEY	LEVELLAND	-	-	-	-	-	-	45	-	-	-	-	-
LUBBOCK	WOLFFORTH	-	-	-	43	204	366	21	10	4	4	9	17
LYNN	TAHOKA PUBLIC WATER SYSTEM	-	-	-	-	-	-	10	-	-	-	-	-
BRISCOE	SILVERTON	-	-	-	-	-	-	3	-	-	-	-	-
DICKENS	SPUR	-	-	-	-	-	-	3	-	-	-	-	-
LAMB	EARTH	-	-	-	-	-	-	5	0	-	-	-	-
FLOYD	FLOYDADA	-	-	-	-	-	-	12	-	-	-	-	-
SWISHER	TULIA	-	-	-	-	-	-	22	2	-	-	-	-
LUBBOCK	IDALOU	-	-	-	-	-	-	13	3	-	-	-	-
LUBBOCK	LUBBOCK	3,716	8,472	13,818	19,356	26,501	32,370	1289	393	-	-	-	-
MOTLEY	COUNTY-OTHER, MOTLEY	-	-	-	-	-	-	3	-	-	-	-	-
PARMER	BOVINA	-	-	-	-	-	-	9	1	-	-	-	-
PARMER	FRIONA	-	-	-	-	-	-	21	4	-	-	-	-
CROSBY	LORENZO	-	-	-	-	-	-	6	0	-	-	-	-
HALE	PLAINVIEW	-	-	-	-	-	-	130	38	-	-	-	-
PARMER	COUNTY-OTHER, PARMER	-	-	-	-	-	-	18	4	-	-	-	-

Table 5-46. Estimated Water Savings for WUGs with Recommended Conservation

County Name	Water User Group	Projected Water Needs						Additional Water Saved With Conservation (ac-ft/yr)					
		2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
BAILEY	MULESHOE	-	-	-	-	-	-	40	22	10	7	13	23
LAMB	OLTON	-	-	-	-	-	-	17	9	3	1	2	5
COCHRAN	MORTON PUBLIC WATER SYSTEM (PWS)	-	-	-	-	-	-	15	6	4	5	7	9
DEAF SMITH	HEREFORD	-	-	-	-	-	-	135	79	42	36	62	98
CASTRO	DIMMITT	-	-	-	-	-	-	39	23	11	7	13	19
DAWSON	LAMESA	-	-	-	-	-	-	83	46	17	24	32	44
COCHRAN	WHITEFACE	-	-	-	-	-	-	4	2	1	2	2	3
HALE	ABERNATHY	-	-	-	-	-	-	22	13	9	7	9	12
LUBBOCK	ABERNATHY	-	-	-	-	-	-	7	5	4	3	4	6
LAMB	SUDAN	-	-	-	-	-	-	10	6	3	3	5	5
DICKENS	RED RIVER AUTHORITY OF TEXAS	-	-	-	-	-	-	0	0	0	0	0	0
MOTLEY	RED RIVER AUTHORITY OF TEXAS	-	-	-	-	-	-	1	-	0	-	0	-
BRISCOE	QUITAQUE	-	-	-	-	-	-	5	3	2	2	2	2
HALE	PETERSBURG MUNICIPAL WATER SYSTEM	-	-	-	-	-	-	13	10	6	6	7	9
YOAKUM	PLAINS	-	-	-	-	-	-	18	13	10	10	13	18
PARMER	FARWELL	-	-	-	-	-	-	16	11	8	8	11	15

Table 5-46. Estimated Water Savings for WUGs with Recommended Conservation

County Name	Water User Group	Projected Water Needs						Additional Water Saved With Conservation (ac-ft/yr)					
		2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
HOCKLEY	SUNDOWN	-	-	-	-	-	-	17	11	10	11	14	17
YOAKUM	DENVER CITY	-	-	-	-	-	-	62	47	39	49	62	77
LUBBOCK	RANSOM CANYON	-	-	-	-	-	-	17	14	13	14	17	20
BRISCOE	COUNTY-OTHER, BRISCOE	-	-	-	-	-	-	8	6	5	6	6	7
GAINES	SEMINOLE	551	774	1,050	1,363	1,614	1,878	120	108	104	115	137	165
MOTLEY	MATADOR	-	-	-	-	-	-	12	10	9	9	10	11
COCHRAN	COUNTY-OTHER, COCHRAN	-	-	-	-	-	-	15	14	15	16	19	20
CASTRO	NAZARETH	-	-	-	-	-	-	7	7	6	7	8	9

ac-ft/yr = acre-feet per year

5.32.4 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. 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 5-47.

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 5-47. Estimated Cost of Conservation to Achieve Water Savings

Water User Group	Costs of Water Savings ($/yr)					
	2020	2030	2040	2050	2060	2070
CROSBYTON	$246	$-	$-	$-	$-	$-
BROWNFIELD	$9,939	$-	$-	$-	$-	$-
SEAGRAVES	$3,251	$-	$-	$-	$-	$-
LEVELLAND	$15,623	$-	$-	$-	$-	$-
WOLFFORTH	$7,380	$3,576	$1,467	$1,472	$3,137	$5,978
TAHOKA PUBLIC WATER SYSTEM	$3,258	$-	$-	$-	$-	$-
SILVERTON	$1,028	$-	$-	$-	$-	$-
SPUR	$1,092	$-	$-	$-	$-	$-
EARTH	$1,564	$18	$-	$-	$-	$-
FLOYDADA	$3,865	$-	$-	$-	$-	$-
TULIA	$7,640	$793	$-	$-	$-	$-
IDALOU	$4,344	$964	$-	$-	$-	$-
LUBBOCK	$447,244	$136,515	$-	$-	$-	$-
COUNTY-OTHER, MOTLEY	$881	$-	$-	$-	$-	$-
BOVINA	$3,121	$415	$-	$-	$-	$-
FRIONA	$7,181	$1,494	$-	$-	$-	$-
LORENZO	$1,917	$99	$-	$-	$-	$-

Table 5-47. Estimated Cost of Conservation to Achieve Water Savings

Water User Group	Costs of Water Savings ($/yr)					
	2020	2030	2040	2050	2060	2070
PLAINVIEW	$45,085	$13,230	$-	$-	$-	$-
COUNTY-OTHER, PARMER	$6,242	$1,554	$-	$-	$-	$-
MULESHOE	$13,805	$7,620	$3,545	$2,538	$4,606	$7,990
OLTON	$5,929	$3,251	$1,181	$373	$730	$1,603
MORTON PUBLIC WATER SYSTEM (PWS)	$5,040	$1,926	$1,287	$1,555	$2,154	$2,938
HEREFORD	$44,153	$25,783	$13,533	$11,702	$20,184	$32,038
DIMMITT	$12,717	$7,463	$3,481	$2,287	$4,151	$6,061
LAMESA	$27,068	$15,111	$5,547	$7,740	$10,370	$14,381
WHITEFACE	$1,346	$772	$347	$728	$808	$970
ABERNATHY	$7,514	$4,611	$3,030	$2,398	$2,964	$4,068
ABERNATHY	$2,552	$1,855	$1,304	$1,047	$1,247	$1,936
SUDAN	$3,454	$1,968	$1,186	$948	$1,582	$1,852
RED RIVER AUTHORITY OF TEXAS	$116	$82	$51	$90	$65	$110
RED RIVER AUTHORITY OF TEXAS	$202	$-	$164	$-	$133	$-
QUITAQUE	$1,709	$1,190	$671	$844	$670	$842

Table 5-47. Estimated Cost of Conservation to Achieve Water Savings

Water User Group	Costs of Water Savings ($/yr)					
	2020	2030	2040	2050	2060	2070
PETERSBURG MUNICIPAL WATER SYSTEM	$4,324	$3,128	$1,824	$1,994	$2,373	$2,788
PLAINS	$6,212	$4,508	$3,460	$3,562	$4,648	$6,405
FARWELL	$5,685	$3,898	$2,926	$2,939	$3,892	$5,125
SUNDOWN	$5,837	$3,973	$3,509	$3,982	$4,956	$5,941
DENVER CITY	$21,362	$16,318	$13,405	$16,998	$21,427	$26,576
RANSOM CANYON	$5,850	$4,905	$4,638	$4,838	$5,771	$6,782
COUNTY-OTHER, BRISCOE	$2,818	$2,143	$1,709	$1,968	$2,225	$2,481
SEMINOLE	$39,214	$35,062	$33,789	$37,451	$44,760	$53,687
MATADOR	$4,069	$3,397	$3,069	$3,087	$3,449	$3,810
COUNTY-OTHER, COCHRAN	$5,271	$4,934	$5,189	$5,625	$6,606	$7,036
NAZARETH	$2,379	$2,342	$1,966	$2,286	$2,646	$3,041

5.32.5 Implementation Issues

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.

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 5-48.

Table 5-48. 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

Water Loss Reduction

TWDB provided results of their 2018 Water Loss Audit for regional water planning groups (RWPGs) to consider when developing the regional water plans (TAC §357.34 (f)(2)D) (Table 5-49). Furthermore, WMS evaluations for the 2021 LERWP are to take into account anticipated water losses associated with the 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 5-49. Summary of Water Loss Percentages Based on 2018 TWDB Water Loss Report

WUG	County Name	Total Apparent Losses (gallons)	Total Real Losses (gallons)	Total Loss Percent (%)
City of Ralls	Crosby	1,358,469	3,452,656	7.1
White River MWD	Crosby	462,180	21,641,497	54.4
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
Valley WSC	Dickens	69,650	3,005,023	35.7
City of Seagraves	Gaines	3,024,717	9,536,620	11.5
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	43,694,473	74,128,123	10.7
City of Anton	Hockley	3,933,681	4,814,917	19.4
City of Levelland	Hockley	25,173,701	45,034,776	10.9
City of Smyer	Hockley	1,108,092	512,770	10.1
City of Littlefield	Lamb	16,369,613	52,602,850	21.8
Lubbock Public Water System	Lubbock	398,153,503	833,751,104	9.9
City of Shallowater	Lubbock	3,742,102	18,069,121	16.7
City of New Deal	Lubbock	304,965	382,626	2.8
City of Tahoka	Lynn	5,875,077	17,335,722	17.8
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

Table 5-49. Summary of Water Loss Percentages Based on 2018 TWDB Water Loss Report

WUG	County Name	Total Apparent Losses (gallons)	Total Real Losses (gallons)	Total Loss Percent (%)

[1]Data from the 2018 Water Loss Report from TWDB
WSC = water supply corporation

5.33 Irrigation Water Conservation

5.33.1 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.

5.33.2 Quantity of Available Water

As part of the regional water planning process, the LERWP recommended a voluntary target reduction voluntary target reduction of 3 percent by 2020, 5 percent by 2030, and 7 percent from 2040-2070, using some of the BMPs identified above. The total conservation savings is 155,095 ac-ft per year by 2070 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 2040-2070 is recommended

The savings based on the voluntary reduction percentages are summarized in Table 5-50 with the amount saved in demands based on conservation reduction in inches per acre of irrigated land. Table 5-51 summarizes the irrigated land in each county (HPWD 2019). Finally, Table 5-52 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 past 5 years. Following is an example calculation.

$$\frac{Inches}{Acre} = \frac{Conservation(ac - ft) * 12\ in\ per\ ft}{Average\ Irrigated\ (acres)}$$

Table 5-50. Conservation Savings in Inches per Acre per County per Year (irrigated acres from 2011-2017) (TWDB 2019)

County	Basin	CONSERVATION (inches/acre)					
		2020	2030	2040	2050	2060	2070
BAILEY	BRAZOS	0.38	0.63	0.72	0.63	0.58	0.55
BRISCOE	RED	0.36	0.60	0.66	0.57	0.52	0.48
CASTRO	BRAZOS	0.34	0.57	0.63	0.53	0.49	0.47
CASTRO	RED	0.18	0.31	0.34	0.29	0.26	0.25
COCHRAN	BRAZOS	0.22	0.37	0.45	0.40	0.36	0.33
COCHRAN	COLORADO	0.11	0.18	0.21	0.19	0.17	0.16
CROSBY	BRAZOS	0.33	0.54	0.76	0.60	0.52	0.48
CROSBY	RED	0.01	0.02	0.03	0.02	0.02	0.02
DAWSON	BRAZOS	0.01	0.01	0.01	0.01	0.01	0.01
DAWSON	COLORADO	0.50	0.84	1.18	1.02	0.93	0.88
DEAF SMITH	CANADIAN	0.00	0.01	0.01	0.01	0.01	0.01
DEAF SMITH	RED	0.46	0.76	0.83	0.70	0.64	0.60
DICKENS	BRAZOS	0.24	0.41	0.57	0.57	0.57	0.57
DICKENS	RED	0.18	0.31	0.43	0.43	0.43	0.43
FLOYD	BRAZOS	0.12	0.19	0.22	0.19	0.17	0.16

Table 5-50. Conservation Savings in Inches per Acre per County per Year (irrigated acres from 2011-2017) (TWDB 2019)

County	Basin	CONSERVATION (inches/acre)					
		2020	2030	2040	2050	2060	2070
FLOYD	RED	0.21	0.35	0.39	0.33	0.30	0.29
GAINES	COLORADO	0.37	0.62	0.79	0.74	0.70	0.68
GARZA	BRAZOS	0.35	0.58	0.81	0.81	0.81	0.81
HALE	BRAZOS	0.38	0.64	0.76	0.70	0.67	0.65
HALE	RED	0.00	0.01	0.01	0.01	0.01	0.01
HOCKLEY	BRAZOS	0.28	0.47	0.49	0.42	0.39	0.37
HOCKLEY	COLORADO	0.02	0.04	0.04	0.03	0.03	0.03
LAMB	BRAZOS	0.39	0.65	0.77	0.72	0.70	0.69
LUBBOCK	BRAZOS	0.31	0.52	0.67	0.63	0.60	0.58
LYNN	BRAZOS	0.32	0.53	0.74	0.74	0.74	0.74
LYNN	COLORADO	0.02	0.04	0.05	0.05	0.05	0.05
MOTLEY	RED	0.39	0.64	0.90	0.90	0.90	0.90
PARMER	BRAZOS	0.36	0.60	0.73	0.67	0.64	0.62
PARMER	RED	0.09	0.15	0.18	0.17	0.16	0.16
SWISHER	BRAZOS	0.08	0.14	0.16	0.14	0.13	0.13
SWISHER	RED	0.38	0.64	0.73	0.64	0.60	0.57
TERRY	BRAZOS	0.02	0.03	0.04	0.03	0.03	0.03
TERRY	COLORADO	0.34	0.57	0.67	0.62	0.59	0.58
YOAKUM	COLORADO	0.47	0.33	0.40	0.37	0.35	0.34

Table 5-51. Irrigated Acres per County from 2011-2017 (TWDB 2017)

County Name	Acres	Acre-Feet	AC-FT GW	AC-FT SW	AC-FT WW	Percentage of Total Irrigated Acres in Region
BAILEY	84,434	78,715	78,581	-	134	3%
BRISCOE	26,399	23,054	23,054	-	-	1%
CASTRO	259,519	346,010	346,010	-	-	9%
COCHRAN	108,481	96,487	96,487	-	-	4%
CROSBY	114,392	94,341	93,684	656	-	4%
DAWSON	75,206	96,477	95,358	188	931	3%

Table 5-51. Irrigated Acres per County from 2011-2017 (TWDB 2017)

County Name	Acres	Acre-Feet	AC-FT GW	AC-FT SW	AC-FT WW	Percentage of Total Irrigated Acres in Region
DEAF SMITH	163,249	187,494	187,494	-	-	6%
DICKENS	7,579	8,520	8,517	-	2	0%
FLOYD	142,761	118,015	117,977	-	38	5%
GAINES	349,771	348,025	348,025	-	-	12%
GARZA	10,724	10,846	10,846	-	-	0%
HALE	290,294	287,242	287,102	140	-	10%
HOCKLEY	156,020	130,433	129,681	-	752	5%
LAMB	238,027	236,706	236,368	-	338	8%
LUBBOCK	166,207	151,271	142,784	108	8,380	6%
LYNN	94,567	90,827	86,026	-	4,802	3%
MOTLEY	8,809	9,707	9,707	-	-	0%
PARMER	191,281	198,827	198,600	-	227	7%
SWISHER	104,327	111,168	111,168	-	-	4%
TERRY	173,081	150,983	150,464	420	99	6%
YOAKUM	125,021	135,957	135,765	-	192	4%

AC-FT = acre-feet; GW = groundwater; SW = surface water; WW = wastewater

Table 5-52. Projected Conservation Amount in ac-ft/yr (TWDB 2019)

County	Basin	Conservation Savings					
		2020	2030	2040	2050	2060	2070
BAILEY	BRAZOS	2,643	4,405	5,040	4,445	4,106	3,893
BRISCOE	RED	793	1,321	1,448	1,248	1,136	1,066
CASTRO	BRAZOS	7,407	12,346	13,672	11,512	10,582	10,142
CASTRO	RED	3,989	6,648	7,362	6,199	5,698	5,461
COCHRAN	BRAZOS	2,029	3,381	4,036	3,604	3,244	2,997
COCHRAN	COLORADO	955	1,591	1,900	1,696	1,527	1,411
CROSBY	BRAZOS	3,100	5,166	7,232	5,724	4,964	4,551

Table 5-52. Projected Conservation Amount in ac-ft/yr (TWDB 2019)

County	Basin	Conservation Savings					
		2020	2030	2040	2050	2060	2070
CROSBY	RED	128	213	298	236	205	188
DAWSON	BRAZOS	31	52	73	63	58	55
DAWSON	COLORADO	3,158	5,263	7,369	6,363	5,831	5,506
DEAF SMITH	CANADIAN	63	105	114	97	88	83
DEAF SMITH	RED	6,237	10,396	11,275	9,582	8,693	8,193
DICKENS	BRAZOS	155	258	361	361	361	361
DICKENS	RED	117	194	272	272	272	272
FLOYD	BRAZOS	1,391	2,319	2,583	2,237	2,039	1,921
FLOYD	RED	2,474	4,123	4,592	3,978	3,624	3,415
GAINES	COLORADO	10,874	18,124	22,991	21,475	20,432	19,771
GARZA	BRAZOS	311	518	725	725	725	725
HALE	BRAZOS	9,223	15,372	18,453	16,932	16,172	15,771
HALE	RED	93	155	186	171	163	159
HOCKLEY	BRAZOS	3,681	6,135	6,367	5,456	5,027	4,794
HOCKLEY	COLORADO	275	458	475	407	375	358
LAMB	BRAZOS	7,784	12,973	15,301	14,277	13,826	13,593
LUBBOCK	BRAZOS	4,346	7,243	9,282	8,702	8,288	7,998
LYNN	BRAZOS	2,490	4,150	5,809	5,809	5,809	5,809
LYNN	COLORADO	178	297	415	415	415	415
MOTLEY	RED	283	471	660	660	660	660
PARMER	BRAZOS	5,743	9,571	11,616	10,747	10,241	9,959
PARMER	RED	1,434	2,390	2,901	2,684	2,557	2,487
SWISHER	BRAZOS	731	1,219	1,387	1,231	1,144	1,090
SWISHER	RED	3,331	5,551	6,316	5,606	5,210	4,967
TERRY	BRAZOS	259	432	511	471	451	439
TERRY	COLORADO	4,924	8,207	9,702	8,958	8,571	8,348
YOAKUM	COLORADO	4,851	8,085	9,670	8,893	8,485	8,238
	TOTAL	95,479	159,132	190,396	171,237	160,978	155,095

5.33.3 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 5-53. 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 $450 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 5-53. 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.

5.33.4 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.

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.

5.34 Industrial Water Conservation

5.34.1 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 48,835 ac-ft/yr in 2020 and are projected to decrease to 44,316 ac-ft/yr in 2070.

Manufacturing sectors require water for food processing, industrial machinery and equipment, and fabricated metals. Manufacturing water demand is projected at 10,881 ac-ft/yr in 2020 and expected to increase to 12,341 ac-ft/yr by 2070. There are four counties in the Llano Estacado Region with projected manufacturing needs: Deaf Smith, Gaines, Hale, and Lubbock. In 2070, the estimated water needs are 6,482 ac-ft/yr, which is 53 percent of the manufacturing water demand for the Llano Estacado Region.

In the Llano Estacado Region, the trends for steam-electric water demands are projected to stay the same each decade with a maximum demand of 21,085 ac-ft/yr by 2070. There are no needs in the counties that have steam electric demands: Hale, Lamb, Lubbock, and Yoakum. The constant projection in water demand is due to no planned expansion of any of the steam-electric plants in the region. The Llano Estacado Region steam-electric users are projected to receive most of the 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 16,869 ac-ft/yr in 2020 to 10,890 ac-ft/yr by 2070. In 2070, 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. Seven counties have projected mining needs over the planning period: Crosby (only in the Red River Basin), Dawson, Hale, Lamb, Lubbock, Lynn, Terry, and Yoakum. In 2070, the estimated water needs are 6,016 ac-ft, approximately 55 percent of the mining water demand for the Llano Estacado Region.

5.34.2 Industrial Water Conservation Approach

The LERWP recommends a voluntary target reduction of 1 percent by 2020, 3 percent by 2030, and 5 percent from 2040-2070. The Task Force report lists the following industrial BMPs that may be used to achieve the recommended water savings:[199]

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 entities are presented on a county basis and are not individually identified, identification of specific water management strategies is not a reasonable expectation.

5.34.3 Quantity of Available Water

The LERWP recommends a voluntary target reduction of 1 percent by 2020, 3 percent by 2030, and 5 percent from 2040 to 2070 by using BMPs identified by the Task Force. A summary of water conservation savings is in Table 5-54.

For manufacturing demands, total water savings are 617 ac-ft/yr after conservation in 2070 as shown in Table 5-54. Mining water demands can be reduced by 545 ac-ft by 2070 with conservation. For the steam-electric users with conservation, demands can be reduced by 1,054 ac-ft/yr in 2070 (Table 5-54).

Table 5-54. Estimated Water Conservation Savings in ac-ft/yr

WUG Name	County	2020	2030	2040	2050	2060	2070
Manufacturing							
MANUFACTURING, CASTRO	CASTRO	1	2	3	3	3	3
MANUFACTURING, DEAF SMITH	DEAF SMITH	10	33	55	55	55	55

[199] Water Conservation Implementation Task Force, Report to the 79th Legislature, Texas Water Development Board.

Table 5-54. Estimated Water Conservation Savings in ac-ft/yr

WUG Name	County	2020	2030	2040	2050	2060	2070
MANUFACTURING, GAINES	GAINES	15	48	79	79	79	79
MANUFACTURING, HALE	HALE	44	152	254	254	254	254
MANUFACTURING, HOCKLEY	HOCKLEY	6	21	35	35	35	35
MANUFACTURING, LAMB	LAMB	8	28	47	47	47	47
MANUFACTURING, LUBBOCK	LUBBOCK	9	30	51	51	51	51
MANUFACTURING, PARMER	PARMER	17	55	92	92	92	92
MANUFACTURING, TERRY	TERRY	0	1	1	1	1	1
	TOTAL	**109**	**370**	**617**	**617**	**617**	**617**
Mining							
MINING, COCHRAN	COCHRAN	2	6	11	8	6	4
MINING, CROSBY	CROSBY	10	29	44	38	33	28
MINING, DAWSON	DAWSON	18	54	91	91	91	91
MINING, DICKENS	DICKENS	0	0	1	1	1	1
MINING, FLOYD	FLOYD	5	15	24	24	24	24
MINING, GAINES	GAINES	18	72	104	76	53	39
MINING, GARZA	GARZA	4	16	22	17	12	8
MINING, HALE	HALE	12	35	51	44	38	33
MINING, HOCKLEY	HOCKLEY	0	1	1	1	1	1
MINING, LAMB	LAMB	6	17	26	22	19	17
MINING, LUBBOCK	LUBBOCK	64	193	296	265	238	216
MINING, LYNN	LYNN	12	40	63	52	41	33
MINING, MOTLEY	MOTLEY	2	6	10	10	9	8
MINING, TERRY	TERRY	4	16	27	21	15	10
MINING, YOAKUM	YOAKUM	13	40	57	48	39	32
	TOTAL	**169**	**541**	**826**	**717**	**619**	**545**
Steam-Electric							
STEAM-ELECTRIC, HALE	HALE	0	1	2	2	2	2
STEAM-ELECTRIC, LAMB	LAMB	135	404	673	673	673	673
STEAM-ELECTRIC, LUBBOCK	LUBBOCK	57	171	285	285	285	285
STEAM-ELECTRIC, YOAKUM	YOAKUM	19	57	96	96	96	96
	TOTAL	**211**	**633**	**1,054**	**1,054**	**1,054**	**1,054**

5.34.4 Strategy Costs

The LERWPG recommends implementing water conservation for industrial users (manufacturing, steam-electric, and mining) with projected needs amounting to a 1 percent water demand reduction by 2020, 3 percent by 2030, and 5 percent from 2040 to 2070. The four counties in the Llano Estacado Region with projected manufacturing shortages can save up to 6,171 ac-ft/yr in 2070. Steam-electric had no needs, but could save 10,543 ac-ft/yr through conservation. The seven counties in the Llano Estacado Region with projected mining shortages can save up to 5,445 ac-ft in 2070. 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.

5.34.5 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.

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.

5.35 Livestock Water Conservation

5.35.1 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 41,589 ac-ft/yr in 2020 to 60,304 ac-ft/yr in 2070. 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.

Three counties have livestock water needs: Bailey, Deaf Smith, and Lamb. The overall needs are 112 ac-ft/yr in 2020 and increased to 5,442 ac-ft/yr by 2070. These increased water needs are based on shortages of water and increased livestock demands.

5.35.2 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.

5.35.3 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 industrial water conservation strategies.

5.35.4 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.

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.

5.36 Current Conservation Activities

5.36.1 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.[200]

5.36.2 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.

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.

5.36.3 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,

[200] AIM Program: Fall 2019, High Plains Water District. http://www.hpwd.org/aim

and many more topics. Currently, they are conducting field days and conferences to discuss water conservation.

D. Potential Additional Water Management Strategies

5.37 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.[201] 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.

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.[202] 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.[203] 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 did not warrant continued research efforts into practicable

[201] Playa Lakes Joint Venture. http://pljv.org/

[202] Texas Board of Water Engineers. 1957. Bulletin 5701. Artificial-Recharge Experiments at McDonald Well Field, Amarillo, Texas, High Plains Underground Water Conservation District No. 1 in conjunction with the Geologic Survey U.S. Department of the Interior and City of Amarillo, January 1957.

[203] Texas Technological College. 1965. Study of Playa Lakes in the High Plains of Texas. Texas Water Development Board, Report 10, December 1965.

means of artificial recharge.[204] 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.[205]

Using the recently reported estimate of infiltration flux of approximately 5 mm/d calculations of yield or the volume of supply available were performed and compared to the earlier estimate. The area of playa lakes was based on the Playa Lakes Joint Venture GIS coverage. The area of playa lakes by county was then multiplied by the infiltration flux to estimate the annual yield volume. The annual yield volumes were summed for the Llano Estacado Region counties. The result was an estimate 1.5 million ac-ft/year. This value is less than but similar to the previously reported estimates.

While playa lakes do naturally recharge the underlying aquifer, enhanced playa lake recharge as a WMS for water resources planning was deemed not to be a viable alternative. Research indicates that the recharge potential is highly variable and smaller than average conditions not practicable. Most importantly, during periods of drought there is limited rainfall that produces minimal runoff to the playas. The TWDB guidance states that WMS yields must be firm under DOR conditions. Therefore, playa lakes enhanced recharge needs further study and is only recommended as an additional strategy for this water planning cycle. Increasing the amount of recharge during non-drought years can provide more groundwater in storage for future drought years.

5.38 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 2021 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.

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[204] Urban, Lloyd V, et al., 1988. Aquifer Recharge Utilizing Playa Lake Water and Filter Underdrains Phase IV, Texas Tech University, Water Resources Center, Lubbock, Texas.

[205] 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.*

5.38.1 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

5.38.2 Quantity of Water

Table 5-55 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 5-55. Population and Demand Projections for South Garza Water Supply System

	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

Table 5-55. Population and Demand Projections for South Garza Water Supply System

	Projected Maximum Number of Connections	Population for Maximum Connections	Per Capita Water Use (gpcd)	Water Demand (ac-ft/yr)
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

5.38.3 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.

5.39 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.

5.39.1 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 Robert 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.

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.

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.

5.39.2 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.

Time to Implement

Supply will be available for the ASR project after CRMWA II is online in 2030.

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 90-95% 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.

5.40 Control of Naturally Occurring Salinity

This WMS is considered in the LERWP because of its potential water supply benefit to the WRMWD. The strategy is summarized below. The full description is presented in the 2021 Brazos G Regional Water Plan.

5.40.1 Characterization of Salinity in the Brazos River

Sources

Natural salt pollution has been recognized as the most serious and widespread water quality problem in the Brazos River Basin. No other pollution source, man-made or natural, has had the impact of the natural salt sources located in the upper basin of the Brazos River. However, as the Brazos River flows to the Gulf of Mexico, inflows from tributaries decrease the concentration of dissolved minerals and salts, which in turn improves the quality of water.

The primary sources of the natural salt concentrations in the Brazos River Basin are northwest of the City of Abilene, principally in the watersheds of the Salt and Double Mountain Forks of the Brazos River. A substantial portion of the salt load in the Brazos River is contributed by Croton Creek and Salt Croton Creek, according to various reports.[206,207,208,209,210,211,212] The natural salt producing area is a semi-arid region, where sedimentary rocks containing gypsum and other salts outcrop in canyon-like stream valleys. The Brazos River receives a tremendous salt load when local rainfall is sufficient to dissolve the deposited salt.

Salinity in the Brazos River Basin is quantified in terms of concentrations or loads of TDS, chlorides (Cl), and sulfates (SO_4). Chlorides and sulfates are primary constituents of the TDS measured in the Basin. The U.S. Geological Survey (USGS) conducted a water quality monitoring program in the Brazos River Basin during the 1964 through 1986 water years. Ganze and Wurbs (1989)[213] and Wurbs et al. (1993)[214] prepared statistical summaries of the salinity data collected at 26 of the 39 USGS water quality monitoring stations having monthly data for at least 3 years during the monitoring period, excerpted from Wurbs et al. (1993). The 26 gages were chosen based on their record durations and their locations. This section highlights data and findings from the Ganze and Wurbs (1989) and Wurbs et al. (1993) studies. The summaries show the range of concentrations in the upper basin were TDS of 1,300 to 57,000 mg/L, Cl of 300 to 33,000 mg/L, and SO_4 of 500 to 2,300 mg/L.

5.40.2 Description of Salinity Control Project

Three salinity control project options were studied in the 2001 Brazos G Regional Water Plan. All three options included brine recovery well fields that penetrate the saline aquifer, lowering the piezometric surface of the water table, thereby eliminating brine springs and seeps in the area. Option 1 involved disposal of the recovered brine in a

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206 Blank, H.R. 1955. “Sources of Salt Water Entering the Upper Brazos River,” Report, Project 99, Texas A&M Research Foundation.

207 Blank, H.R. 1956. “Supplementary Report on Sources of Salt Water entering the Upper Brazos Basin,” Project 99, Texas A&M University Research Foundation.

208 Baker, R.C., Hughes, L.S., Yost, I.D. 1962. “Natural Sources of Salinity in the Brazos River, Texas, with Particular Reference to the Salt Croton and Croton Creek Basins, U.S.”

209 Mason-Johnson & Associates. 1955. “Dove Creek Salt Study, Stonewall County, Texas.”

210 U.S. Army Corps of Engineers Fort Worth District. 1973. “Natural Salt Pollution Control Study, Brazos River Basin, Texas,” Volumes 1-4.

211 U.S. Army Corps of Engineers, Fort Worth District. 1983. “Brazos Natural Salt Pollution Control, Brazos River Basin, Texas, Design Memorandum No. 1, General Phase 1 – Plan Formulation.”

212 Ganze, C.K., and Wurbs, R.A. 1989. “Compilation and Analysis of Monthly Salt Loads and Concentrations in the Brazos River Basin,” Civil Engineering Department, Texas A&M University.

213 Ganze, C.K. and, R.A. Wurbs. 1989. “Compilation and Analysis of Monthly Salt Loads and Concentrations in the Brazos River Basin,” Prepared for U.S. Army Corps of Engineers Forth Worth District under Contract DACW63-88-M-0793, January 1989.

214 Wurbs, R.A., A.S. Karama, I. Saleh, and C.K. Ganze, “Natural Salt Pollution and Water Supply Reliability in the Brazos River Basin,” Texas Water Resources Institute, 1993.

deep well injection system. Option 2 involved disposal of the brine in Kiowa Peak Reservoir, which would serve as a permanent impoundment for the recovered brine. Option 3, which has evolved into the project studied further herein, would convey the recovered brine to a brine utilization and management complex (BUMC) where it would be converted into marketable sodium chloride (NaCl) salt products and potable water. Stonewall, Garza, and Kent Counties have formed a local government corporation called the Salt Fork Water Quality (SFWQ) Corporation to work on advance planning for the project in cooperation with the Brazos River Authority.

5.40.3 Evaluation of the Potential Effectiveness of the Salinity Control Project

Evaluating the potential effectiveness of the salinity control project involved modeling TDS concentrations in the Brazos River Basin under the hydrologic, water use, and reservoir operating policies of the 2070 Brazos G water availability model (Brazos WAM). Model simulations were developed to represent conditions with and without the salinity control project, and the resulting TDS concentration frequency data were compared. Work by Wurbs and Lee (2009)[215] provided salinity input data used in the modeling.

The WRAP-SALT input files representing conditions with and without the salinity control project were executed with the 2070 version of the Brazos WAM, which models reservoirs at their projected year 2070 capacity. The reduction percentages show that the effects of the project are most pronounced at the upstream model limit (Seymour), and diminish with distance downstream. Wurbs and Lee (2009) explain that this is due to the effects of load losses in the channel and reservoirs.[216] There is a 32 percent reduction in mean TDS concentration at Seymour, while reductions of 19 to 13 percent are computed at the three reservoirs. With the removal of two of the three well fields proposed in the 2016 Plan, benefits of the salinity control project are not realized further down the basin. There is no reduction in TDS concentrations at Bryan or Richmond.

For example, the percentage of months in which the TCEQ secondary TDS standard is equaled or exceeded in Lake Whitney is reduced by approximately 18 percent (36.2% - 18.5% = 17.7%). Lake Whitney is the location with the greatest reduction in time exceeding the TCEQ standard. The greatest reduction in time exceeding the industrial limits is also seen in Lake Whitney, at approximately 6 percent, while the greatest reduction in time exceeding agricultural limits is 2 percent at Lake Granbury.

5.40.4 Strategy Costs

Table 5-56 summarizes the estimated costs for the salinity control system. The majority of project costs, including operation and maintenance costs, engineering costs, land acquisition costs, and some capital costs were provided by the SFWQ Corporation's consultants, while other costs were estimated for preparation of the regional water plan using the unified cost model (UCM). Costs calculated through the UCM are the brine transmission pump station and storage tank; treated water transmission pipelines, pump

[215] Wurbs, R.A. and C. Lee, "Salinity Budget and WRAP Salinity Simulation Studies of the Brazos River/Reservoir System," Texas Water Resources Institute Technical Report No. 352, July 2009.

[216] Wurbs, R.A. and C. Lee, "Salinity Budget and WRAP Salinity Simulation Studies of the Brazos River/Reservoir System," Texas Water Resources Institute Technical Report No. 352, July 2009.

stations, and storage tanks; debt service; and interest during construction. Treated water transmission pipeline costs are based on mileage provided by the SFWQ Corporation. A two-year construction period was assumed for computing interest during construction.

The operation and maintenance costs in Table 5-56 are offset by salt revenue. The SFWQ Corporation's consultants have prepared a pro forma analysis indicating that revenue from salt sales would cover well field, pipeline, and BUMC operation and maintenance costs. It is anticipated that once the project was constructed, a salt company would operate and maintain the facilities and generate sufficient revenue such that operation and maintenance costs to the public would be zero. The SFWQ Corporation's consultants have also assumed that right of way costs for the brine transmission pipeline would be negligible; the pipeline would run within existing county road right of ways and the counties are participants in the project.

Overall, the estimated combined capital cost for the brine collection and transmission system and the BUMC is $57,606,000. The estimated combined total project cost for the brine collection and transmission system and the BUMC is $106,537,000, and the estimated combined annual cost is $6,194,000 – offset by salt revenue and water sales. Estimated total capital costs for the treated water delivery systems range from $1,021,000 for Jayton to $6,789,000 for WRMWD, and total annual costs range from $542,000 to $1,128,000.

Table 5-56. Cost Estimate Summary for the Salinity Control Project

Item	Brine Utilization and Management System	White River Municipal Water District	Jayton	Aspermont
Brine Transmission Pipeline (12 in dia., 17 miles)	$14,467,000	-	-	-
Brine Transmission Pump Station(s) & Storage Tank(s)	$1,874,000	-	-	-
Treated Water Transmission Pipeline	-	$5,836,000	$579,000	$4,057,000
Treated Water Transmission Pump Station(s) & Storage Tank(s)	-	$953,000	$442,000	$1,384,000
Well Fields (Wells, Pumps, and Piping)	$839,000	-	-	-
Storage Tanks (Other Than at Booster Pump Stations)	$600,000	-	-	-
Two Water Treatment Plants (1 MGD and 1 MGD)	$34,326,000	-	-	-
Integration, Relocations, & Other	$5,500,000	-	-	-
TOTAL COST OF FACILITIES	$57,606,000	$6,789,000	$1,021,000	$5,441,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$36,216,000	$2,084,000	$328,000	$1,702,000
Environmental & Archaeology Studies and Mitigation	$1,619,000	$150,000	$600,000	$625,000
Land Acquisition and Surveying (80 acres)	$5,541,000	-	$55,000	$55,000
Interest During Construction (3% for 2 years with a 0.5% ROI)	$5,555,000	$497,000	$111,000	$431,000
TOTAL COST OF PROJECT	$106,537,000	$9,520,000	$2,115,000	$8,254,000
Debt Service (3.5 percent, 20 years)	$7,496,000	$670,000	$149,000	$581,000
Operation & Maintenance	$7,826,000	$82,000	$17,000	$75,000
Purchase of Water (949 ac-ft/yr @ 1189.36 $/ac-ft)	-$1,128,000	$214,000	$140,000	$296,000
Salt Revenue	-$8,000,000	-	-	-
TOTAL ANNUAL COST	$6,194,000	$966,000	$306,000	$952,000
Available Project Yield (ac-ft/yr)	949	180	118	249
Annual Cost of Water ($ per ac-ft), based on PF=1	$6,527	$5,367	$2,593	$3,823
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$20.03	$16.47	$7.96	$11.73

5.40.5 Implementation Issues

Environmental Issues

The proposed project area is located in the upper Brazos River Basin east of the Llano Estacado Region within portions of Kent, King, and Stonewall counties in north-central Texas. The primary environmental issues related to the development of the salt control WMS are the construction of ten brine recovery wells, a brine conveyance pipeline, the BUMC, and three water supply pipelines.

Environmental Setting

The study area is located in the Southwestern Tablelands Ecological Region as designated by the TPWD[217] and is located in the Rolling Plains Vegetational area.[218] For a complete summary, refer to the 2021 Brazos G Regional Water Plan.

Threatened & 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. Numerous endangered, threatened or rare plant, wildlife and fish species are possibly found within Dickens, Kent, King, and Stonewall counties. For a full summary, refer to the 2021 Brazos G Regional Water Plan.

Planning and Permitting Issues

The salinity control project will increase the usability of Brazos River water throughout the Brazos G and Region H areas. Distribution of project costs to beneficiaries will not be straightforward. A summary of the implementation steps for the project is presented below. Numerous regulatory requirements would need to be met before project implementation. For a complete summary of planning and permitting issues, refer to the 2021 Brazos G Regional Water Plan.

5.41 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

[217] TPWD. 2005.
[218] Gould, F.W., G.O. Hoffman, and C.A. Rechenthin. "Vegetational areas of Texas," TX Agri. Ext. Serv. L-492.

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.

5.41.1 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).

5.41.2 Strategy Costs

A cost summary is provided in Table 5-57. Assumptions and conditions associated with these costs include the following.

- Water is purchased from Levelland at the 2018 cost of CRMWA water for Levelland of $1.49 per 1,000 gallons or $485.59 per ac-ft.[219]
- Engineering, legal, and contingency costs are 35 percent for facilities required by this strategy.
- Power is available at $0.08 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 $5,577,000. Annual debt service is $392,000, and annual operational cost, including power and purchase of water, is $202,000. The unit cost for 300 ac-ft/yr supply is estimated to be $1,980 per ac-ft or $6.08 per 1,000 gallons.

[219] CRMWA Comprehensive Annual Financial Report. September 2019.

Table 5-57. City of Smyer Water Management Strategy Costs (September 2018 Dollars)

Item	*Estimated Costs for Facilities*
Pump Station (0.4 mgd)	$865,000
Transmission Pipeline (6 in dia., 2 miles)	$288,000
Elevation Storage Tank (1 mg)	$2,826,000
TOTAL COST OF FACILITIES	**$3,979,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,378,000
Environmental & Archaeology Studies and Mitigation	$56,000
Land Acquisition and Surveying (14 acres)	$14,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$150,000
TOTAL COST OF PROJECT	**$5,577,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$392,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$31,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$22,000
Pumping Energy Costs (0.08 $/kW-hr)	$3,000
Purchase of Water (300 ac-ft/yr @ $485.59 $/ac-ft)	$146,000
TOTAL ANNUAL COST	**$594,000**
Available Project Yield (ac-ft/yr)	300
Annual Cost of Water ($ per ac-ft), based on PF=1.5	$1,980
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=1.5	$673
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$6.08
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$2.07

Notes: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.41.3 Implementation Issues

Permitting Issues

The City of Smyer would require the necessary permits to construct the pipeline and elevated storage tank.

5.42 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.

5.42.1 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.

5.42.2 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 5.58 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
- 11,500 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)

Table 5.58. City of Seminole Costs (Sept 2018 Prices)

Item	Estimated Costs for Facilities
Primary Pump Station (1.34 MGD)	$1,307,000
Transmission Pipeline (10 in dia., 40 miles)	$839,000
Well Fields (Wells, Pumps, and Piping)	$14,811,000
Storage Tanks (Other Than at Booster Pump Stations)	$2,316,000
Water Treatment Plant (1.3 MGD)	$6,109,000
TOTAL COST OF FACILITIES	**$25,382,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$8,842,000

Table 5.58. City of Seminole Costs (Sept 2018 Prices)

Item	Estimated Costs for Facilities
Environmental & Archaeology Studies and Mitigation	$204,000
Land Acquisition and Surveying (40 acres)	$296,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$955,000
TOTAL COST OF PROJECT	**$35,679,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,510,000
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$180,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$33,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$1,281,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (1155383 kW-hr @ 0.08 $/kW-hr)	$92,000
Purchase of Water (ac-ft/yr @ $/ac-ft)	$0
TOTAL ANNUAL COST	**$4,096,000**
Available Project Yield (ac-ft/yr)	500
Annual Cost of Water ($ per ac-ft), based on PF=2	$8,192
Annual Cost of Water After Debt Service ($ per ac-ft), based on PF=2	$3,172
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$25.14
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$9.73
Note: One or more cost element has been calculated externally	
PN	*2/4/2020*

*Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018.
Acronyms: ROI = return on investment; kW-hr = kilowatt-hour; ac-ft/yr = acre-feet per year; PF = peak factor

5.42.3 Implementation Issues

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[220]. The project components are within an area defined as crops vegetation type[221]. Crops include a variety of cultivated row or cover crops. EMST data and TPWD's more detailed and recently produced vegetation data[222], 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[223]. 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 12 for utility line activities. TCEQ's Surface Water Quality Viewer[224] 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 north east 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 publically-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

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

[221] 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.

[222] TPWD. 2019. Ecological Mapping Systems of Texas, High Plains. Accessible to download online https://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector

[223] 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.

[224] TCEQ. 2020. Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed February 3, 2020.

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 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.

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.

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

5.43 Bailey County Water Supply Plan

Table 5-59 lists each WUG in Bailey County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-59. Bailey County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Muleshoe	1,659	1,269	Projected surplus
County-Other	91	0	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	No Mining demand
Irrigation	(45,670)	(45,670)	Projected shortage – see plan below
Livestock	7	(881)	Projected shortage – see plan below

ac-ft/yr = acre-feet per year

5.43.1 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).

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: 2020
- Unit Cost: $326/ ac-ft

b. Additional Groundwater Development (Ogallala Aquifer)

- Date to be Implemented: 2030
- Total Project Cost: $631,000

- Unit Cost: $204/ac-ft

Table 5-60. Recommended Plan Costs by Decade for the City of Muleshoe

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*1,883*	*1,773*	*1,659*	*1,533*	*1,401*	*1,269*
Conservation						
Supply From Plan Element (ac-ft/yr)	40	22	10	7	13	23
Annual Cost ($/yr)	$12,970	$7,159	$3,331	$2,384	$4,328	$7,506
Projected Surplus/(Shortage) after Conservation	*1,923*	*1,795*	*1,669*	*1,540*	*1,414*	*1,292*
Additional Groundwater Development (Ogallala Aquifer)						
Supply From Plan Element (ac-ft/yr)	–	240	240	240	240	240
Annual Cost ($/yr)	–	$49,000	$49,000	$5,000	$5,000	$5,000
Unit Cost ($/ac-ft)	–	$204	$204	$21	$21	$21

ac-ft/yr = acre-feet per year

5.43.2 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.

5.43.3 Manufacturing

There is no projected manufacturing demand in Bailey County.

5.43.4 Steam-Electric

There is no projected steam-electric demand in Bailey County.

5.43.5 Mining

There is no projected mining demand in Bailey County.

5.43.6 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 2020 and continuing throughout the remainder of 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.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-61. Recommended Plan Costs by Decade for Bailey County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(15,298)*	*(45,670)*	*(45,670)*	*(45,670)*	*(45,670)*	*(45,670)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	2,643	4,405	5,040	4,445	4,106	3,893
Annual Cost ($/yr)	$1,189,350	$1,982,250	$2,268,000	$2,000,250	$1,847,700	$1,751,850
Projected Surplus/(Shortage) after Conservation	*(12,655)*	*(41,265)*	*(40,630)*	*(41,225)*	*(41,564)*	*(41,777)*

ac-ft/yr = acre-feet per year

5.43.7 Livestock

Bailey County livestock obtains water supply from the Ogallala Aquifer. The water supply entities for Bailey County Livestock show a projected shortage beginning in 2050 and lasting through the remainder of 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. There are no additional strategies to meet the projected shortage for Bailey County livestock.

5.44 Briscoe County Water Supply Plan

Table 5-62 lists each WUG in Briscoe County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-62. Briscoe County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Quitaque	216	217	Projected surplus
City of Silverton	7	8	Projected surplus
County-Other	65	65	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	No Mining demand
Irrigation	(4,234)	(4,234)	Projected shortage - see plan below
Livestock	38	1	Projected surplus

ac-ft/yr = acre-feet per year

5.44.1 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-63. Recommended Plan Costs by Decade for the City of Quitaque

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*212*	*214*	*216*	*216*	*217*	*217*
Conservation						
Supply From Plan Element (ac-ft/yr)	5	3	2	2	2	2
Annual Cost ($/yr)	$1,709	$1,190	$671	$844	$670	$842
Projected Surplus/(Shortage) after Conservation	*217*	*217*	*218*	*218*	*219*	*219*

ac-ft/yr = acre-feet per year

5.44.2 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-64. Recommended Plan Costs by Decade for the City of Silverton

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*0*	*4*	*7*	*8*	*8*	*8*
Conservation						
Supply From Plan Element (ac-ft/yr)	3	–	–	–	–	–
Annual Cost ($/yr)	$1,094	–	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*3*	*4*	*7*	*8*	*8*	*8*

ac-ft/yr = acre-feet per year

5.44.3 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-65. Recommended Plan Costs by Decade for Briscoe County-Other

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*60*	*63*	*65*	*65*	*65*	*65*
Conservation						
Supply From Plan Element (ac-ft/yr)	8	6	5	6	6	7
Annual Cost ($/yr)	$2,818	$2,143	$1,709	$1,968	$2,225	$2,481
Projected Surplus/(Shortage) after Conservation	*68*	*69*	*70*	*71*	*71*	*72*

ac-ft/yr = acre-feet per year

5.44.4 Manufacturing

There is no projected manufacturing demand in Briscoe County.

5.44.5 Steam-Electric

There is no projected steam-electric demand in Briscoe County.

5.44.6 Mining

There is no projected mining demand in Briscoe County.

5.44.7 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 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; 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 that may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Briscoe County Irrigation.

b. Irrigation Water Conservation

- Date to be Implemented: 2020
- Unit Cost: $450/ac-ft

Table 5-66. Recommended Plan Costs by Decade for Briscoe County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*7,251*	*(4,234)*	*(4,234)*	*(4,234)*	*(4,234)*	*(4,234)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	793	1,321	1,448	1,248	1,136	1,066
Annual Cost ($/yr)	$356,850	$594,450	$651,600	$561,600	$511,200	$479,700
Projected Surplus/(Shortage) after Conservation	*8,044*	*(2,913)*	*(2,786)*	*(2,986)*	*(3,098)*	*(3,168)*

ac-ft/yr = acre-feet per year

5.44.8 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.

5.45 Castro County Water Supply Plan

Table 5-67 lists each WUG in Castro County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-67. Castro County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Dimmitt	2,718	2,588	Projected surplus
Hart Municipal Water System	371	350	Projected surplus
City of Nazareth	402	384	Projected surplus
County-Other	62	16	Projected surplus
Manufacturing	29	29	Projected surplus
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	No Mining demand
Irrigation	(207,865)	(207,865)	Projected shortage - see plan below.
Livestock	3,160	1,078	Projected surplus

ac-ft/yr = acre-feet per year

5.45.1 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.

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: 2020
- Unit Cost: $326/ac-ft

Table 5-68. Recommended Plan Costs by Decade for the City of Dimmitt

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*2,832*	*2,764*	*2,718*	*2,669*	*2,624*	*2,588*
Conservation						
Supply From Plan Element (ac-ft/yr)	39	23	11	7	13	19
Annual Cost ($/yr)	$12,717	$7,463	$3,481	$2,287	$4,151	$6,061
Projected Surplus/(Shortage) after Conservation	*2,871*	*2,787*	*2,729*	*2,676*	*2,637*	*2,607*

ac-ft/yr = acre-feet per year

5.45.2 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.

5.45.3 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.

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: 2020

- Unit Cost: $347/ac-ft

Table 5-69. Recommended Plan Costs by Decade for the City of Nazareth

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*418*	*408*	*402*	*395*	*389*	*384*
Conservation						
Supply From Plan Element (ac-ft/yr)	7	7	6	7	8	9
Annual Cost ($/yr)	$2,532	$2,493	$2,092	$2,433	$2,817	$3,237
Projected Surplus/(Shortage) after Conservation	*425*	*415*	*408*	*402*	*397*	*393*

ac-ft/yr = acre-feet per year

5.45.4 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.

5.45.5 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.

5.45.6 Steam-Electric

There is no projected steam-electric demand in Castro County.

5.45.7 Mining

There is no projected mining demand in Castro County.

5.45.8 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 2020 and continuing throughout the remainder of 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.

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: $450/ac-ft

Table 5-70. Recommended Plan Costs by Decade for Castro County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(125,042)*	*(207,865)*	*(207,865)*	*(207,865)*	*(207,865)*	*(207,865)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	11,396	18,994	21,034	17,711	16,280	15,603
Annual Cost ($/yr)	$5,128,200	$8,547,300	$9,465,300	$7,969,950	$7,326,000	$7,021,350
Projected Surplus/(Shortage) after Conservation	*(113,646)*	*(188,871)*	*(186,831)*	*(190,154)*	*(191,585)*	*(192,262)*

ac-ft/yr = acre-feet per year

5.45.9 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.

5.46 Cochran County Water Supply Plan

Table 5-71 lists each WUG in Cochran County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-71. Cochran County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
Morton PWS	127	126	Projected surplus

Table 5-71. Cochran County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Whiteface	193	190	Projected surplus
County-Other	29	7	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	102	231	Projected surplus
Irrigation	(22,283)	(22,283)	Projected shortage - see plan below
Livestock	565	556	Projected surplus

ac-ft/yr = acre-feet per year; PWS = public water system

5.46.1 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-72. Recommended Plan Costs by Decade for the Morton PWS

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*121*	*121*	*127*	*139*	*129*	*126*
Conservation						
Supply From Plan Element (ac-ft/yr)	15	6	4	5	7	9
Annual Cost ($/yr)	$5,365	$2,050	$1,370	$1,655	$2,293	$3,127
Projected Surplus/(Shortage) after Conservation	*136*	*127*	*131*	*144*	*136*	*135*

ac-ft/yr = acre-feet per year

5.46.2 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-73. Recommended Plan Costs by Decade for the City of Whiteface

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*196*	*192*	*193*	*194*	*191*	*190*
Conservation						
Supply From Plan Element (ac-ft/yr)	4	2	1	2	2	3
Annual Cost ($/yr)	$1,433	$821	$370	$775	$860	$1,032
Projected Surplus/(Shortage) after Conservation	*200*	*194*	*194*	*196*	*193*	*193*

ac-ft/yr = acre-feet per year

5.46.3 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-74. Recommended Plan Costs by Decade for Cochran County-Other

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*77*	*40*	*29*	*27*	*12*	*7*
Conservation						
Supply From Plan Element (ac-ft/yr)	15	14	15	16	19	20
Annual Cost ($/yr)	$5,271	$4,934	$5,189	$5,625	$6,606	$7,036
Projected Surplus/(Shortage) after Conservation	*92*	*54*	*44*	*43*	*31*	*27*

ac-ft/yr = acre-feet per year

5.46.4 Manufacturing

There is no projected manufacturing demand in Cochran County.

5.46.5 Steam-Electric

There is no projected steam-electric demand in Cochran County.

5.46.6 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.

5.46.7 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; 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.

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: 2020

- Unit Cost: $450/ac-ft

Table 5-75. Recommended Plan Costs by Decade for Cochran County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(24,789)*	*(29,351)*	*(22,283)*	*(22,283)*	*(22,283)*	*(22,283)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	2,984	4,972	5,936	5,300	4,771	4,407
Annual Cost ($/yr)	$1,342,800	$2,237,400	$2,671,200	$2,385,000	$2,146,950	$1,983,150
Projected Surplus/(Shortage) after Conservation	*(21,805)*	*(24,379)*	*(16,347)*	*(16,983)*	*(17,512)*	*(17,876)*

ac-ft/yr = acre-feet per year

5.46.8 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.

5.47 Crosby County Water Supply Plan

Table 5-76 lists each WUG in Crosby County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-76. Crosby County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Crosbyton	59	6	Projected surplus
City of Lorenzo	646	594	Projected surplus
City of Ralls	(98)	(146)	Projected shortage – see plan below
County-Other	27	3	Projected surplus
Manufacturing	0	0	Projected supply equals demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	312	615	Projected shortage - see plan below
Irrigation	(28,302)	(28,302)	Projected shortage - see plan below.
Livestock	23	2	Projected surplus

ac-ft/yr = acre-feet per year

5.47.1 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 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.

5.47.2 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-77. Recommended Plan Costs by Decade for the City of Lorenzo

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*673*	*658*	*646*	*629*	*608*	*594*
Conservation						
Supply From Plan Element (ac-ft/yr)	6	–	–	–	–	–
Annual Cost ($/yr)	$1,917	–	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*679*	*658*	*646*	*629*	*608*	*594*

ac-ft/yr = acre-feet per year

5.47.3 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). The City of Ralls is projected to have a shortage beginning in 2020 and continuing throughout the planning period. In addition to the water supply plan below, additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for the City of Ralls.

a. Additional Water Conservation

- Date to be Implemented: 2020
- Unit Cost: $347/ac-ft

b. Additional Groundwater Development

- Date to be Implemented: 2020
- Total Project Cost: $849,000
- Unit Cost: $450/ac-ft

Table 5-78. Recommended Plan Costs by Decade for the City of Ralls

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(78)*	*(89)*	*(98)*	*(112)*	*(129)*	*(146)*
Conservation						
Supply From Plan Element (ac-ft/yr)	6	–	–	–	–	–
Annual Cost ($/yr)	$1,917	–	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*(72)*	*(89)*	*(98)*	*(112)*	*(129)*	*(146)*
Additional Groundwater Supply (Ogallala)						
Supply From Plan Element (ac-ft/yr)	160	160	160	160	160	160
Annual Cost ($/yr)	$72,000	$72,000	$12,000	$12,000	$12,000	$12,000
Unit Cost ($/ac-ft)	$450	$450	$75	$75	$75	$75

ac-ft/yr = acre-feet per year

5.47.4 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.

5.47.5 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.

5.47.6 Steam-Electric

There is no projected steam-electric demand in Crosby County.

5.47.7 Mining

Crosby County mining obtains its water supply from groundwater from the Ogallala Aquifer. Crosby County mining is projected to have a water shortage beginning in 2020 (only in the Red River Basin portion of the County) and lasting through the remainder of the planning period.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Crosby County Mining.

a. Mining Water Conservation

- Date to be Implemented: 2020
- Unit Cost: Costs to implement conservation 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.

b. Additional Groundwater Development

- Date to be Implemented: 2020
- Total Project Cost: $1,298,000
- Unit Cost: $244/ac-ft

Table 5-79. Recommended Plan Costs by Decade for Crosby County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(368)*	*(363)*	*(322)*	*(280)*	*(243)*	*(210)*
Mining Water Conservation						
Supply From Plan Element (ac-ft/yr)	10	29	44	38	33	28
Annual Cost ($/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Projected Surplus/(Shortage) after Conservation	*(358)*	*(334)*	*(278)*	*(242)*	*(210)*	*(182)*
Additional Groundwater Supply (Ogallala)						
Supply From Plan Element (ac-ft/yr)	480	480	480	480	480	480
Annual Cost ($/yr)	$117,000	$117,000	$26,000	$26,000	$26,000	$26,000
Unit Cost ($/ac-ft)	$244	$244	$54	$54	$54	$54

ac-ft/yr – acre-feet per year

5.47.8 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 has a projected need beginning in 2020 in the Red River Basin and 2040 in the Brazos River Basin. 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.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-80. Recommended Plan Costs by Decade for Crosby County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*58,977*	*12,100*	*(28,302)*	*(28,302)*	*(28,302)*	*(28,302)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	3,228	5,379	7,530	5,960	5,169	4,739
Annual Cost ($/yr)	$1,452,600	$2,420,550	$3,388,500	$2,682,000	$2,326,050	$2,132,550
Projected Surplus/(Shortage) after Conservation	*62,205*	*17,479*	*(20,772)*	*(22,342)*	*(23,133)*	*(23,563)*

5.47.9 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.

5.48 Dawson County Water Supply Plan

Table 5-81 lists each WUG in Dawson County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-81. Dawson County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Lamesa	142	15	Projected surplus
City of O'Donnell			See Lynn County
County-Other	95	11	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	(1,546)	(1,546)	Projected shortage - see plan below
Irrigation	(13,244)	(13,243)	Projected shortage - see plan below
Livestock	143	136	Projected surplus

ac-ft/yr = acre-feet per year

5.48.1 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. There are no projected shortages for the City of Lamesa; however, additional conservation is recommended to achieve a per capita water use goal of 140 gpcd.

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: 2020
    - Unit Cost: $326/ac-ft

b. CRMWA I & II Supply Replacement (New Wells Only)
    - Date to be Implemented: 2040
    - Unit Cost: $159/ac-ft

c. CRMWA II New Supply (Wells and Pipeline)
    - Date to be Implemented: 2030

- Unit Cost: $799/ac-ft

d. CRMWA Supplies from Aquifer Storage and Recovery

- Date to be Implemented: 2030
- Unit Cost: $355/ac-ft

Table 5-82. Recommended Plan Costs by Decade for the City of Lamesa

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*42*	*50*	*142*	*263*	*60*	*15*
Conservation						
Supply From Plan Element (ac-ft/yr)	83	46	17	24	32	44
Annual Cost ($/yr)	$27,068	$15,111	$5,547	$7,740	$10,370	$14,381
Projected Surplus/(Shortage) after Conservation	*125*	*96*	*159*	*287*	*92*	*59*
Supply from CRMWA I & II Supply Replacement (New Wells Only)						
Supply From Plan Element (ac-ft/yr)	–	–	38	118	259	329
Annual Cost ($/yr)	–	–	$6,042	$18,762	$22,533	$28,623
Unit Cost ($/ac-ft)	–	–	$159	$159	$87	$87
Supply from CRMWA II New Supply (Wells and Pipeline)						
Supply From Plan Element (ac-ft/yr)	–	260	465	708	707	640
Annual Cost ($/yr)	–	$207,740	$371,535	$220,896	$220,584	$199,680
Unit Cost ($/ac-ft)	–	$799	$799	$312	$312	$312
CRMWA Aquifer Storage and Recovery (ASR)						
Supply From Plan Element (ac-ft/yr)	–	100	100	100	100	100
Annual Cost ($/yr)	–	$35,500	$35,500	$15,900	$15,900	$15,900

ac-ft/yr = acre-feet per year

5.48.2 City of O'Donnell

See Lynn County for the water supply plan for the City of O'Donnell.

5.48.3 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.

5.48.4 Manufacturing

There is no projected manufacturing demand in Dawson County.

5.48.5 Steam-Electric

There is no projected steam-electric demand in Dawson County.

5.48.6 Mining

Dawson County mining obtains its water supply from groundwater from the Ogallala Aquifer. Dawson County mining is projected to have a water shortage beginning in 2020 and lasting through the remainder of the planning period.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Dawson County Mining.

a. Mining Water Conservation

- Date to be Implemented: 2020
- Unit Cost: Costs to implement conservation 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.

b. Additional Groundwater Development

- Date to be Implemented: 2020
- Total Project Cost: $1,976,000
- Unit Cost: $121/ac-ft

Table 5-83. Recommended Plan Costs by Decade for Dawson County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(1,546)*	*(1,546)*	*(1,546)*	*(1,546)*	*(1,546)*	*(1,546)*
Mining Water Conservation						
Supply From Plan Element (ac-ft/yr)	18	54	91	91	91	91
Annual Cost ($/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Projected Surplus/(Shortage) after Conservation	*(1,528)*	*(1,492)*	*(1,455)*	*(1,455)*	*(1,455)*	*(1,455)*
Additional Groundwater Development (Ogallala)						
Supply From Plan Element (ac-ft/yr)	1,600	1,600	1,600	1,600	1,600	1,600
Annual Cost ($/yr)	$193,000	$193,000	$54,000	$54,000	$54,000	$54,000
Unit Cost ($/ac-ft)	$121	$121	$34	$34	$34	$34

ac-ft/yr = acre-feet per year

5.48.7 Irrigation

Dawson County irrigation obtains its water supply from groundwater from the Ogallala Aquifer. Dawson County Irrigation has a projected need beginning in 2040 (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; 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.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-84. Recommended Plan Costs by Decade for Dawson County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*50,523*	*13,437*	*(13,244)*	*(13,243)*	*(13,243)*	*(13,243)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	3,189	5,315	7,442	6,426	5,889	5,561
Annual Cost ($/yr)	$1,435,050	$2,391,750	$3,348,900	$2,891,700	$2,650,050	$2,502,450
Projected Surplus/(Shortage) after Conservation	*53,712*	*18,752*	*(5,802)*	*(6,817)*	*(7,354)*	*(7,682)*

ac-ft/yr = acre-feet per year

5.48.8 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.

5.49 Deaf Smith County Water Supply Plan

Table 5-85 lists each WUG in Deaf Smith County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-85. Deaf Smith County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Hereford	1,842	20	Projected surplus
County-Other	264	0	Projected surplus
Manufacturing	(1,103)	(1,103)	Projected shortage – see plan below
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	No Mining demand
Irrigation	(87,769)	(87,669)	Projected shortage – see plan below
Livestock	(844)	(3,515)	Projected shortage – see plan below

ac-ft/yr = acre-feet per year

5.49.1 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.

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: 2020
- Unit Cost: $326/ac-ft

Table 5-86. Recommended Plan Costs by Decade for the City of Hereford

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*2,902*	*2,405*	*1,842*	*1,170*	*623*	*20*
Conservation						
Supply From Plan Element (ac-ft/yr)	135	79	42	36	62	98
Annual Cost ($/yr)	$44,153	$25,783	$13,533	$11,702	$20,184	$32,038
Projected Surplus/(Shortage) after Conservation	*3,037*	*2,484*	*1,884*	*1,206*	*685*	*118*

ac-ft/yr = acre-feet per year

5.49.2 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.

5.49.3 Manufacturing

Deaf Smith County manufacturing obtains its water supply from groundwater from the Ogallala Aquifer. Deaf Smith County manufacturing is projected to have a water shortage beginning in 2020 and lasting through the remainder of the planning period.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Deaf Smith County manufacturing.

a. Industrial Water Conservation

- Date to be Implemented: 2020
- Unit Cost: Costs to implement conservation 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.

b. Additional Groundwater Development

- Date to be Implemented: 2020
- Total Project Cost: $3,222,000
- Unit Cost: $226/ac-ft

Table 5-87. Recommended Plan Costs by Decade for Deaf Smith County Manufacturing

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(998)*	*(1,103)*	*(1,103)*	*(1,103)*	*(1,103)*	*(1,103)*
Industrial Water Conservation						
Supply From Plan Element (ac-ft/yr)	10	33	55	55	55	55
Annual Cost ($/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Projected Surplus/(Shortage) after Conservation	*(988)*	*(1,070)*	*(1,048)*	*(1,048)*	*(1,048)*	*(1,048)*
Additional Groundwater Development (Ogallala)						
Supply From Plan Element (ac-ft/yr)	1,250	1,250	1,250	1,250	1,250	1,250
Annual Cost ($/yr)	$283,000	$283,000	$56,000	$56,000	$56,000	$56,000
Unit Cost ($/ac-ft)	$226	$226	$45	$45	$45	$45

ac-ft/yr = acre-feet per year

5.49.4 Steam-Electric

There is no projected steam-electric demand in Deaf Smith County.

5.49.5 Mining

There is no projected mining demand in Deaf Smith County.

5.49.6 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 2020 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; 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 that may necessitate more dry land farming in the region or using formerly irrigated land for other purposes such as livestock production.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-88. Recommended Plan Costs by Decade for Deaf Smith County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(18,836)*	*(87,769)*	*(87,769)*	*(87,769)*	*(87,719)*	*(87,669)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	6,300	10,501	11,389	9,679	8,781	8,276
Annual Cost ($/yr)	$2,835,000	$4,725,450	$5,125,050	$4,355,550	$3,951,450	$3,724,200
Projected Surplus/(Shortage) after Conservation	*(12,536)*	*(77,268)*	*(76,380)*	*(78,090)*	*(78,938)*	*(79,393)*

ac-ft/yr = acre-feet per year

5.49.7 Livestock

Deaf Smith County livestock obtains water supply from the Ogallala Aquifer. The water supply entities for Deaf Smith County livestock show a projected shortage beginning in 2020 for the Canadian River Basin portion of the County and 2040 for the Red River Basin portion of the County. 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. There are no additional strategies to meet the projected shortage for Deaf Smith County livestock.

5.50 Dickens County Water Supply Plan

Table 5-89 lists each WUG in Dickens County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-89. Dickens County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
Red River Authority of Texas	0	0	Projected supply equals demand in Region O – See the Region B plan for complete water supply plan
City of Spur	52	53	Projected surplus
County-Other	47	49	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	17	17	Projected surplus
Irrigation	1,337	1,337	Projected surplus

Table 5-89. Dickens County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
Livestock	61	12	Projected surplus

ac-ft/yr = acre-feet per year

5.50.1 Red River Authority of Texas

See the Region B plan for the water supply plan for the Red River Authority of Texas.

5.50.2 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-90. Recommended Plan Costs by Decade for the City of Spur

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*44*	*50*	*52*	*52*	*53*	*53*
Conservation						
Supply From Plan Element (ac-ft/yr)	3	–	–	–	–	–
Annual Cost ($/yr)	$1,163	–	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*47*	*50*	*52*	*52*	*53*	*53*

ac-ft/yr = acre-feet per year

5.50.3 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.

5.50.4 Manufacturing

There is no projected manufacturing demand in Dickens County.

5.50.5 Steam-Electric

There is no projected steam-electric demand in Dickens County.

5.50.6 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.

5.50.7 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.

5.50.8 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.

5.51 Floyd County Water Supply Plan

Table 5-91 lists each WUG in Floyd County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-91. Floyd County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) 2040 (ac-ft/yr)	Surplus/(Shortage) 2070 (ac-ft/yr)	Comment
City of Floydada	1,410	1,412	Projected surplus
City of Lockney	254	229	Projected surplus
County-Other	59	4	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	3	7	Projected surplus
Irrigation	(23,187)	(23,187)	Projected shortage - see plan below.
Livestock	427	371	Projected surplus

ac-ft/yr = acre-feet per year

5.51.1 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-92. Recommended Plan Costs by Decade for the City of Floydada

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*1,384*	*1,402*	*1,410*	*1,411*	*1,412*	*1,412*
Conservation						
Supply From Plan Element (ac-ft/yr)	12	–	–	–	–	–
Annual Cost ($/yr)	$4,114	–	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*1,396*	*1,402*	*1,410*	*1,411*	*1,412*	*1,412*

ac-ft/yr = acre-feet per year

5.51.2 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.

5.51.3 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.

5.51.4 Manufacturing

There is no projected manufacturing demand in Floyd County.

5.51.5 Steam-Electric

There is no projected steam-electric demand in Floyd County.

5.51.6 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.

5.51.7 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 2020 in the Red River Basin and 2050 in the Brazos River Basin. 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.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-93. Recommended Plan Costs by Decade for Floyd County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(19,644)*	*(23,187)*	*(23,187)*	*(23,187)*	*(23,187)*	*(23,187)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	3,865	6,442	7,175	6,215	5,663	5,336
Annual Cost ($/yr)	$1,739,250	$2,898,900	$3,228,750	$2,796,750	$2,548,350	$2,401,200
Projected Surplus/(Shortage) after Conservation	*(15,779)*	*(16,745)*	*(16,012)*	*(16,972)*	*(17,524)*	*(17,851)*

ac-ft/yr = acre-feet per year

5.51.8 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.

5.52 Gaines County Water Supply Plan

Table 5-94 lists each WUG in Gaines County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-94. Gaines County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Seagraves	519	463	Projected surplus
City of Seminole	(1,050)	(1,878)	Projected shortage – see plan below
County-Other	(452)	(1,880)	Projected shortage – see plan below
Manufacturing	(1,043)	(1,043)	Projected shortage – see plan below
Steam-Electric	0	0	No Steam-Electric demand
Mining	5,658	6,953	Projected surplus

Table 5-94. Gaines County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
Irrigation	(167,104)	(167,104)	Projected shortage - see plan below.
Livestock	74	66	Projected surplus

ac-ft/yr = acre-feet per year

5.52.1 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-95. Recommended Plan Costs by Decade for the City of Seagraves

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*546*	*536*	*519*	*495*	*480*	*463*
Conservation						
Supply From Plan Element (ac-ft/yr)	10	–	–	–	–	–
Annual Cost ($/yr)	$3,461	–	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*556*	*536*	*519*	*495*	*480*	*463*

ac-ft/yr = acre-feet per year

5.52.2 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 2020 and lasting through the planning period. The water supply plan for the City is below.

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: 2020
- Unit Cost: $326/ac-ft

b. Additional Groundwater Development (ETHP Aquifer)

- Date to be Implemented: 2020
- Total Project Cost: $37,482,000
- Unit Cost: $2,608/ac-ft

In addition to these recommended WMS's, brackish groundwater desalination from the Dockum Aquifer is an alternative strategy for the City of Seminole.

Table 5-96. Recommended Plan Costs by Decade for the City of Seminole

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(551)*	*(774)*	*(1,050)*	*(1,363)*	*(1,614)*	*(1,878)*
Conservation						
Supply From Plan Element (ac-ft/yr)	120	108	104	115	137	165
Annual Cost ($/yr)	$39,214	$35,062	$33,789	$37,451	$44,760	$53,687
Projected Surplus/(Shortage) after Conservation	*(431)*	*(666)*	*(946)*	*(1,248)*	*(1,477)*	*(1,713)*
Additional Groundwater Development (ETHP Aquifer)						
Supply From Plan Element (ac-ft/yr)	1,225	1,225	1,725	1,725	1,725	1,725
Annual Cost ($/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

5.52.3 County-Other

Gaines County-Other obtains its water supply from groundwater from the Ogallala Aquifer. Gaines County-Other is projected to have a water shortage beginning in 2030 and continuing throughout the remainder of the planning period. The water supply plan for Gaines County-Other is below. Conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Gaines County-Other.

a. Additional Water Conservation

- Date to be Implemented: 2020
- Unit Cost: $347/ac-ft

b. Additional Groundwater Development

- Date to be Implemented: 2030
- Total Project Cost: $4,159,000
- Unit Cost: $208/ac-ft

Table 5-97. Recommended Plan Costs by Decade for Gaines County-Other

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*350*	*(10)*	*(452)*	*(938)*	*(1,398)*	*(1,880)*
Conservation						
Supply From Plan Element (ac-ft/yr)	8	6	5	6	6	7
Annual Cost ($/yr)	$2,818	$2,143	$1,709	$1,968	$2,225	$2,481
Projected Surplus/(Shortage) after Conservation	*358*	*(4)*	*(447)*	*(932)*	*(1,392)*	*(1,873)*
Additional Groundwater Development (Ogallala)						
Supply From Plan Element (ac-ft/yr)		1,930	1,930	1,930	1,930	1,930
Annual Cost ($/yr)		$401,000	$401,000	$108,000	$108,000	$108,000
Unit Cost ($/ac-ft)		$208	$208	$56	$56	$56

ac-ft/yr = acre-feet per year

5.52.4 Manufacturing

Gaines County manufacturing obtains its water supply from groundwater from the Ogallala Aquifer. Gaines County manufacturing is projected to have a water shortage beginning in 2020 and lasting through the remainder of the planning period.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Gaines County Manufacturing.

a. Industrial Water Conservation

- Date to be Implemented: 2020
- Unit Cost: Costs to implement conservation 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.

b. Additional Groundwater Development

- Date to be Implemented: 2020
- Total Project Cost: $3,066,000
- Unit Cost: $231/ac-ft

Table 5-98. Recommended Plan Costs by Decade for Gaines County Manufacturing

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(968)*	*(1,043)*	*(1,043)*	*(1,043)*	*(1,043)*	*(1,043)*
Industrial Water Conservation						
Supply From Plan Element (ac-ft/yr)	15	48	79	79	79	79
Annual Cost ($/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Projected Surplus/(Shortage) after Conservation	*(988)*	*(1,070)*	*(964)*	*(964)*	*(964)*	*(964)*
Additional Groundwater Development (Ogallala)						
Supply From Plan Element (ac-ft/yr)	1,200	1,200	1,200	1,200	1,200	1,200
Annual Cost ($/yr)	$277,000	$277,000	$61,000	$61,000	$61,000	$61,000
Unit Cost ($/ac-ft)	$231	$231	$51	$51	$51	$51

ac-ft/yr = acre-feet per year

5.52.5 Steam-Electric

There is no projected steam-electric demand in Gaines County.

5.52.6 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.

5.52.7 Irrigation

Gaines County irrigation obtains its water supply from groundwater from the Ogallala Aquifer. Gaines County irrigation has a projected need beginning in 2020 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; 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.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-99. Recommended Plan Costs by Decade for Gaines County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(105,558)*	*(167,104)*	*(167,104)*	*(167,104)*	*(167,104)*	*(167,104)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	10,874	18,124	22,991	21,475	20,432	19,771
Annual Cost ($/yr)	$4,893,300	$8,155,800	$10,345,950	$9,663,750	$9,194,400	$8,896,950
Projected Surplus/(Shortage) after Conservation	*(94,684)*	*(148,980)*	*(144,113)*	*(145,629)*	*(146,672)*	*(147,333)*

ac-ft/yr = acre-feet per year

5.52.8 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.

5.53 Garza County Water Supply Plan

Table 5-100 lists each WUG in Garza County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-100. Garza County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Post	104	0	Projected surplus
County-Other	47	39	Projected surplus
Manufacturing	0	0	Projected supply equals demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	106	380	Projected surplus
Irrigation	3,014	1,474	Projected surplus
Livestock	22	3	Projected surplus

ac-ft/yr = acre-feet per year

5.53.1 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.

5.53.2 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.

5.53.3 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.

5.53.4 Steam-Electric

There is no projected steam-electric demand in Garza County.

5.53.5 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.

5.53.6 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.

5.53.7 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.

5.54 Hale County Water Supply Plan

Table 5-101 lists each WUG in Hale County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-101. Hale County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Abernathy	1,089	1,021	Projected surplus
City of Hale Center	692	697	Projected surplus
Petersburg Municipal Water	265	258	Projected surplus
City of Plainview	3,955	3,623	Projected surplus
County-Other	249	231	Projected surplus
Manufacturing	(3,660)	(3,660)	Projected shortage – see plan below
Steam-Electric	0	0	Projected supply equals demand
Mining	(807)	(447)	Projected shortage - see plan below.
Irrigation	(211,765)	(211,765)	Projected shortage - see plan below.
Livestock	773	0	Projected surplus

ac-ft/yr = acre-feet per year

5.54.1 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-102. Recommended Plan Costs by Decade for the City of Abernathy

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*1,136*	*1,108*	*1,089*	*1,079*	*1,047*	*1,021*
Conservation						
Supply From Plan Element (ac-ft/yr)	29	18	13	10	13	18
Annual Cost ($/yr)	$10,066	$6,466	$4,334	$3,445	$4,211	$6,004
Projected Surplus/(Shortage) after Conservation	*1,165*	*1,126*	*1,102*	*1,089*	*1,060*	*1,039*

ac-ft/yr = acre-feet per year

5.54.2 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.

5.54.3 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-103. Recommended Plan Costs by Decade for the Petersburg Municipal Water System

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*273*	*265*	*265*	*269*	*261*	*258*
Conservation						
Supply From Plan Element (ac-ft/yr)	13	10	6	6	7	9
Annual Cost ($/yr)	$4,602	$3,329	$1,941	$2,123	$2,526	$2,968
Projected Surplus/(Shortage) after Conservation	*286*	*275*	*271*	*275*	*268*	*267*

ac-ft/yr = acre-feet per year

5.54.4 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.

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: 2020
- Unit Cost: $326/ac-ft

b. CRMWA I & II Supply Replacement (New Wells Only)
- Date to be Implemented: 2040
- Unit Cost: $159/ac-ft

c. CRMWA II New Supply (Wells and Pipeline)
- Date to be Implemented: 2030
- Unit Cost: $799/ac-ft

d. CRMWA Supplies from Aquifer Storage and Recovery
- Date to be Implemented: 2030
- Unit Cost: $355/ac-ft

e. City of Plainview Aquifer Storage and Recovery
- Date to be Implemented: 2030
- Unit Cost: $1,430/ac-ft
- Capital Cost: $8,857,000

f. City of Plainview Reuse (Phase I Only)
- Date to be Implemented: 2040
- Unit Cost: $2,511/ac-ft
- Capital Cost: $10,349,000

Table 5-104. Recommended Plan Costs by Decade for the City of Plainview

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*3,846*	*3,997*	*3,955*	*3,964*	*3,677*	*3,623*
Conservation						
Supply From Plan Element (ac-ft/yr)	130	38	–	–	–	–
Annual Cost ($/yr)	$42,356	$12,429	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*3,976*	*4,035*	*3,955*	*3,964*	*3,677*	*3,623*
Supply from CRMWA I & II Supply Replacement (New Wells Only)						
Supply From Plan Element (ac-ft/yr)	–	–	53	151	330	419
Annual Cost ($/yr)	–	–	$8,427	$24,009	$28,710	$36,453
Unit Cost ($/ac-ft)	–	–	$159	$159	$87	$87
Supply from CRMWA II New Supply (Wells and Pipeline)						
Supply From Plan Element (ac-ft/yr)	–	354	298	530	527	441
Annual Cost ($/yr)	–	$282,846	$238,102	$165,360	$164,424	$137,592
Unit Cost ($/ac-ft)	–	$799	$799	$312	$312	$312
CRMWA Aquifer Storage and Recovery (ASR)						
Supply From Plan Element (ac-ft/yr)	–	200	500	500	500	500
Annual Cost ($/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	$798
City of Plainview Reuse (Phase I Only)						
Supply From Plan Element (ac-ft/yr)	–	–	560	560	560	560
Annual Cost ($/yr)	–	–	$1,406,000	$1,406,000	$678,000	$678,000
Unit Cost ($/ac-ft)	–	–	$2,511	$2,511	$1,211	$1,211

ac-ft/yr = acre-feet per year

5.54.5 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.

5.54.6 Manufacturing

Hale County manufacturing obtains its water supply from groundwater from the Ogallala Aquifer. Hale County manufacturing is projected to have a water shortage beginning in 2020 and lasting through the remainder of the planning period.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Hale County Manufacturing.

a. Industrial Water Conservation

- Date to be Implemented: 2020
- Unit Cost: Costs to implement conservation 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.

b. Additional Groundwater Development

- Date to be Implemented: 2020
- Project Cost: $8,932,000
- Unit Cost: $207/ac-ft

Table 5-105. Recommended Plan Costs by Decade for Hale County Manufacturing

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(2,967)*	*(3,660)*	*(3,660)*	*(3,660)*	*(3,660)*	*(3,660)*
Industrial Water Conservation						
Supply From Plan Element (ac-ft/yr)	44	152	254	254	254	254
Annual Cost ($/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Projected Surplus/(Shortage) after Conservation	*(2,923)*	*(3,508)*	*(3,406)*	*(3,406)*	*(3,406)*	*(3,406)*
Additional Groundwater Development (Ogallala)						
Supply From Plan Element (ac-ft/yr)	4,000	4,000	4,000	4,000	4,000	4,000
Annual Cost ($/yr)	$829,000	$829,000	$201,000	$201,000	$201,000	$201,000
Unit Cost ($/ac-ft)	$207	$207	$50	$50	$50	$50

ac-ft/yr = acre-feet per year

5.54.7 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.

5.54.8 Mining

Hale County mining obtains its water supply from groundwater from the Ogallala Aquifer. Hale County mining is projected to have a water shortage beginning in 2020 and lasting through the remainder of the planning period.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Hale County mining.

a. Mining Water Conservation

- Date to be Implemented: 2020
- Unit Cost: Costs to implement conservation 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.

b. Additional Groundwater Development

- Date to be Implemented: 2020
- Project Cost: $1,562,000
- Unit Cost: $166/ac-ft

Table 5-106. Recommended Plan Costs by Decade for Hale County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(953)*	*(937)*	*(807)*	*(671)*	*(551)*	*(447)*
Mining Water Conservation						
Supply From Plan Element (ac-ft/yr)	12	35	51	44	38	33
Annual Cost ($/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Projected Surplus/(Shortage) after Conservation	*(941)*	*(902)*	*(756)*	*(627)*	*(513)*	*(414)*
Additional Groundwater Development (Ogallala)						
Supply From Plan Element (ac-ft/yr)	965	965	965	965	965	965
Annual Cost ($/yr)	$160,000	$160,000	$50,000	$50,000	$50,000	$50,000
Unit Cost ($/ac-ft)	$166	$166	$52	$52	$52	$52

ac-ft/yr = acre-feet per year

5.54.9 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

2020 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; 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.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-107. Recommended Plan Costs by Decade for Hale County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(106,582)*	*(211,765)*	*(211,765)*	*(211,765)*	*(211,765)*	*(211,765)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	9,316	15,527	18,639	17,103	16,335	15,930
Annual Cost ($/yr)	$4,192,200	$6,987,150	$8,387,550	$7,696,350	$7,350,750	$7,168,500
Projected Surplus/(Shortage) after Conservation	*(97,266)*	*(196,238)*	*(193,126)*	*(194,662)*	*(195,430)*	*(195,835)*

ac-ft/yr = acre-feet per year

5.54.10 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.

5.55 Hockley County Water Supply Plan

Table 5-108 lists each WUG in Hockley County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-108. Hockley County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Anton	670	659	Projected surplus
City of Levelland	2,456	2,114	Projected surplus
City of Sundown	413	378	Projected surplus
County-Other	199	140	Projected surplus
Manufacturing	9	9	Projected surplus
Steam-Electric	0	0	No Steam-Electric demand
Mining	1,530	1,532	Projected surplus
Irrigation	(27,096)	(27,096)	Projected shortage - see plan below.
Livestock	264	251	Projected surplus

ac-ft/yr = acre-feet per year

5.55.1 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.

5.55.2 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.

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: 2020
- Unit Cost: $326/ac-ft

b. CRMWA I & II Supply Replacement (New Wells Only)

- Date to be Implemented: 2040
- Unit Cost: $159/ac-ft

c. CRMWA II New Supply (Wells and Pipeline)

- Date to be Implemented: 2030
- Unit Cost: $799/ac-ft

d. CRMWA Supplies from Aquifer Storage and Recovery

- Date to be Implemented: 2030
- Unit Cost: $355/ac-ft

Table 5-109. Recommended Plan Costs by Decade for the City of Levelland

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*2,773*	*2,608*	*2,456*	*2,333*	*2,146*	*2,114*
Conservation						
Supply From Plan Element (ac-ft/yr)	45	–	–	–	–	–
Annual Cost ($/yr)	$14,677	–	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*2,818*	*2,608*	*2,456*	*2,333*	*2,146*	*2,144*
Supply from CRMWA I & II Supply Replacement (New Wells Only)						
Supply From Plan Element (ac-ft/yr)	–	–	41	111	252	328
Annual Cost ($/yr)	–	–	$6,519	$17,649	$21,924	$28,536
Unit Cost ($/ac-ft)	–	–	$159	$159	$87	$87
Supply from CRMWA II New Supply (Wells and Pipeline)						
Supply From Plan Element (ac-ft/yr)	–	343	114	261	284	238
Annual Cost ($/yr)	–	$274,057	$91,086	$81,432	$88,608	$74,256
Unit Cost ($/ac-ft)	–	$799	$799	$312	$312	$312
CRMWA Aquifer Storage and Recovery (ASR)						
Supply From Plan Element (ac-ft/yr)	–	100	500	500	500	500
Annual Cost ($/yr)	–	$35,500	$177,500	$79,500	$79,500	$79,500

ac-ft/yr = acre-feet per year

5.55.3 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.

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.

b. Additional Water Conservation

- Date to be Implemented: 2020
- Unit Cost: $347/ac-ft

Table 5-110. Recommended Plan Costs by Decade for the City of Sundown

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*443*	*425*	*413*	*411*	*391*	*378*
Conservation						
Supply From Plan Element (ac-ft/yr)	17	11	10	11	14	17
Annual Cost ($/yr)	$5,837	$3,973	$3,509	$3,982	$4,956	$5,941
Projected Surplus/(Shortage) after Conservation	*460*	*436*	*423*	*422*	*405*	*395*

ac-ft/yr = acre-feet per year

5.55.4 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 to water. This additional suppy 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.

5.55.5 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.

5.55.6 Steam-Electric

There is no projected steam-electric demand in Hockley County.

5.55.7 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.

5.55.8 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 2050 in the Colorado River Basin. 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.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-111. Recommended Plan Costs by Decade for Hockley County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*6,867*	*(38,249)*	*(27,096)*	*(27,096)*	*(27,096)*	*(27,096)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	3,956	6,593	6,842	5,863	5,402	5,152
Annual Cost ($/yr)	$1,780,200	$2,966,850	$3,078,900	$2,638,350	$2,430,900	$2,318,400
Projected Surplus/(Shortage) after Conservation	*10,823*	*(31,656)*	*(20,254)*	*(21,233)*	*(21,694)*	*(21,944)*

ac-ft/yr = acre-feet per year

5.55.9 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.

5.56 Lamb County Water Supply Plan

Table 5-112 lists each WUG in Lamb County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-112. Lamb County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Amherst	124	110	Projected surplus
City of Earth	504	504	Projected surplus
City of Littlefield	1,451	1,464	Projected surplus
City of Olton	901	916	Projected surplus
City of Sudan	146	118	Projected surplus
County-Other	124	83	Projected surplus
Manufacturing	60	60	Projected surplus
Steam-Electric	2,216	2,216	Projected surplus
Mining	(405)	(225)	Projected shortage – see plan below
Irrigation	(186,771)	(186,771)	Projected shortage – see plan below
Livestock	315	(1,046)	Projected shortage – see plan below

ac-ft/yr = acre-feet per year

5.56.1 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.

5.56.2 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 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.

5.56.3 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.

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: 2030
- Project Cost: $902,000
- Unit Cost: $329/ac-ft

Table 5-113. Recommended Plan Costs by Decade for the City of Littlefied

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*1,391*	*1,422*	*1,451*	*1,462*	*1,464*	*1,464*
Additional Groundwater Supply (Ogallala Aquifer)						
Supply From Plan Element (ac-ft/yr)	–	240	240	240	240	240
Annual Cost ($/yr)	–	$79,000	$79,000	$16,000	$16,000	$16,000
Unit Cost ($/ac-ft)	–	$329	$329	$67	$67	$67

ac-ft/yr = acre-feet per year

5.56.4 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-114. Recommended Plan Costs by Decade for the City of Olton

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*886*	*891*	*901*	*915*	*914*	*916*
Conservation						
Supply From Plan Element (ac-ft/yr)	17	9	3	1	2	5
Annual Cost ($/yr)	$5,929	$3,251	$1,181	$373	$730	$1,603
Projected Surplus/(Shortage) after Conservation	*903*	*900*	*904*	*916*	*916*	*921*

ac-ft/yr = acre-feet per year

5.56.5 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-115. Recommended Plan Costs by Decade for the City of Sudan

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*169*	*155*	*146*	*141*	*127*	*118*
Conservation						
Supply From Plan Element (ac-ft/yr)	10	6	3	3	5	5
Annual Cost ($/yr)	$3,454	$1,968	$1,186	$948	$1,582	$1,852
Projected Surplus/(Shortage) after Conservation	*179*	*161*	*149*	*144*	*132*	*123*

ac-ft/yr = acre-feet per year

5.56.6 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.

5.56.7 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.

5.56.8 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.[225] Groundwater availability studies prepared by Lamb County steam-electric generation operators 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.

5.56.9 Mining

Lamb County mining obtains its water supply from groundwater from the Ogallala Aquifer. Lamb County mining is projected to have a water shortage beginning in 2020 and lasting through the remainder of the planning period.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Lamb County Mining.

a. Mining Water Conservation

- Date to be Implemented: 2020
- Unit Cost: Costs to implement conservation 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.

b. Additional Groundwater Development

- Date to be Implemented: 2020
- Project Cost: $1,019,000
- Unit Cost: $202/ac-ft

Table 5-116. Recommended Plan Costs by Decade for Lamb County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(478)*	*(471)*	*(405)*	*(337)*	*(277)*	*(225)*
Industrial Water Conservation						
Supply From Plan Element (ac-ft/yr)	6	17	26	22	19	17
Annual Cost ($/yr)	N/A	N/A	N/A	N/A	N/A	N/A

[225] WSP, USA, 2019. 2019 Groundwater Modeling Results. Prepared for Xcel Energy.

Table 5-116. Recommended Plan Costs by Decade for Lamb County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) after Conservation	*(472)*	*(454)*	*(379)*	*(315)*	*(258)*	*(208)*
Additional Groundwater Development (Ogallala)						
Supply From Plan Element (ac-ft/yr)	480	480	480	480	480	480
Annual Cost ($/yr)	$97,000	$97,000	$25,000	$25,000	$25,000	$25,000
Unit Cost ($/ac-ft)	$202	$202	$52	$52	$52	$52

ac-ft/yr = acre-feet per year

5.56.10 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 2020 and continuing throughout the remainder of 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.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-117. Recommended Plan Costs by Decade for Lamb County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(75,376)*	*(186,771)*	*(186,771)*	*(186,771)*	*(186,771)*	*(186,771)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	7,784	12,973	15,301	14,277	13,826	13,593
Annual Cost ($/yr)	$3,502,800	$5,837,850	$6,885,450	$6,424,650	$6,221,700	$6,116,850
Projected Surplus/(Shortage) after Conservation	*(67,592)*	*(173,798)*	*(171,470)*	*(172,494)*	*(172,945)*	*(173,178)*

ac-ft/yr = acre-feet per year

5.56.11 Livestock

Lamb County livestock obtains water supply from the Ogallala Aquifer. The water supply entities for Lamb County Livestock show a projected shortage beginning in 2050 and lasting through the remainder of 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. There are no additional strategies to meet the projected shortage for Lamb County livestock.

5.57 Lubbock County Water Supply Plan

Table 5-118 lists each WUG in Lubbock County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-118. Lubbock County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Abernathy			See Hale County Plan
City of Idalou	855	803	Projected surplus
City of Lubbock	(13,818)	(32,370)	Projected shortage – see plan below
City of New Deal	358	328	Projected surplus
City of Ransom Canyon	193	121	Projected surplus
City of Shallowater	159	4	Projected surplus
City of Slaton	1,190	1,006	Projected surplus
City of Wolfforth	119	(366)	Projected shortage - see plan below.
County-Other	3,111	1	Projected surplus
Manufacturing	(676)	(676)	Projected shortage – see plan below
Steam-Electric	4,404	2,164	Projected surplus
Mining	(4,931)	(3,332)	Projected shortage - see plan below.
Irrigation	(41,064)	(41,064)	Projected shortage - see plan below.
Livestock	117	3	Projected surplus

ac-ft/yr = acre-feet per year

5.57.1 City of Abernathy

See Hale County Plan.

5.57.2 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-119. Recommended Plan Costs by Decade for the City of Idalou

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*872*	*865*	*855*	*839*	*821*	*803*
Conservation						
Supply From Plan Element (ac-ft/yr)	13	3	–	–	–	–
Annual Cost ($/yr)	$4,344	$964	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*885*	*868*	*855*	*839*	*821*	*803*

ac-ft/yr = acre-feet per year

5.57.3 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 considers 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.

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.

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: 2020
   - Unit Cost: $288/ac-ft

b. CRMWA I & II Supply Replacement (New Wells Only)
   - Date to be Implemented: 2040
   - Unit Cost: $159/ac-ft

c. CRMWA II New Supply (Wells and Pipeline)
   - Date to be Implemented: 2030
   - Unit Cost: $799/ac-ft

d. Bailey County Well Field (BCWF) Capacity Maintenance
   - Date to be Implemented: 2020
   - Project Cost: $94,704,000
   - Unit Cost: $3,067/ac-ft

e. Lake Alan Henry Phase 2
   - Date to be Implemented: 2030

- Project Cost: $103,152,000
- Unit Cost: $2,206/ac-ft

f. Jim Bertram Lake 7

- Date to be Implemented: 2040
- Project Cost: $251,043,000
- Unit Cost: $1,713/ac-ft

g. CRMWA Supplies to ASR

- Date to be Implemented: 2060
- Project Cost: $103,917,000
- Unit Cost: $906/ac-ft

h. Direct Potable Reuse to North Water Treatment Plant

- Date to be Implemented: 2070
- Project Cost: $125,890,000
- Unit Cost: $1,421/ac-ft

Table 5-120. Recommended Plan Costs by Decade for the City of Lubbock

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(3,716)*	*(8,472)*	*(13,818)*	*(19,356)*	*(26,501)*	*(32,370)*
Conservation						
Supply From Plan Element (ac-ft/yr)	1,289	393	–	–	–	–
Annual Cost ($/yr)	$371,199	$113,303	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*(2,427)*	*(8,079)*	*(13,818)*	*(19,356)*	*(26,501)*	*(32,370)*
Supply from CRMWA I & II Supply Replacement (New Wells Only)						
Supply From Plan Element (ac-ft/yr)	–	–	711	2,024	4,431	5,627
Annual Cost ($/yr)	–	–	$113,049	$321,816	$385,497	$489,549
Unit Cost ($/ac-ft)	–	–	$159	$159	$87	$87
Supply from CRMWA II New Supply (Wells and Pipeline)						
Supply From Plan Element (ac-ft/yr)	–	1,701	4,979	8,112	8,092	6,942
Annual Cost ($/yr)	–	$1,359,099	$3,978,221	$2,530,944	$2,524,704	$2,165,904
Unit Cost ($/ac-ft)	–	$799	$799	$312	$312	$312
BCWF Capacity Maintenance						
Supply From Plan Element (ac-ft/yr)	2,431	2,431	2,431	2,431	2,431	2,431
Annual Cost ($/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
Lake Alan Henry Phase 2						

Table 5-120. Recommended Plan Costs by Decade for the City of Lubbock

Plan Element	2020	2030	2040	2050	2060	2070
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	$783
Jim Bertram Lake 7						
Supply From Plan Element (ac-ft/yr)	–	–	11,975	11,975	11,975	11,975
Annual Cost ($/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

5.57.4 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; however due to recent growth trends additional groundwater development is included as an alternative water management strategy. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

5.57.5 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 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-121. Recommended Plan Costs by Decade for the City of Ransom Canyon

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*233*	*214*	*193*	*169*	*145*	*121*
Conservation						
Supply From Plan Element (ac-ft/yr)	17	14	13	14	17	20
Annual Cost ($/yr)	$5,850	$4,905	$4,638	$4,838	$5,771	$6,782
Projected Surplus/(Shortage) after Conservation	*250*	*220*	*206*	*183*	*162*	*141*

ac-ft/yr = acre-feet per year

5.57.6 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 no projected shortages for the City of Shallowater 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.

5.57.7 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 no projected shortages for the City of Slaton; however additional water supply from CRMWA is included in the City's water supply plan. Additional conservation was considered; however, the entity's current per capita use rate is below the selected target rate of 140 gpcd.

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 I & II Supply Replacement (New Wells Only)

- Date to be Implemented: 2040
- Unit Cost: $159/ac-ft

b. CRMWA II New Supply (Wells and Pipeline)

- Date to be Implemented: 2030
- Unit Cost: $799/ac-ft

Table 5-122. Recommended Plan Costs by Decade for the City of Slaton

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*1,334*	*1,273*	*1,190*	*1,098*	*1,015*	*1,006*
Supply from CRMWA I & II Supply Replacement (New Wells Only)						
Supply From Plan Element (ac-ft/yr)	–	–	24	64	139	177
Annual Cost ($/yr)	–	–	$3,816	$10,176	$12,093	$15,399
Unit Cost ($/ac-ft)	–	–	$159	$159	$87	$87
Supply from CRMWA II New Supply (Wells and Pipeline)						
Supply From Plan Element (ac-ft/yr)	–	264	357	435	433	397
Annual Cost ($/yr)	–	$210,936	$285,243	$135,720	$135,096	$123,864
Unit Cost ($/ac-ft)	–	$799	$799	$312	$312	$312

ac-ft/yr = acre-feet per year

5.57.8 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 2050 and continuing throughout the planning period. The recommended water supply plan is shown below.

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: 2020
- Unit Cost: $326/ac-ft

b. Additional Groundwater Development (Ogallala Aquifer)

- Date to be Implemented: 2040
- Project Cost: $9,968,000
- Unit Cost: $2,021/ac-ft

Table 5-123. Recommended Plan Costs by Decade for the City of Wolfforth

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*415*	*268*	*119*	*(43)*	*(204)*	*(366)*
Conservation						
Supply From Plan Element (ac-ft/yr)	21	10	4	4	9	17
Annual Cost ($/yr)	$6,933	$3,360	$1,379	$1,383	$2,948	$5,616

Table 5-123. Recommended Plan Costs by Decade for the City of Wolfforth

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) after Conservation	*436*	*278*	*123*	*(39)*	*(195)*	*(349)*
Additional Groundwater Development (Ogallala Aquifer)						
Supply From Plan Element (ac-ft/yr)	—	—	800	800	800	800
Annual Cost ($/yr)	—	—	$1,616,800	$1,616,800	$635,200	$635,200
Unit Cost ($/yr)	—	—	$2,021	$2,021	$794	$794

ac-ft/yr = acre-feet per year

5.57.9 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.

5.57.10 Manufacturing

Lubbock County manufacturing obtains its water supply from groundwater from the Ogallala Aquifer. Lubbock County manufacturing is projected to have a water shortage beginning in 2020 and lasting through the remainder of the planning period.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Lubbock County Manufacturing.

a. Industrial Water Conservation

- Date to be Implemented: 2020
- Unit Cost: Costs to implement conservation 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.

b. Additional Groundwater Development

- Date to be Implemented: 2020
- Project Cost: $2,742,000
- Unit Cost: $291/ac-ft

Table 5-124. Recommended Plan Costs by Decade for Lubbock County Manufacturing

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(521)*	*(676)*	*(676)*	*(676)*	*(676)*	*(676)*
Industrial Water Conservation						
Supply From Plan Element (ac-ft/yr)	9	30	51	51	51	51
Annual Cost ($/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Projected Surplus/(Shortage) after Conservation	*(512)*	*(646)*	*(625)*	*(625)*	*(625)*	*(625)*
Additional Groundwater Development (Ogallala)						
Supply From Plan Element (ac-ft/yr)	800	800	800	800	800	800
Annual Cost ($/yr)	$233,000	$233,000	$40,000	$40,000	$40,000	$40,000
Unit Cost ($/ac-ft)	$291	$291	$50	$50	$50	$50

ac-ft/yr = acre-feet per year

5.57.11 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.

5.57.12 Mining

Lubbock County mining obtains its water supply from groundwater from the Ogallala Aquifer. Lubbock County mining is projected to have a water shortage beginning in 2020 and lasting through the remainder of the planning period.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Lubbock County Mining.

a. Mining Water Conservation

- Date to be Implemented: 2020
- Unit Cost: Costs to implement conservation 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.

b. Additional Groundwater Development (Ogallala Aquifer)

- Date to be Implemented: 2020

- Project Cost: $18,678,000
- Unit Cost: $265/ac-ft

Table 5-125. Recommended Plan Costs by Decade for Lubbock County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(5,372)*	*(5,443)*	*(4,931)*	*(4,320)*	*(3,781)*	*(3,332)*
Mining Water Conservation						
Supply From Plan Element (ac-ft/yr)	64	193	296	265	238	216
Annual Cost ($/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Projected Surplus/(Shortage) after Conservation	*(5,308)*	*(5,250)*	*(4,635)*	*(4,055)*	*(3,543)*	*(3,116)*
Additional Groundwater Development (Ogallala)						
Supply From Plan Element (ac-ft/yr)	5,560	5,560	5,560	5,560	5,560	5,560
Annual Cost ($/yr)	$1,471,000	$1,471,000	$157,000	$157,000	$157,000	$157,000
Unit Cost ($/ac-ft)	$265	$265	$28	$28	$28	$28

ac-ft/yr = acre-feet per year

5.57.13 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 throughout the remainder of 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.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-126. Recommended Plan Costs by Decade for Lubbock County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(3,892)*	*(40,264)*	*(41,064)*	*(41,064)*	*(41,064)*	*(41,064)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	4,346	7,243	9,282	8,702	8,288	7,998
Annual Cost ($/yr)	$1,955,700	$3,259,350	$4,176,900	$3,915,900	$3,729,600	$3,599,100
Projected Surplus/(Shortage) after Conservation	*454*	*(33,021)*	*(31,782)*	*(32,362)*	*(32,776)*	*(33,066)*

ac-ft/yr = acre-feet per year

5.57.14 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.

5.58 Lynn County Water Supply Plan

Table 5-127 lists each WUG in Lynn County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-127. Lynn County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of O'Donnell	83	64	Projected surplus
Tahoka Public Water System	317	245	Projected surplus
County-Other	84	70	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	(713)	(118)	Projected shortage – see plan below
Irrigation	(5,420)	(19,274)	Projected shortage – see plan below
Livestock	96	88	Projected surplus

ac-ft/yr = acre-feet per year

5.58.1 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.

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 I & II Supply Replacement (New Wells Only)

- Date to be Implemented: 2040
- Unit Cost: $159/ac-ft

b. CRMWA II New Supply (Wells and Pipeline)

- Date to be Implemented: 2030
- Unit Cost: $799/ac-ft

Table 5-128. Recommended Plan Costs by Decade for the City of O'Donnell

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*101*	*92*	*83*	*74*	*66*	*64*
Supply from CRMWA I & II Supply Replacement (New Wells Only)						
Supply From Plan Element (ac-ft/yr)	–	–	2	5	12	16
Annual Cost ($/yr)	–	–	$318	$795	$1,044	$1,392
Unit Cost ($/ac-ft)	–	–	$159	$159	$87	$87
Supply from CRMWA II New Supply (Wells and Pipeline)						
Supply From Plan Element (ac-ft/yr)	–	23	30	36	38	36
Annual Cost ($/yr)	–	$18,377	$23,970	$11,232	$11,856	$11,232
Unit Cost ($/ac-ft)	–	$799	$799	$312	$312	$312

ac-ft/yr = acre-feet per year

5.58.2 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.

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: 2020
- Unit Cost: $347/ac-ft

b. CRMWA I & II Supply Replacement (New Wells Only)

- Date to be Implemented: 2040
- Unit Cost: $159/ac-ft

c. CRMWA II New Supply (Wells and Pipeline)

- Date to be Implemented: 2030
- Unit Cost: $799/ac-ft

Table 5-129. Recommended Plan Costs by Decade for the Tahoka Public Water System

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*389*	*352*	*317*	*283*	*250*	*245*
Conservation						
Supply From Plan Element (ac-ft/yr)	10	–	–	–	–	–
Annual Cost ($/yr)	$3,468	–	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*399*	*352*	*317*	*283*	*250*	*245*
Supply from CRMWA I & II Supply Replacement (New Wells Only)						
Supply From Plan Element (ac-ft/yr)	–	–	8	20	46	60
Annual Cost ($/yr)	–	–	$1,272	$3,180	$4,002	$5,220
Unit Cost ($/ac-ft)	–	–	$159	$159	$87	$87
Supply from CRMWA II New Supply (Wells and Pipeline)						
Supply From Plan Element (ac-ft/yr)	–	90	117	138	144	135
Annual Cost ($/yr)	–	$71,910	$93,483	$43,056	$44,928	$42,120
Unit Cost ($/ac-ft)	–	$799	$799	$312	$312	$312

ac-ft/yr = acre-feet per year

5.58.3 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.

5.58.4 Manufacturing

There is no projected manufacturing demand in Lynn County.

5.58.5 Steam-Electric

There is no projected steam-electric demand in Lynn County.

5.58.6 Mining

Lynn County mining obtains its water supply from groundwater from the Ogallala Aquifer. Lynn County mining is projected to have a water shortage beginning in 2020 (in the Brazos River Basin portion of the County only) and lasting through the remainder of the planning period.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Lynn County Mining.

a. Mining Water Conservation

- Date to be Implemented: 2020
- Unit Cost: Costs to implement conservation 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.

b. Additional Groundwater Development

- Date to be Implemented: 2020
- Project Cost: $1,342,000
- Unit Cost: $143/ac-ft

Table 5-130. Recommended Plan Costs by Decade for Lynn County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(635)*	*(785)*	*(718)*	*(511)*	*(319)*	*(165)*
Mining Water Conservation						
Supply From Plan Element (ac-ft/yr)	12	40	63	52	41	33
Annual Cost ($/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Projected Surplus/(Shortage) after Conservation	*(623)*	*(745)*	*(655)*	*(459)*	*(278)*	*(132)*
Additional Groundwater Development (Ogallala)						
Supply From Plan Element (ac-ft/yr)	800	800	800	800	800	800
Annual Cost ($/yr)	$114,000	$114,000	$20,000	$20,000	$20,000	$20,000
Unit Cost ($/ac-ft)	$143	$143	$25	$25	$25	$25

ac-ft/yr = acre-feet per year

5.58.7 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 2040 in the Brazos River Basin and 2050 in the Colorado 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.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-131. Recommended Plan Costs by Decade for Lynn County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*20,772*	*3,925*	*(5,420)*	*(12,311)*	*(16,566)*	*(19,274)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	2,668	4,447	6,224	6,224	6,224	6,224
Annual Cost ($/yr)	$1,200,600	$2,001,150	$2,800,800	$2,800,800	$2,800,800	$2,800,800
Projected Surplus/(Shortage) after Conservation	*23,440*	*8,372*	*804*	*(6,087)*	*(10,342)*	*(13,050)*

ac-ft/yr = acre-feet per year

5.58.8 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.

5.59 Motley County Water Supply Plan

Table 5-132 lists each WUG in Motley County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-132. Motley County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Matador	555	556	Projected surplus
Red River Authority of Texas	0	0	Projected supply equals demand in Region O – see the Region B plan for the water supply plan for the Red River Authority of Texas.
County-Other	31	32	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	39	83	Projected surplus
Irrigation	2,681	2,680	Projected surplus
Livestock	70	35	Projected surplus

ac-ft/yr = acre-feet per year

5.59.1 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-133. Recommended Plan Costs by Decade for the City of Matador

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*550*	*553*	*555*	*556*	*556*	*556*
Conservation						
Supply From Plan Element (ac-ft/yr)	12	10	9	9	10	11
Annual Cost ($/yr)	$4,069	$3,397	$3,069	$3,087	$3,449	$3,810
Projected Surplus/(Shortage) after Conservation	*562*	*563*	*564*	*565*	*566*	*567*

ac-ft/yr = acre-feet per year

5.59.2 Red River Authority of Texas

See the Region B Plan for the water supply plan for the Red River Authority of Texas.

5.59.3 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. 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.

5.59.4 Manufacturing

There is no projected manufacturing demand in Motley County.

5.59.5 Steam-Electric

There is no projected steam-electric demand in Motley County.

5.59.6 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.

5.59.7 Irrigation

Motley County Irrigation obtains groundwater supply from the Ogallala Aquifer, Dockum Aquifer, Seymour Aquifer, and other minor aquifers located within Motley County. There is 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.

5.59.8 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.

5.60 Parmer County Water Supply Plan

Table 5-134 lists each WUG in Parmer County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-134. Parmer County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Bovina	142	40	Projected surplus
City of Farwell	401	289	Projected surplus
City of Friona	1,241	1,020	Projected surplus
County-Other	186	1	Projected surplus
Manufacturing	25	25	Projected surplus
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	No Mining demand
Irrigation	(161,748)	(160,887)	Projected shortage – see plan below
Livestock	2,362	53	Projected surplus

ac-ft/yr = acre-feet per year

5.60.1 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-135. Recommended Plan Costs by Decade for the City of Bovina

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*198*	*169*	*142*	*113*	*75*	*40*
Conservation						
Supply From Plan Element (ac-ft/yr)	9	1	–	–	–	–
Annual Cost ($/yr)	$3,121	$415	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*207*	*170*	*142*	*113*	*75*	*40*

ac-ft/yr = acre-feet per year

5.60.2 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-136. Recommended Plan Costs by Decade for the City of Farwell

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*465*	*432*	*401*	*368*	*327*	*289*
Conservation						
Supply From Plan Element (ac-ft/yr)	16	11	8	8	11	15
Annual Cost ($/yr)	$5,685	$3,898	$2,926	$2,939	$3,892	$5,125
Projected Surplus/(Shortage) after Conservation	*481*	*443*	*409*	*376*	*338*	*304*

ac-ft/yr = acre-feet per year

5.60.3 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.

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: 2020
- Unit Cost: $326/ac-ft

Table 5-137. Recommended Plan Costs by Decade for the City of Friona

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*1,362*	*1,299*	*1,241*	*1,178*	*1,096*	*1,020*
Conservation						
Supply From Plan Element (ac-ft/yr)	21	4	–	–	–	–
Annual Cost ($/yr)	$6,747	$1,403	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*1,383*	*1,303*	*1,241*	*1,178*	*1,096*	*1,020*

ac-ft/yr = acre-feet per year

5.60.4 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.

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: 2020
- Unit Cost: $326/ac-ft

Table 5-138. Recommended Plan Costs by Decade for Parmer County-Other

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*285*	*233*	*186*	*130*	*64*	*1*
Conservation						
Supply From Plan Element (ac-ft/yr)	18	4	–	–	–	–
Annual Cost ($/yr)	$5,864	$1,460	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*303*	*237*	*186*	*130*	*64*	*1*

ac-ft/yr = acre-feet per year

5.60.5 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.

5.60.6 Steam-Electric

There is no projected Steam-Electric demand in Parmer County.

5.60.7 Mining

There is no projected Mining demand in Parmer County.

5.60.8 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 2020 in the Brazos River Basin and 2030 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.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-139. Recommended Plan Costs by Decade for Parmer County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(100,831)*	*(161,748)*	*(161,748)*	*(161,748)*	*(160,988)*	*(160,887)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	7,177	11,961	14,517	13,431	12,798	12,446
Annual Cost ($/yr)	$3,229,650	$5,382,450	$6,532,650	$6,043,950	$5,759,100	$5,600,700
Projected Surplus/(Shortage) after Conservation	*(93,654)*	*(149,787)*	*(147,231)*	*(148,317)*	*(148,190)*	*(148,441)*

ac-ft/yr = acre-feet per year

5.60.9 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.

5.61 Swisher County Water Supply Plan

Table 5-140 lists each WUG in Swisher County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-140. Swisher County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Happy	362	349	Projected surplus
City of Tulia	928	881	Projected surplus
County-Other	90	70	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	0	0	No Mining demand
Irrigation	(70,822)	(70,500)	Projected shortage – see plan below
Livestock	3,082	0	Projected surplus

ac-ft/yr = acre-feet per year

5.61.1 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.

5.61.2 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.

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: 2020
- Unit Cost: $326/ac-ft

Table 5-141. Recommended Plan Costs by Decade for the City of Tulia

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*939*	*921*	*928*	*941*	*901*	*881*
Conservation						
Supply From Plan Element (ac-ft/yr)	22	2	–	–	–	–
Annual Cost ($/yr)	$7,178	$745	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*961*	*923*	*928*	*941*	*901*	*881*

ac-ft/yr = acre-feet per year

5.61.3 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.

5.61.4 Manufacturing

There is no projected manufacturing demand in Swisher County.

5.61.5 Steam-Electric

There is no projected steam-electric demand in Swisher County.

5.61.6 Mining

There is no projected mining demand in Swisher County.

5.61.7 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 2020 and continuing throughout the remainder of 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.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-142. Recommended Plan Costs by Decade for Swisher County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(13,178)*	*(70,822)*	*(70,822)*	*(70,822)*	*(71,362)*	*(70,500)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	4,062	6,770	7,703	6,837	6,354	6,057
Annual Cost ($/yr)	$1,827,900	$3,046,500	$3,466,350	$3,076,650	$2,859,300	$2,725,650
Projected Surplus/(Shortage) after Conservation	*(9,116)*	*(64,052)*	*(63,119)*	*(63,985)*	*(65,008)*	*(64,443)*

ac-ft/yr = acre-feet per year

5.61.8 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.

5.62 Terry County Water Supply Plan

Table 5-143 lists each WUG in Terry County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-143. Terry County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Brownfield	132	(291)	Projected shortage – see plan below
County-Other	91	69	Projected surplus
Manufacturing	0	0	Projected supply equals demand
Steam-Electric	0	0	No Steam-Electric demand
Mining	(403)	(66)	Projected shortage – see plan below
Irrigation	(42,583)	(42,743)	Projected shortage – see plan below
Livestock	98	4	Projected surplus

ac-ft/yr = acre-feet per year

5.62.1 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 2050 and continuing through the planning period.

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: 2020
- Unit Cost: $326/ac-ft

b. Additional Groundwater Supply (Ogallala Aquifer)

- Date to be Implemented: 2050
- Project Cost: $633,000

- Unit Cost: $331/ac-ft

c. CRMWA I & II Supply Replacement (New Wells Only)

- Date to be Implemented: 2040
- Unit Cost: $159/ac-ft

d. CRMWA II New Supply (Wells and Pipeline)

- Date to be Implemented: 2030
- Unit Cost: $799/ac-ft

e. CRMWA Supplies from Aquifer Storage and Recovery

- Date to be Implemented: 2030
- Unit Cost: $355/ac-ft

Table 5-144. Recommended Plan Costs by Decade for the City of Brownfield

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*365*	*236*	*132*	*(49)*	*(216)*	*(291)*
Conservation						
Supply From Plan Element (ac-ft/yr)	30	–	–	–	–	–
Annual Cost ($/yr)	$9,939	–	–	–	–	–
Projected Surplus/(Shortage) after Conservation	*395*	*236*	*132*	*(49)*	*(216)*	*(291)*
Additional Groundwater Development (Ogallala Aquifer)						
Supply From Plan Element (ac-ft/yr)	–	–	–	160	160	160
Annual Cost ($/yr)	–	–	–	$53,000	$53,000	$9,000
Unit Cost ($/ac-ft)	–	–	–	$331	$331	$56
Supply from CRMWA I & II Supply Replacement (New Wells Only)						
Supply From Plan Element (ac-ft/yr)	–	–	27	75	165	210
Annual Cost ($/yr)	–	–	$4,293	$11,925	$14,355	$18,270
Unit Cost ($/ac-ft)	–	–	$159	$159	$87	$87
Supply from CRMWA II New Supply (Wells and Pipeline)						
Supply From Plan Element (ac-ft/yr)	–	186	205	314	314	271
Annual Cost ($/yr)	–	$148,614	$163,795	$97,968	$97,968	$84,552
Unit Cost ($/ac-ft)	–	$799	$799	$312	$312	$312
CRMWA Aquifer Storage and Recovery (ASR)						
Supply From Plan Element (ac-ft/yr)	–	100	200	200	200	200
Annual Cost ($/yr)	–	$35,500	$71,000	$31,800	$31,800	$31,800

ac-ft/yr = acre-feet per year

5.62.2 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.

5.62.3 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.

5.62.4 Steam-Electric

There is no projected steam-electric demand in Terry County.

5.62.5 Mining

Terry County mining obtains its water supply from groundwater from the Ogallala Aquifer. Terry County mining is projected to have a water shortage beginning in 2020 (in the Colorado River Basin portion of the County only) and lasting through the remainder of the planning period.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Terry County Mining.

a. Mining Water Conservation

- Date to be Implemented: 2020
- Unit Cost: Costs to implement conservation 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.

b. Additional Groundwater Development

- Date to be Implemented: 2020
- Project Cost: $993,000
- Unit Cost: $143/ac-ft

Table 5-145. Recommended Plan Costs by Decade for Terry County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(230)*	*(388)*	*(405)*	*(287)*	*(172)*	*(91)*
Mining Water Conservation						
Supply From Plan Element (ac-ft/yr)	4	16	27	21	15	10
Annual Cost ($/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Projected Surplus/(Shortage) after Conservation	*(226)*	*(372)*	*(378)*	*(266)*	*(157)*	*(81)*
Additional Groundwater Development (Ogallala)						
Supply From Plan Element (ac-ft/yr)	640	640	640	640	640	640
Annual Cost ($/yr)	$95,000	$95,000	$25,000	$25,000	$25,000	$25,000
Unit Cost ($/ac-ft)	$148	$148	$39	$39	$39	$39

ac-ft/yr = acre-feet per year

5.62.6 Irrigation

Terry County irrigation obtains its water supply from groundwater from the Ogallala Aquifer. Terry County irrigation has a projected need beginning in 2020 in the Brazos River Basin and 2030 in the Colorado 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.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-146. Recommended Plan Costs by Decade for Terry County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*15,408*	*(42,583)*	*(42,583)*	*(42,743)*	*(42,743)*	*(42,743)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	5,183	8,639	10,213	9,429	9,022	8,787
Annual Cost ($/yr)	$2,332,350	$3,887,550	$4,595,850	$4,243,050	$4,059,900	$3,954,150
Projected Surplus/(Shortage) after Conservation	*20,591*	*(33,944)*	*(32,370)*	*(33,314)*	*(33,721)*	*(33,956)*

ac-ft/yr = acre-feet per year

5.62.7 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.

5.63 Yoakum County Water Supply Plan

Table 5-147 lists each WUG in Yoakum County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the WUGs and the plan for the selected water users are presented in the following subsections.

Table 5-147. Yoakum County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) 2040 (ac-ft/yr)	Surplus/(Shortage) 2070 (ac-ft/yr)	Comment
City of Denver City	3,593	3,077	Projected surplus
City of Plains	609	453	Projected surplus
County-Other	89	1	Projected surplus
Manufacturing	0	0	No Manufacturing demand
Steam-Electric	90	90	Projected surplus
Mining	(383)	123	Projected shortage – see plan below
Irrigation	(79,186)	(79,186)	Projected shortage – see plan below
Livestock	90	78	Projected surplus

ac-ft/yr = acre-feet per year

5.63.1 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.

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: 2020
- Unit Cost: $326/ac-ft

Table 5-148. Recommended Plan Costs by Decade for the City of Denver City

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*3,890*	*3,732*	*3,593*	*3,425*	*3,247*	*3,077*
Conservation						
Supply From Plan Element (ac-ft/yr)	62	47	39	49	62	77
Annual Cost ($/yr)	$20,069	$15,331	$12,594	$15,969	$20,130	$24,967
Projected Surplus/(Shortage) after Conservation	*3,952*	*3,779*	*3,632*	*3,474*	*3,309*	*3,154*

ac-ft/yr = acre-feet per year

5.63.2 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.

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: 2020
- Unit Cost: $347/ac-ft

Table 5-149. Recommended Plan Costs by Decade for the City of Plains

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*700*	*652*	*609*	*560*	*506*	*453*
Conservation						
Supply From Plan Element (ac-ft/yr)	18	13	10	10	13	18
Annual Cost ($/yr)	$6,212	$4,508	$3,460	$3,562	$4,648	$6,405
Projected Surplus/(Shortage) after Conservation	*718*	*665*	*619*	*570*	*519*	*471*

ac-ft/yr = acre-feet per year

5.63.3 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.

5.63.4 Manufacturing

There is no projected manufacturing demand in Yoakum County.

5.63.5 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.

5.63.6 Mining

Yoakum County mining obtains its water supply from groundwater from the Ogallala Aquifer. Yoakum County mining is projected to have a water shortage beginning in 2020 and lasting through 2060.

Water Supply Plan

Working within the planning criteria established by the LERWPG and the TWDB, the following WMS is recommended for Yoakum County Mining.

a. Mining Water Conservation

- Date to be Implemented: 2020
- Unit Cost: Costs to implement conservation 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.

b. Additional Groundwater Development

- Date to be Implemented: 2020
- Project Cost: $1,300,000
- Unit Cost: $143/ac-ft

Table 5-150. Recommended Plan Costs by Decade for Yoakum County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(536)*	*(570)*	*(383)*	*(193)*	*(19)*	*123*
Mining Water Conservation						
Supply From Plan Element (ac-ft/yr)	13	40	57	48	39	32
Annual Cost ($/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Projected Surplus/(Shortage) after Conservation	*(523)*	*(530)*	*(326)*	*(145)*	*20*	*155*
Additional Groundwater Development (Ogallala)						
Supply From Plan Element (ac-ft/yr)	640	640	640	640	640	640
Annual Cost ($/yr)	$123,000	$123,000	$31,000	$31,000	$31,000	$31,000
Unit Cost ($/ac-ft)	$192	$192	$48	$48	$48	$48

ac-ft/yr = acre-feet per year

5.63.7 Irrigation

Yoakum County irrigation obtains its water supply from groundwater from the Ogallala Aquifer. Yoakum County irrigation has a projected need beginning in 2020 and continuing throughout the remainder of 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.

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: 2020
- Unit Cost: $450/ac-ft

Table 5-151. Recommended Plan Costs by Decade for Yoakum County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Projected Surplus/(Shortage) (ac-ft/yr)	*(33,198)*	*(79,186)*	*(79,186)*	*(79,186)*	*(79,186)*	*(79,186)*
Irrigation Conservation						
Supply From Plan Element (ac-ft/yr)	4,851	8,085	9,670	8,893	8,485	8,238
Annual Cost ($/yr)	$2,182,950	$3,638,250	$4,351,500	$4,001,850	$3,818,250	$3,707,100
Projected Surplus/(Shortage) after Conservation	*(28,347)*	*(71,101)*	*(69,516)*	*(70,293)*	*(70,701)*	*(70,948)*

ac-ft/yr = acre-feet per year

5.63.8 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 5-152. The supply factors shown are just for the MWPs' service area within the Llano Estacado Planning Area.

Table 5-152. 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

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 2021 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, 2021 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 2021 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[226], the Colorado River Basin Highlights Report[227], and the Canadian and Red River Basin Highlights Report[228] 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),

[226] https://www.brazos.org/Portals/0/crpPDF/BasinHighlightsReport-2019.pdf

[227] https://www.lcra.org/water/quality/texas-clean-rivers-program/Documents/2018_BasinHighlights_Report_FINAL.pdf

[228] http://rra.texas.gov/publications/crp/crp2016/FY2016%20BHR.pdf

- Total suspended solids (TSS),
- Dissolved oxygen,
- pH range,
- 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 2021 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 2021 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 2021 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 2021 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 2021 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 2021 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 2021 LERWP will continue to preserve water for wildlife.

6.5.2 Public Lands

No recommended strategies in the 2021 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 2021 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 2021 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 2021 LERWP.

6.6.1 Groundwater

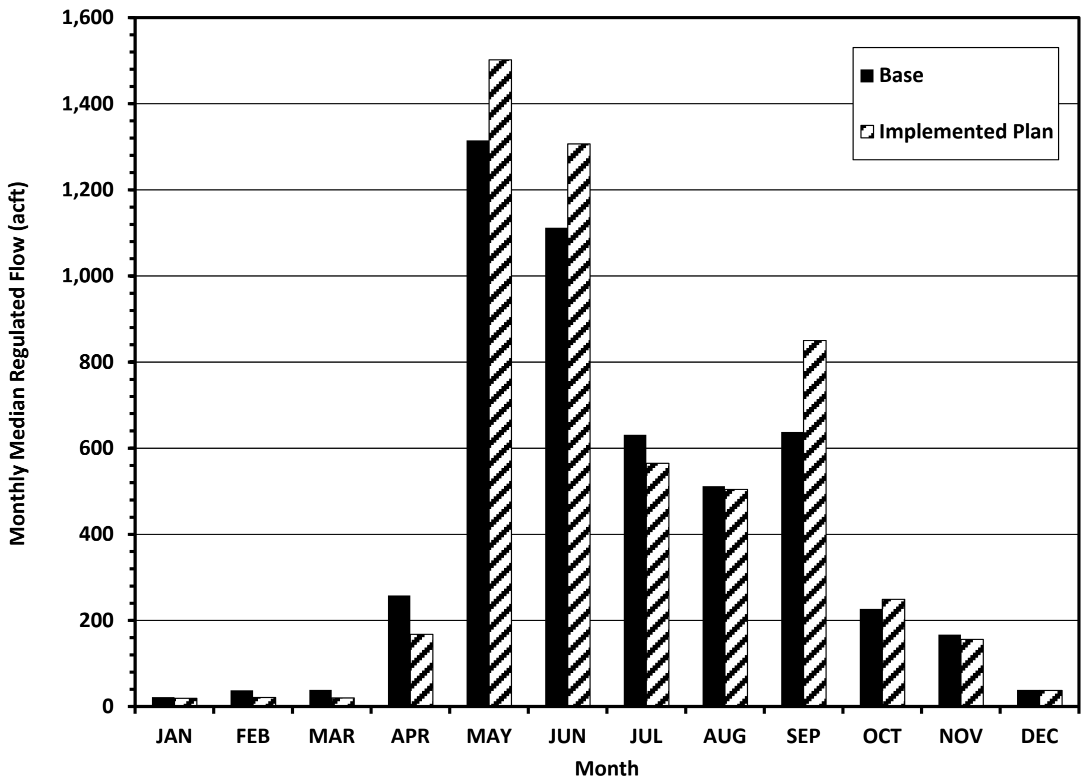
Recommended WMSs involving additional development of groundwater would increase groundwater usage by entities in the Llano Estacado Region. The development of groundwater by WMSs recommended in the 2021 plan is likely to be concentrated in a few areas that could experience noticeable declines locally 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 2021 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 2070, 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. Jim Bertram Lake 7 was operated junior to the proposed appropriation under the Brazos River Authority (BRA) System Operations Permit because this strategy will receive a priority date from TCEQ that is senior to Jim Bertram Lake 7.

The effects of Jim Bertram 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.



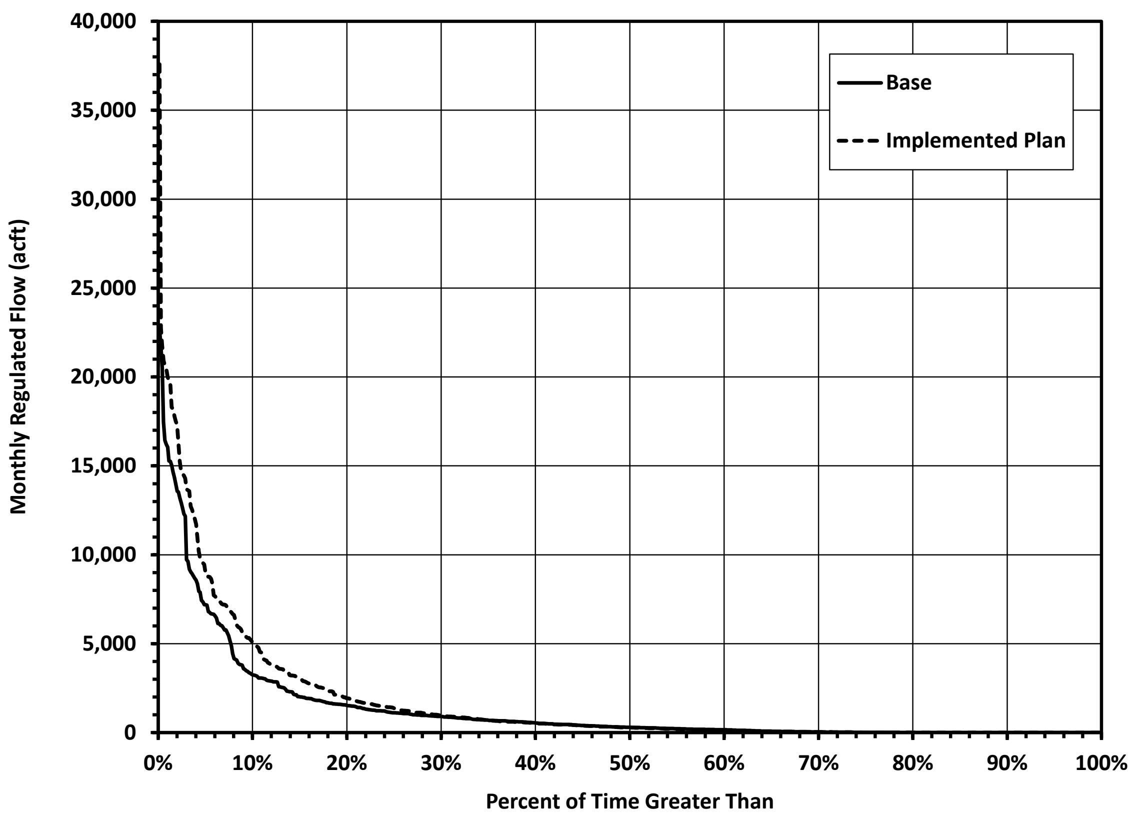


Figure 6.1. Comparisons for Regulated Streamflow at the Brazos River at Seymour

The effects of implementing Jim Bertram Lake 7 will have slight effects on streamflows in the Brazos Basin with both increases and decreases. 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. Significantly different streamflows will not occur with implementation of recommended WMSs in the 2021 LERWP.

Overall, the strategies recommended in the 2021 LERWP will have limited negative effects on the environment. The largest localized impact is from one new reservoir. In the 2021 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.

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 2021 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 2021 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 2021 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 2021 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 2021 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 2021 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 2021 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 with a combined market value of over $7.0 billion in 2017. In the semi-arid Llano Estacado Region, farmers supplement precipitation with irrigation from groundwater to increase crop yields and to raise livestock. In 2020, it is projected that irrigated crop land and livestock will account for approximately 96 percent of the total water used in the Llano Estacado Region.

The projected agricultural water supply need is 705,992 ac-ft/yr in 2020, increasing to 1,445,026 ac-ft/yr in 2070. 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 resource 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 numerous meetings during the 2021 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 2021 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 2021 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)					
	2020	2030	2040	2050	2060	2070
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

7

Drought Response Information, Activities, and Recommendations

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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[229], 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 takes into account 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[230] 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[231] 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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[229] Palmer, W. C, 1965: Meteorological Drought. Res. Paper No.45, 58pp, Dept. of Commerce, Washington, D.C.

[230] NOAA: U.S. Climate Divisions, National Climatic Data Center, www.ncdc.noaa.gov/monitoring-references/maps/us-climate-divisions.php

[231] NOAA: National Environmental Satellite, Data, and Information Service [database], National Climatic Data Center, Retrieved from https://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp#

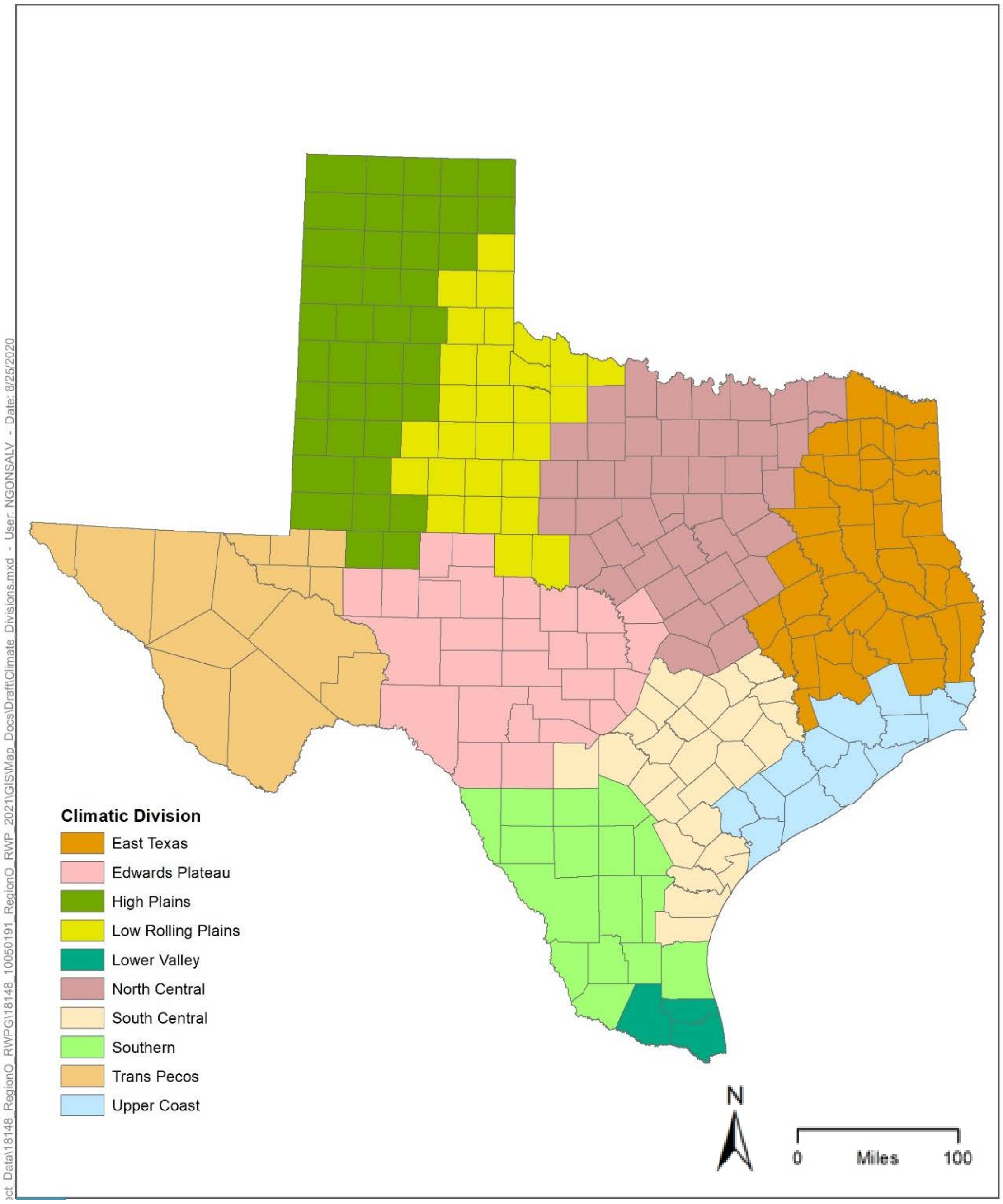

Figure 7.1. NOAA Climate Divisions in Texas

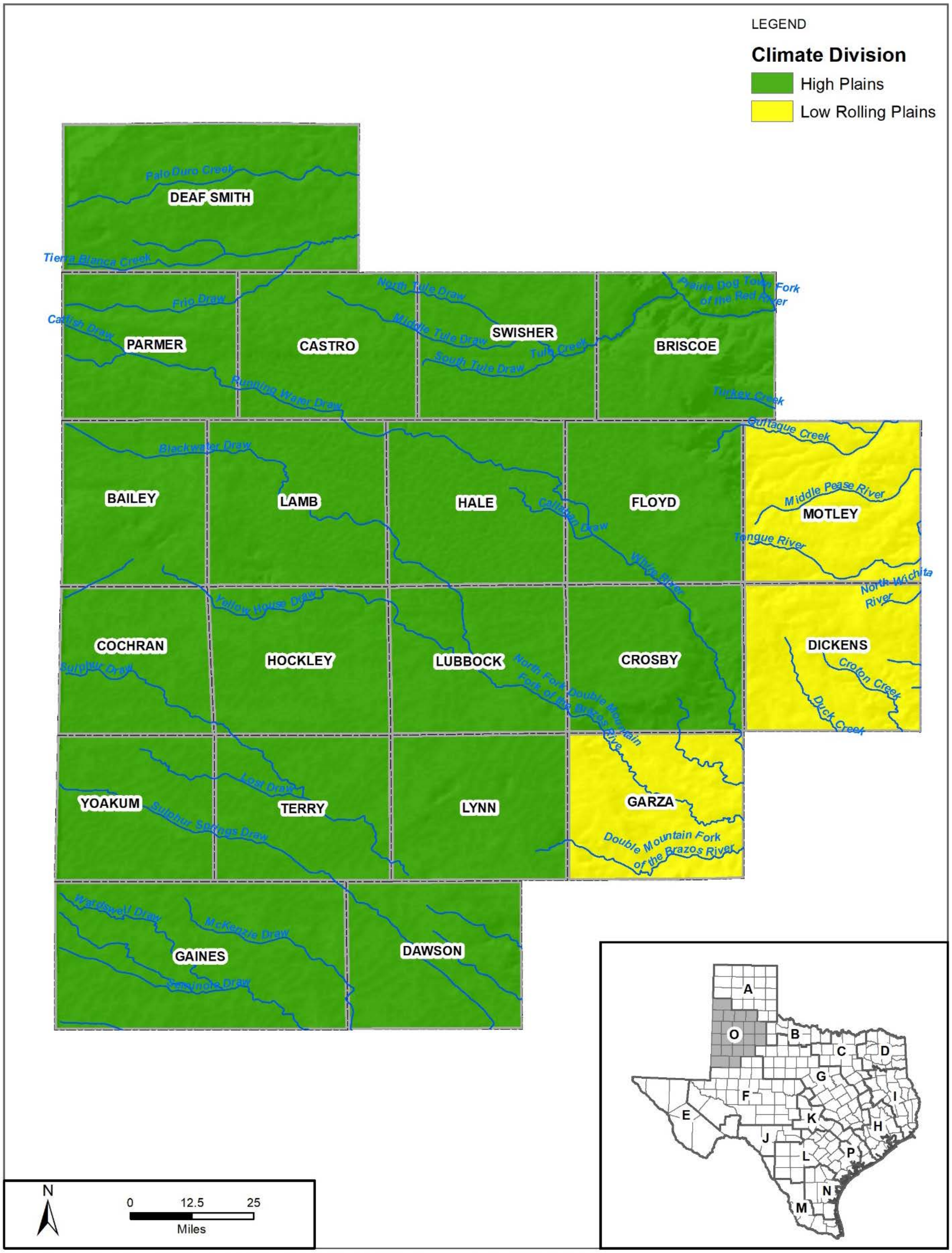

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Figure 7.2. Climate Division within the Llano Estacado Region

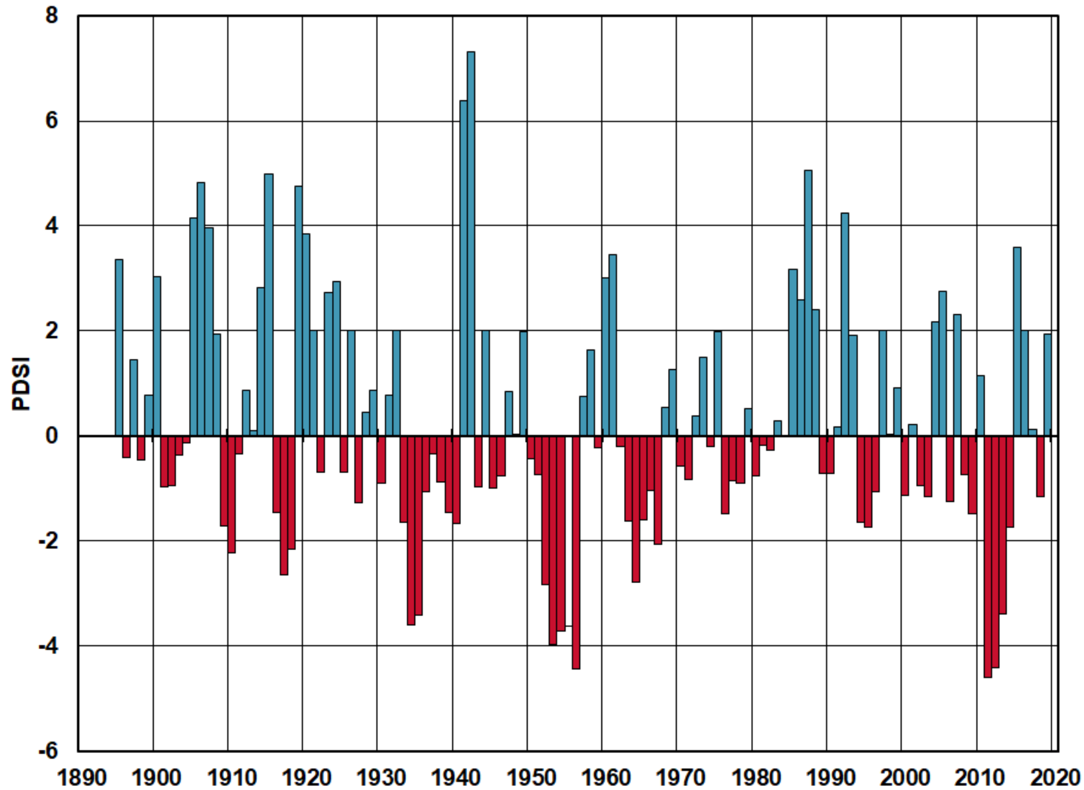

Figure 7.3. Palmer Drought Severity Index: Division 1

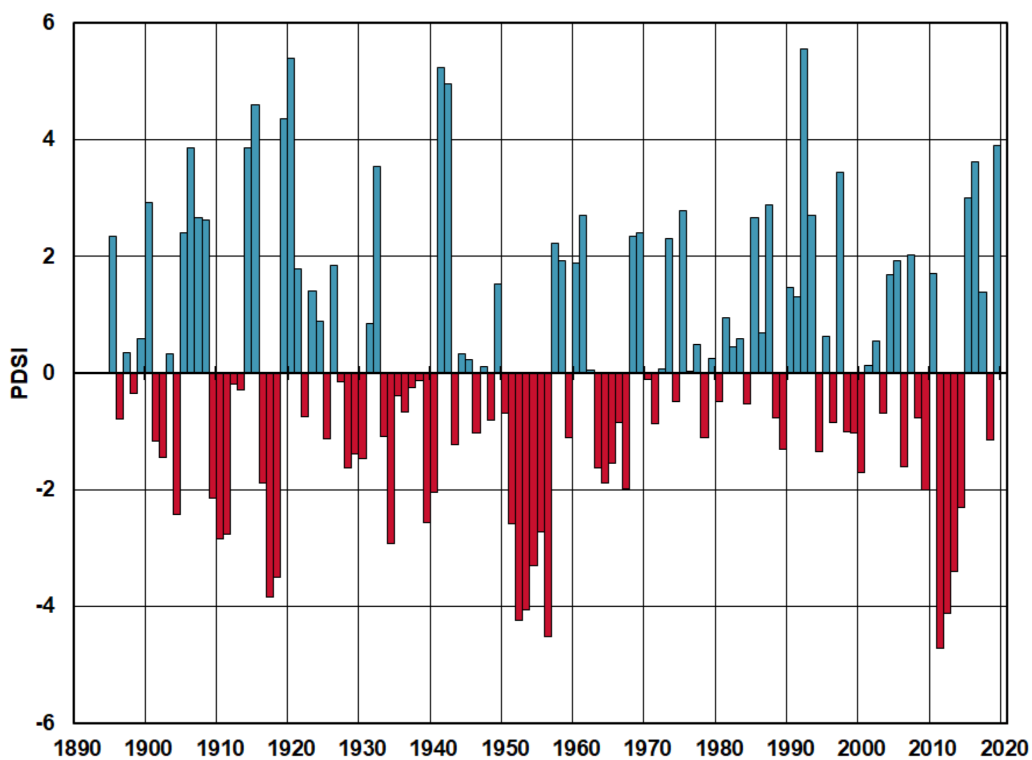

Figure 7.4. Palmer Drought Severity Index: Division 2

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 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[232].

Upon completion of the White River, 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[233].

[232] TWDB. 2006. http://www.twdb.texas.gov/hydro_survey/alanhenry/2005-07/AlanHenry2005_FinalReport.pdf

[233] TWDB. 2003. http://www.twdb.texas.gov/hydro_survey/whiteriver/1992-10/WhiteRiver1993_FinalReport.pdf

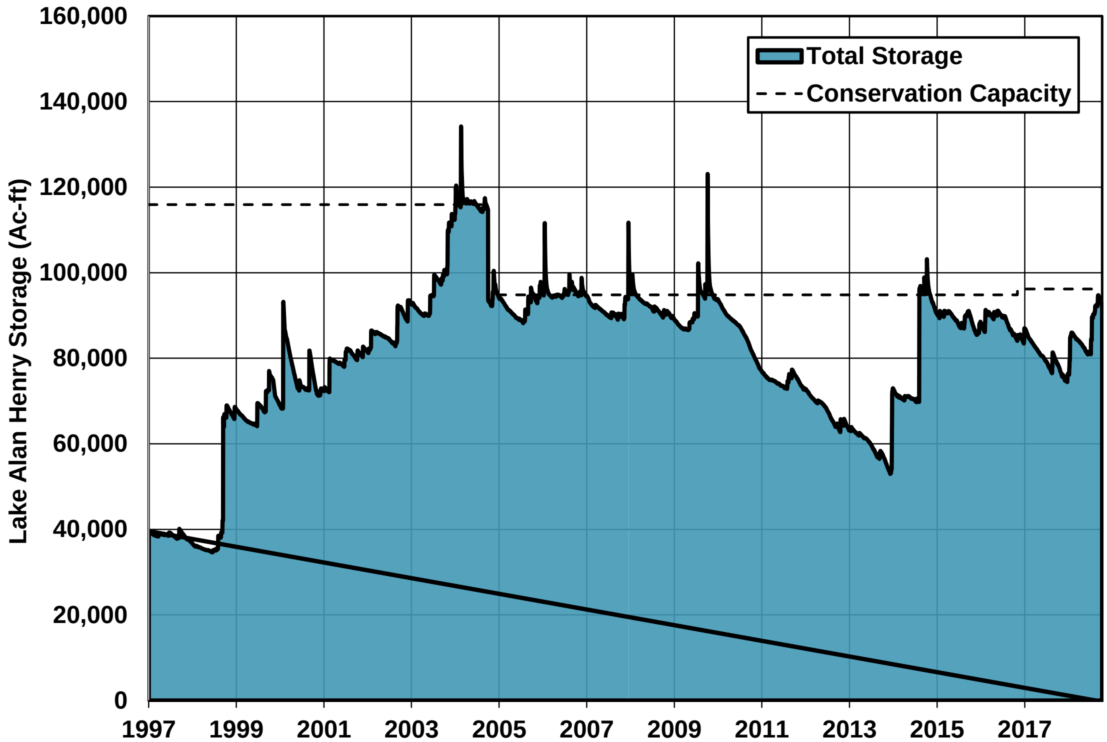

Figure 7.5. Lake Alan Henry Storage

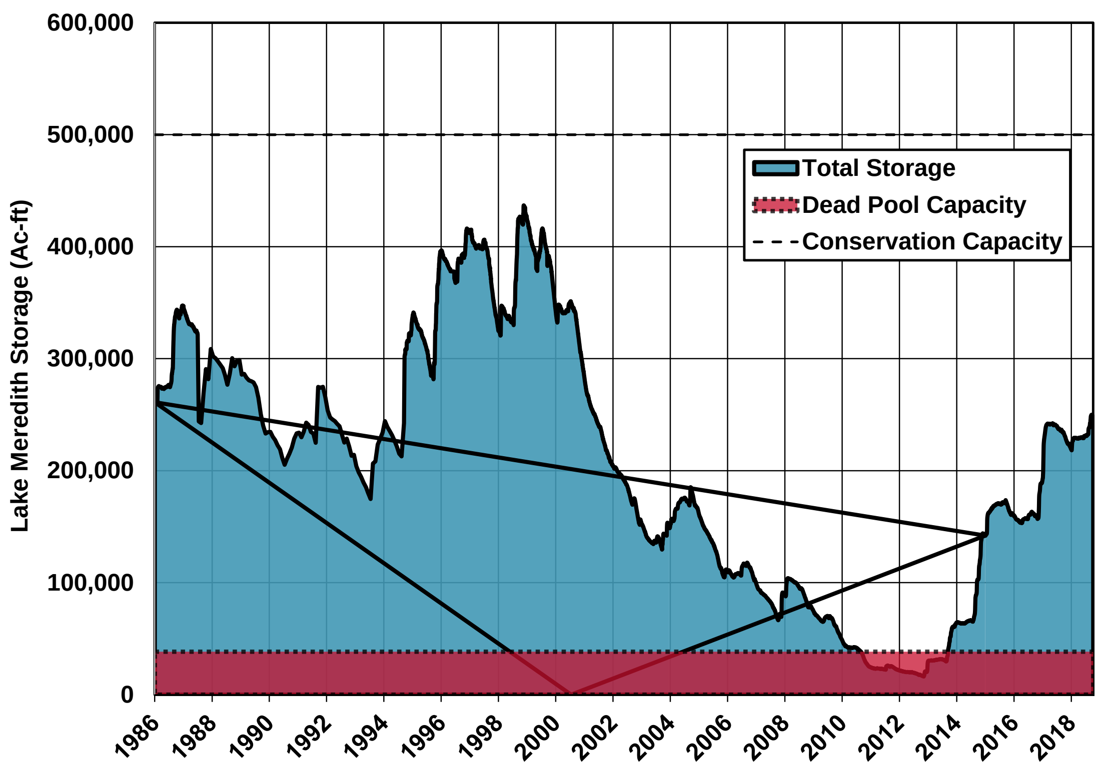

Figure 7.6. Lake Meredith Storage

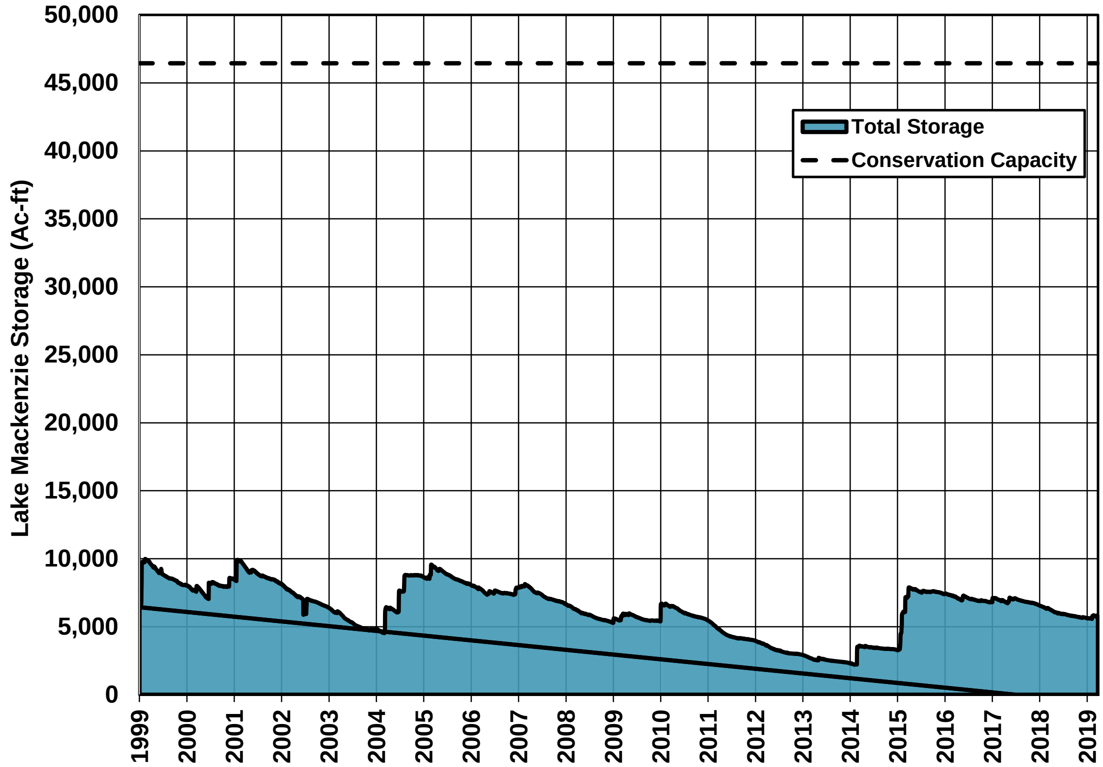

Figure 7.7. Lake Mackenzie Storage

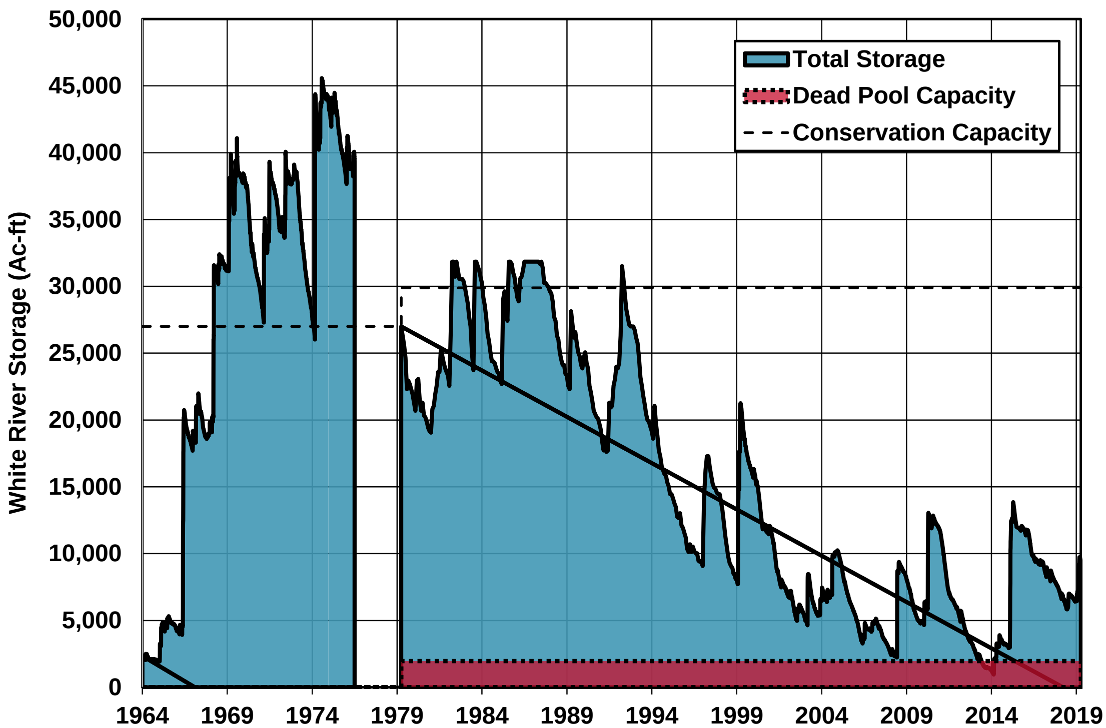

Figure 7.8. White River Lake Storage

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 2021 LERWP. The Brazos River Basin WAM (Brazos WAM) includes hydrologic information from 1940 to 1997 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[234]. 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

[234] HDR, Inc., Update of Lake Alan Henry Yield and 5-Year Projections, City of Lubbock Water Supply Support, August 2015.

Estacado Region were selected as representative of the long-term decline in water levels (Figure 7.9).

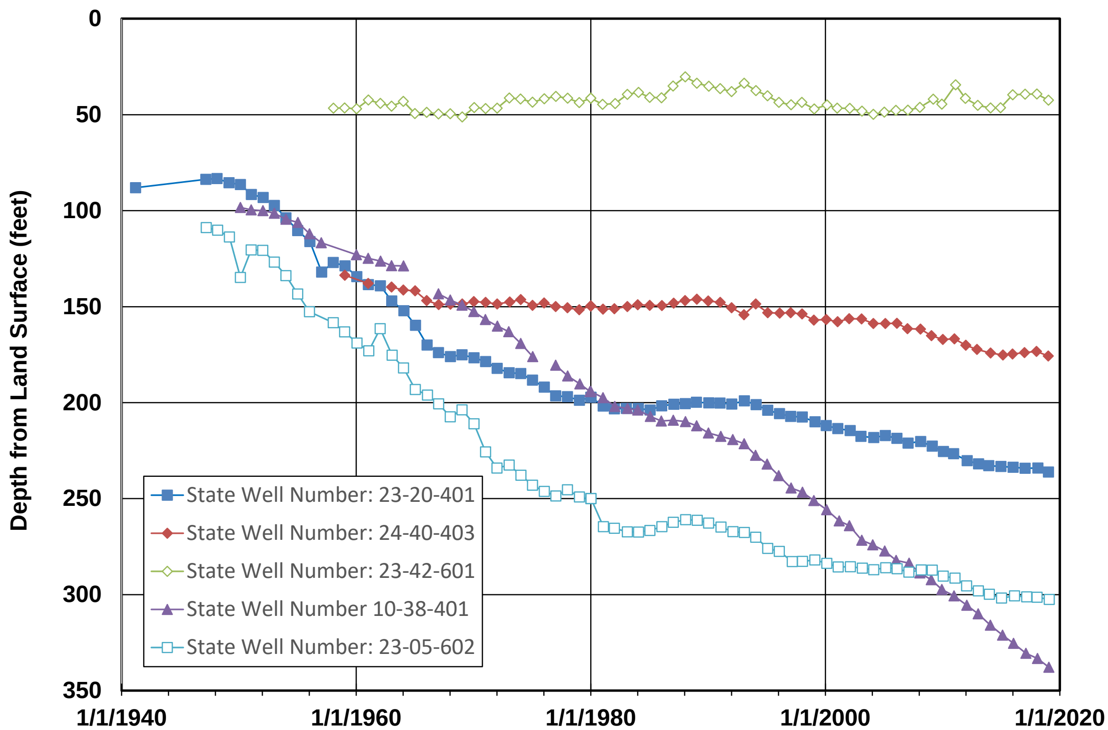

Figure 7.9. Representative Wells with Long-term Records Demonstrating Declining Water Levels

7.1.5 Climate

Most of the planning region is identified as a cold, steppe climate (BSk) under the Köppen climate classification system[235]. 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[236]; annual evaporation typically exceeds precipitation in these areas[237]. A summary of climatological conditions for the region is provided in Table 7-3.

[235] Kottek, M.J., Grieser, C., Beck, B., Rubel, F., 2006. World Map of the Köppen-Geiger climate classification updated. Meteorol. Z., 15, 259-263.

[236] Larson, T.J., Bomar, G.W. 1983. Climatic atlas of Texas. Texas Water Development Board, LP-192.

[237] 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 2018) for the Llano Estacado Region[238] [239]

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	23	67	51	92	45
Castro	19	June	Feb	56	21	63	51	91	46
Cochran	17	July	Jan	58	23	64	54	92	47
Crosby	21	May	Jan	60	25	67	53	93	45
Dawson	17	Sept	Jan	61	26	67	55	94	51
Deaf Smith	18	Aug	Feb	57	21	63	51	92	46
Dickens	21	May	Jan	62	27	69	55	95	46
Floyd	20	June	Jan	59	24	67	52	92	45
Gaines	16	Sept	Dec	61	27	66	56	94	54
Garza	20	May	Jan	63	28	70	55	94	46
Hale	18	June	Jan	59	24	65	52	91	45
Hockley	18	June	Feb	59	24	65	54	92	47
Lamb	17	June	Jan	58	22	64	53	92	46
Lubbock	18	June	Jan	56	26	68	54	93	46
Lynn	19	May	Jan	61	26	67	54	93	46
Motley	22	June	Jan	62	28	70	54	95	44
Parmer	18	Aug	Feb	57	22	63	51	91	46
Swisher	20	June	Dec	58	22	64	51	92	45
Terry	18	May	Dec	60	25	66	54	93	48
Yoakum	16	Sept	Jan	59	25	64	54	92	41

°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

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[238] 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/

[239] Texas Water Development Board, 2019. Water Data for Texas: Lake Evaporation and Precipitation. https://waterdatafortexas.org/lake-evaporation-rainfall

periods of cold, dry air from North American Polar Regions surge southward and cut off the supply of moisture from the Gulf of Mexico.

Table 7-4. Percentage of Mean Annual Precipitation Occurring by Month (1945 to 2018) 240

County	Percentage of Mean Annual Precipitation											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bailey	3%	3%	4%	5%	12%	14%	14%	16%	13%	9%	3%	3%
Briscoe	3%	4%	5%	8%	14%	17%	11%	12%	11%	9%	4%	3%
Castro	3%	3%	4%	5%	13%	16%	13%	15%	11%	9%	4%	3%
Cochran	3%	3%	4%	5%	12%	13%	15%	15%	14%	9%	4%	3%
Crosby	3%	4%	5%	7%	14%	14%	12%	11%	13%	10%	4%	4%
Dawson	3%	4%	4%	6%	14%	13%	12%	10%	15%	10%	4%	4%
Deaf Smith	3%	3%	5%	5%	12%	15%	15%	16%	11%	9%	4%	3%
Dickens	3%	4%	5%	8%	15%	13%	11%	11%	12%	10%	4%	4%
Floyd	3%	3%	5%	7%	14%	16%	11%	11%	13%	9%	4%	3%
Hale	3%	3%	5%	6%	14%	16%	12%	12%	12%	9%	4%	3%
Hockley	3%	3%	4%	5%	13%	14%	13%	13%	14%	9%	4%	3%
Gaines	4%	4%	4%	5%	13%	12%	13%	12%	15%	10%	4%	4%
Garza	3%	4%	5%	7%	14%	13%	11%	11%	13%	10%	5%	4%
Lamb	3%	3%	4%	5%	13%	16%	13%	14%	12%	9%	4%	3%
Lubbock	3%	4%	4%	6%	14%	15%	12%	11%	13%	10%	4%	3%
Lynn	3%	4%	4%	6%	15%	13%	12%	11%	13%	10%	4%	4%
Motley	3%	4%	5%	8%	14%	15%	10%	11%	12%	9%	4%	4%
Parmer	3%	3%	4%	5%	12%	15%	15%	16%	11%	9%	3%	3%
Swisher	3%	3%	5%	7%	14%	17%	12%	13%	11%	9%	4%	3%
Terry	3%	3%	4%	6%	14%	14%	13%	11%	14%	10%	4%	3%
Yoakum	3%	3%	4%	5%	12%	13%	14%	13%	15%	9%	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

[240] 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/

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[241]. 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 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.

[241] 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.

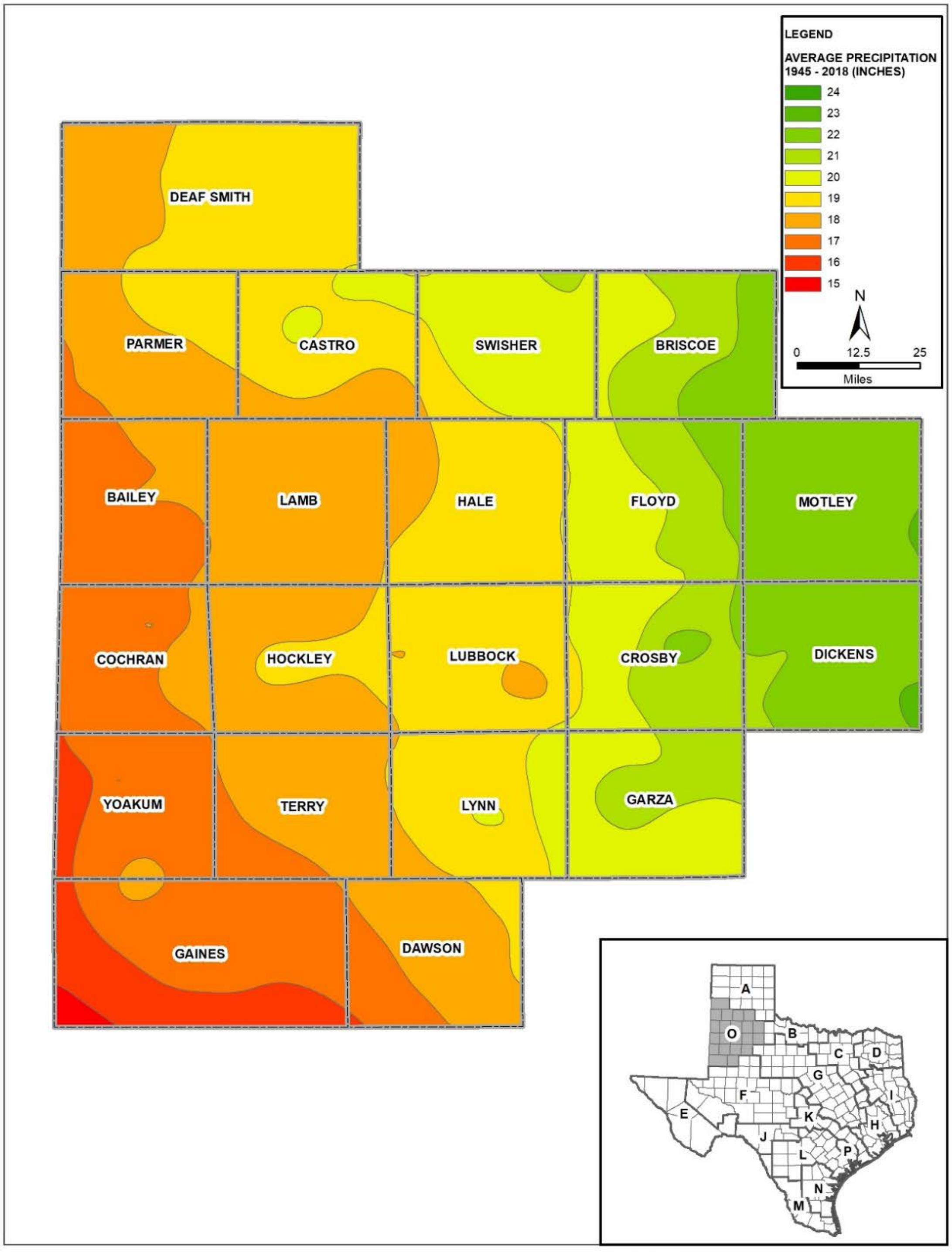

Figure 7.10. Average Annual Precipitation of the Llano Estacado Region 1945-2018[242]

[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/

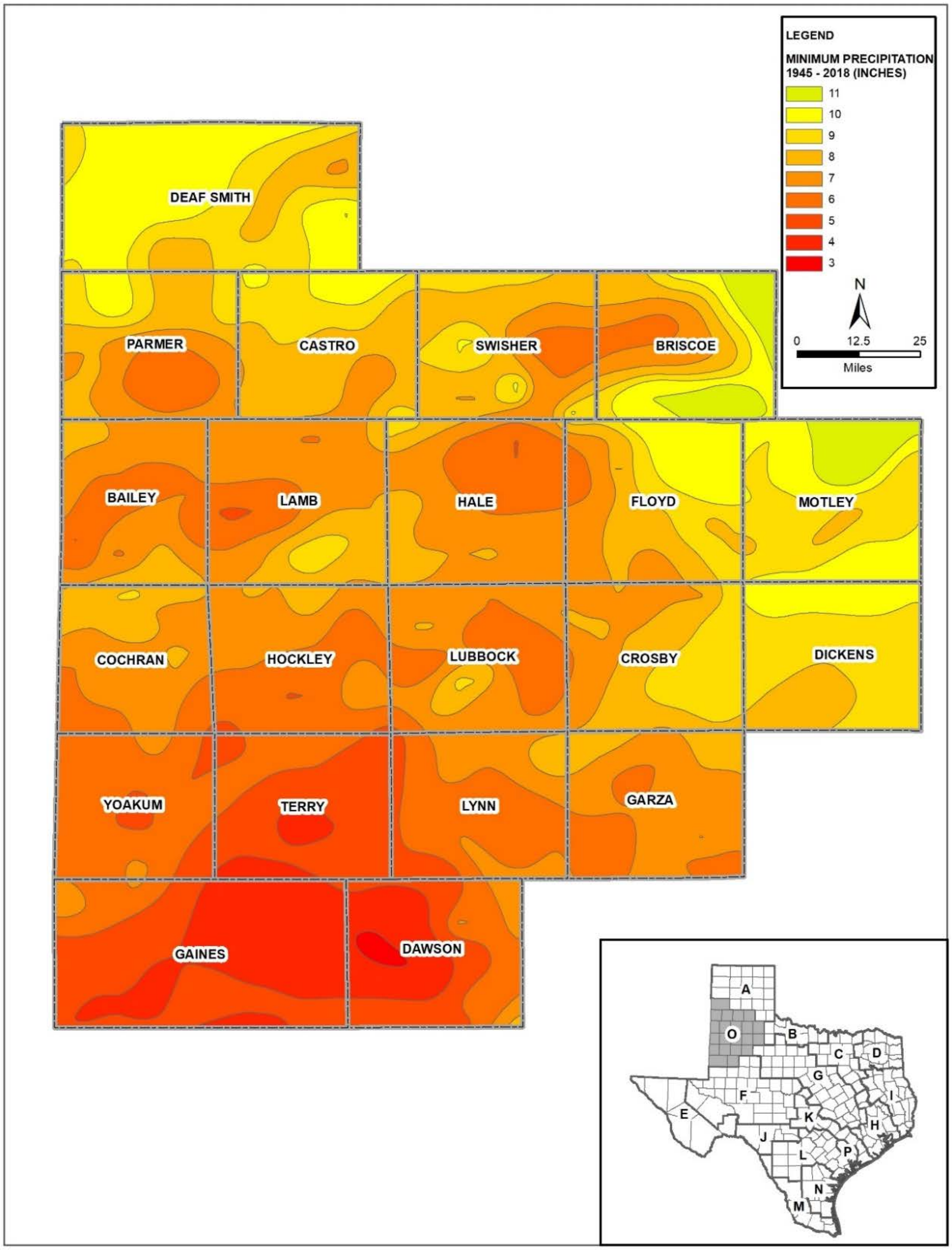

Figure 7.11. Minimum Annual Precipitation of the Llano Estacado Region: 1945-2018 [243]

[243] 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/

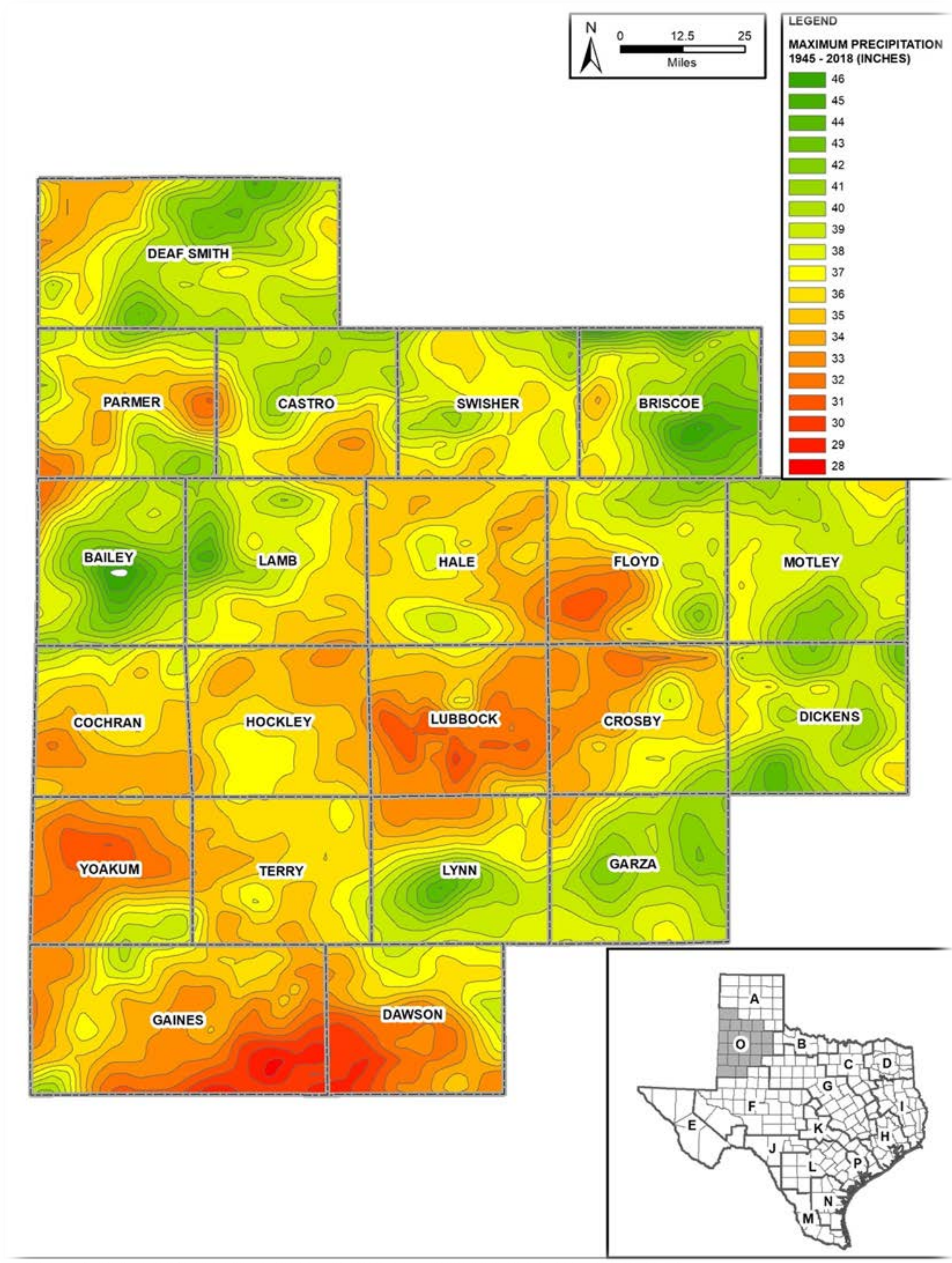

Figure 7.12. Maximum Annual Precipitation of the Llano Estacado Region: 1945-2018 [244]

[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/

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[245]. 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[246].

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. Precipatation was intermittend 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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245 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

246 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.”[247] According to a TCEQ handbook[248], 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,

[247] http://www.twdb.texas.gov/conservation/training/archives/more-than-a-drop-workshop/doc/5_%20TCEQ%20Rules.pdf

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

- 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.

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.[249] 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	3/19/2019	1							X		X		X							X
		2							X		X		X			X	X			

249 https://www.lubbockonline.com/news/20200131/lubbocks-stingy-water-usage-buying-time-on-infrastructure-projects

Table 7-5. Common Drought Response Measures

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			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
		3	X	X					X		X		X			X	X			
		4							X		X		X			X	X			
		5	X		X				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
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 Plainview	4/23/2019	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	

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 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	8/1/2019										X									X
City of Shallowater	9/1/2018										X									X
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			

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 September 2019 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, 29 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			

Entity Receiving Supply	Entity Providing Supply	Providers Sources			
		Source #1	Source #2	Source #3	Source #4
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			
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	

Entity Receiving Supply	Entity Providing Supply	Providers Sources			
		Source #1	Source #2	Source #3	Source #4
Lorenzo	Idalou	Ogallala Aquifer			
Morton / White Face (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	White Face	Ogallala Aquifer			
Tulia/Mackenzie MWA	CRMWA	Purchased from CRMWA in Region A			

Entity Receiving Supply	Entity Providing Supply	Providers Sources			
		Source #1	Source #2	Source #3	Source #4
Wellman	Brownfield	Ogallala Aquifer	Purchased from CRMWA in Region A		
White Face	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	2020 Population	2020 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	3,049	722			X		X	X		CRMWA, SHALLOWATER			Well, Pipeline, Transportation
AMHERST	LAMB	799	102			X		X	X		LUBBOCK, SUDAN			Well, Pipeline, Transportation
ANTON	HOCKLEY	1,235	160			X		X	X		LUBBOCK			Well, Pipeline, Transportation
BOVINA	PARMER	2,082	373			X		X	X		FRIONA			Well, Pipeline, Transportation
BROWNFIELD	TERRY	10,000	1,604			X		X	X		SEAGRAVES			Well, Pipeline, Transportation
COUNTY-OTHER, BAILEY	BAILEY	2,243	277			X		X	X		MULESHOE			Well, Pipeline, Transportation
COUNTY-OTHER, BRISCOE	BRISCOE	499	159			X		X	X		SILVERTON			Well, Pipeline, Transportation
COUNTY-OTHER, CASTRO	CASTRO	2,519	368			X		X	X		DIMMITT			Well, Pipeline, Transportation
COUNTY-OTHER, COCHRAN	COCHRAN	822	306			X		X	X		MORTON			Well, Pipeline, Transportation
COUNTY-OTHER, CROSBY	CROSBY	1,269	150			X		X	X		RALLS			Well, Pipeline, Transportation
COUNTY-OTHER, DAWSON	DAWSON	4,924	606			X		X	X		LAMESA			Well, Pipeline, Transportation
COUNTY-OTHER, DEAF SMITH	DEAF SMITH	5,001	590			X		X	X		HEREFORD			Well, Pipeline, Transportation
COUNTY-OTHER, DICKENS	DICKENS	1,078	145			X		X	X	X	SPUR (RESALE OF WHITE RIVER MWD WATER)			Well, Pipeline, Transportation
COUNTY-OTHER, FLOYD	FLOYD	1,598	192			X		X	X		FLOYDADA			Well, Pipeline, Transportation
COUNTY-OTHER, GAINES	GAINES	11,656	1,400			X		X	X		SEMINOLE			Well, Pipeline, Transportation
COUNTY-OTHER, GARZA	GARZA	1,065	135			X		X	X		POST			Well, Pipeline, Transportation
COUNTY-OTHER, HALE	HALE	7,923	1,031			X		X	X		PLAINVIEW			Well, Pipeline, Transportation
COUNTY-OTHER, HOCKLEY	HOCKLEY	7,518	921			X		X	X		LEVELLAND			Well, Pipeline, Transportation
COUNTY-OTHER, LAMB	LAMB	2,783	401			X		X	X		LITTLEFIELD			Well, Pipeline, Transportation
COUNTY-OTHER, LUBBOCK	LUBBOCK	29,236	3,797			X		X	X		LUBBOCK			Well, Pipeline, Transportation
COUNTY-OTHER, LYNN	LYNN	2,682	311			X		X	X		TAHOKA			Well, Pipeline, Transportation
COUNTY-OTHER, MOTLEY	MOTLEY	546	98			X		X	X		MATADOR			Well, Pipeline, Transportation

Entity				Potential Emergency Water Supply Sources							Implementation Requirements			
Water User Group	County	2020 Population	2020 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
COUNTY-OTHER, PARMER	PARMER	3,398	661			X		X	X		FRIONA			Well, Pipeline, Transportation
COUNTY-OTHER, SWISHER	SWISHER	2,729	357			X		X	X		TULIA			Well, Pipeline, Transportation
COUNTY-OTHER, TERRY	TERRY	3,599	445			X		X	X		BROWNFIELD			Well, Pipeline, Transportation
COUNTY-OTHER, YOAKUM	YOAKUM	2,146	263			X		X	X		PLAINS			Well, Pipeline, Transportation
CROSBYTON	CROSBY	1,922	301			X		X	X		RALLS			Well, Pipeline, Transportation
DENVER CITY	YOAKUM	5,072	1,423			X		X	X		PLAINS, SEAGRAVES, SEMINOLE			Well, Pipeline, Transportation
DIMMITT	CASTRO	4,825	1,091			X		X	X		HEREFORD, FRIONA, BOVINA, FARWELL			Well, Pipeline, Transportation
EARTH	LAMB	1,099	191			X		X	X		SPRINGLAKE, OLTON			Well, Pipeline, Transportation
FARWELL	PARMER	1,507	393			X		X	X		CLOVIS, NM			Well, Pipeline, Transportation
FLOYDADA	FLOYD	3,242	572			X		X	X		LUBBOCK			Well, Pipeline, Transportation
FRIONA	PARMER	4,437	801			X		X	X		BOVINA			Well, Pipeline, Transportation
HALE CENTER	HALE	2,252	281			X		X	X		CRMWA, PLAINVIEW			Well, Pipeline, Transportation
HAPPY	SWISHER	649	99			X		X	X		TULIA			Well, Pipeline, Transportation
HART MUNICIPAL WATER SYSTEM	CASTRO	1,194	175			X		X	X		DIMMITT			Well, Pipeline, Transportation
HEREFORD	DEAF SMITH	17,150	3,857			X		X	X		CANYON			Well, Pipeline, Transportation
IDALOU	LUBBOCK	2,425	434			X		X	X		LUBBOCK			Well, Pipeline, Transportation
LAMESA	DAWSON	9,755	2,240			X		X	X		O'DONNELL			Well, Pipeline, Transportation
LEVELLAND	HOCKLEY	14,839	2,441			X		X	X		WHITE FACE			Well, Pipeline, Transportation
LITTLEFIELD	LAMB	6,642	987			X		X	X	X	LUBBOCK		X	Well, Pipeline, Transportation
LOCKNEY	FLOYD	2,029	277			X		X	X		FLOYDADA			Well, Pipeline, Transportation
LORENZO	CROSBY	1,260	231			X		X	X		IDALOU			Well, Pipeline, Transportation
LUBBOCK	LUBBOCK	261,706	46,775			X		X						Well, Transportation
MATADOR	MOTLEY	643	224			X		X	X		DICKENS			Well, Pipeline, Transportation

Entity				Potential Emergency Water Supply Sources							Implementation Requirements			
Water User Group	County	2020 Population	2020 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
MORTON PWS	COCHRAN	2,168	477			X		X	X		LUBBOCK			Pipeline, Transportation
MULESHOE	BAILEY	5,769	1,173			X		X	X		LUBBOCK			Well, Pipeline, Transportation
NAZARETH	CASTRO	352	134			X		X	X		HART			Well, Pipeline, Transportation
NEW DEAL	LUBBOCK	869	113			X		X	X		LUBBOCK, PLAINVIEW, FLOYDADA			Well, Pipeline, Transportation
ODONNELL	DAWSON	893	124			X		X	X		LAMESA			Well, Pipeline, Transportation
OLTON	LAMB	2,250	466			X		X	X		PLAINVIEW			Well, Pipeline, Transportation
PETERSBURG MUNICIPAL WATER SYSTEM	HALE	1,252	321			X		X	X		LUBBOCK			Well, Pipeline, Transportation
PLAINS	YOAKUM	1,702	438			X		X	X		DENVER CITY, SEAGRAVES, SEMINOLE			Well, Pipeline, Transportation
PLAINVIEW	HALE	24,624	4,587			X		X	X		LUBBOCK			Well, Pipeline, Transportation
POST	GARZA	6,012	792			X		X	X		LUBBOCK			Well, Pipeline, Transportation
QUITAQUE	BRISCOE	420	106			X		X	X		SILVERTON, TURKEY, FLOYDADA			Well, Pipeline, Transportation
RALLS	CROSBY	2,075	311			X		X	X		CROSBYTOWN			Well, Pipeline, Transportation
RANSOM CANYON	LUBBOCK	1,171	336			X		X	X		LUBBOCK			Well, Pipeline, Transportation
RED RIVER AUTHORITY OF TEXAS	DICKENS	68	17			X		X	X		SPUR			Well, Pipeline, Transportation
SEAGRAVES	GAINES	2,558	423			X		X	X		PLAINS, DENVER CITY, SEMINOLE			Well, Pipeline, Transportation
SEMINOLE	GAINES	7,102	2,348			X		X	X		PLAINS, DENVER CITY, SEAGRAVES			Well, Pipeline, Transportation
SHALLOWATER	LUBBOCK	2,820	422			X		X	X		LUBBOCK			Well, Pipeline, Transportation
SILVERTON	BRISCOE	754	128			X		X	X	X	TULIA		X	Well, Pipeline, Transportation
SLATON	LUBBOCK	6,179	745			X		X	X		SOUTHLAND ISD			Well, Pipeline, Transportation
SPUR	DICKENS	1,041	180			X		X	X		DICKENS			Well, Pipeline, Transportation
SUDAN	LAMB	1,042	250			X		X	X		LUBBOCK			Well, Pipeline, Transportation
SUNDOWN	HOCKLEY	1,538	417			X		X	X		WHITE FACE			Well, Pipeline, Transportation
TAHOKA PUBLIC WATER SYSTEM	LYNN	2,832	476			X		X	X		LUBBOCK			Well, Pipeline, Transportation

Entity				Potential Emergency Water Supply Sources							Implementation Requirements			
Water User Group	County	2020 Population	2020 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
TULIA	SWISHER	4,879	865			X		X	X		CRMWA			Well, Pipeline, Transportation
WHITEFACE	COCHRAN	501	118			X		X	X		LEVELLAND, MORTON			Well, Pipeline, Transportation
WOLFFORTH	LUBBOCK	4,577	765			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 2070 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 2070 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 hand held hose or 5 gallon bucket. • Vehicle washing allowed only with hand held 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 hand held 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 with regard to 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 in order 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

In addition, the LERWPG supports the efforts of the Texas Drought Preparedness Council administered by the Texas Department of Public Safety, and recommends that entities review information developed by the council. The Texas Drought Preparedness Council was established by the Texas Legislature in 1999 and is composed of 15 representatives from several state agencies. The council is responsible for assessing and public reporting of drought monitoring and water supply conditions, advising the governor on drought conditions, and ensuring effective coordination among agencies. More information on the Texas Drought Preparedness Council can be found here:

http://www.txdps.state.tx.us/dem/CouncilsCommittees/droughtCouncil/stateDroughtPrepCouncil.htm

8

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

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Chapter 8: Recommendations for Unique Stream Segments, Unique Reservoir Sites, and Other Legislative Policy 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 2021 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[250]. 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.

[250] U.S. Fish and Wildlife Service (USFWS). 2016. Sharpnose shiner and smalleye shiner. Arlington, Texas Ecological Services Field Office. Available at https://www.fws.gov/southwest/es/ArlingtonTexas/pdf/Brazos%20Shiners%20Fact%20sheet%202016%20FINAL.pdf

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 2021 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 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.

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

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.

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.

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.

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 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 Right 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

As stated in the 2016 LERWP, 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.

The initiative has projects in Castro, Floyd, Swisher, Briscoe, Hale, and Armstrong counties thus far, and as of spring 2019, had completed 13 pit filling projects with 489 playa acres restored. To date, TxPCI has spent an average of $12,305 per project. "That's pretty cheap for wetland restoration," Kahl said.

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.

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 such as in the spring and early summer of 2019.

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.

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Infrastructure Financing

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Chapter 9: Infrastructure Financing

[31 TAC §357.44]

9.1 Introduction

Senate Bill 2 (SB 2), 77th Texas Legislature, requires that regional water plans (RWPs) include a description of financing needed to implement recommended water management strategies (WMS) and projects, including how local governments and others propose to pay for WMSs identified in the RWP. The Texas Water Development Board (TWDB) issued an Infrastructure Financing Report (IFR) Survey requesting information from water user groups (WUGs) to examine the

- funding needed to implement the water management strategies and projects identified, and
- recommended in the planning area's 2016 RWP.

9.2 Objectives of the Infrastructure Financing Report

The primary objective of the IFR is to determine the financing options proposed by political subdivisions to meet future water infrastructure needs, including identifying any state funding sources considered.

9.3 Methods and Procedures

For the Llano Estacado Region, WUGs and wholesale water providers (WWPs) having WMSs with an associated capital cost in the initially prepared regional plan were surveyed using the questionnaire provided by the TWDB (Appendix J).

For each project with an identified capital cost, those WUGs surveyed were asked to enter only the amounts that they wish to receive from the following TWDB program.

- Planning, Design, and Permitting: Costs were entered into this category if the entity wanted to participate in the TWDB programs offering subsidized interest and deferral of principal and interest for planning, design, and permitting costs.
- Construction Funding: Costs were entered into this category if the entity wants to obtain subsidized interest for all construction costs, including planning, design, and construction.
- State Participation: Percentages of costs were entered into this category if the entity wanted to participate in the State Participation Program. State participation funding offers partial interest and principal deferral for the incremental cost of project elements which are designed and built to serve needs beyond 10 years.

9.4 Survey Responses

The Llano Estacado Regional Water Planning Group (LERWPG) mailed a survey package, including a cover letter (Appendix K) and TWDB-provided survey information, to representatives for the following WUGs:

- City of Brownfield
- City of Littlefield
- City of Lubbock
- City of Muleshoe
- City of Plainview
- City of Ralls
- City of Seminole
- City of Wolfforth

The non-municipal WUG surveys were sent to the groundwater conservation district (GCD) managers that serve the respective counties of each of the non-municipal WUGs.

Comments were received from four of the WUGs that were sent the survey.

As shown in Table 9-1, the four responses represent about 88 percent of the estimated capital costs of WMSs included in the Llano Estacado Regional Water Plan (LERWP). Of those responding, the survey shows that approximately $607 million would be sought through the state participation programs. The completed IFR survey collection spreadsheet requested by the TWDB is provided as an electronic appendix submitted separately alongside this Plan.

With respect to the role of the state in financing the recommended water supply projects, significant state participation is required in order to provide adequate funding for implementing WMSs in the plan.

Table 9-1. Summary of Responses to the Infrastructure Financing Survey

Sponsor Entity Name	Received Response to Survey	ProjectName	Capital Cost	Planning, Design, Permitting and Acquisition Funding		Construction Funding		Percent State Participation in Owning Excess Capacity
				Amount	Year of Need	Amount	Year of Need	
Brownfield	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$633,000	No Response Received to Date				
County-Other, Gaines	No	LOCAL GROUNDWATER DEVELOPMENT	$ 4,159,00	No Response Received to Date				
Littlefield	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$902,000	No Response Received to Date				
Lubbock	Yes	BAILEY COUNTY WELL FIELD CAPACITY MAINTENANCE	$94,704,000	$25,000,000	2023	$69,700,000	2024	0%
Lubbock	Yes	CRMWA AQUIFER STORAGE AND RECOVERY	$103,917,000	$41,800,000	2045	$62,100,000	2050	0%
Lubbock	Yes	DIRECT POTABLE REUSE TO NORTH WATER TREATMENT PLANT	$125,890,000	$37,300,000	2050	$88,600,000	2055	0%
Lubbock	Yes	JIM BERTRAM LAKE 7	$149,975,000	$77,100,000	2030	$173,900,000	2035	0%
Lubbock	Yes	LAKE ALAN HENRY PHASE 2	$103,152,000	$30,800,000	2023	$72,400,000	2027	0%
Manufacturing, Deaf Smith Co	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$3,222,000	not to be funded by State Programs				0%
Manufacturing, Gaines Co	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$3,066,000	not to be funded by State Programs				0%
Manufacturing, Hale Co	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$8,932,000	not to be funded by State Programs				0%
Manufacturing, Lubbock	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$2,742,000	not to be funded by State Programs				0%

Sponsor Entity Name	Received Response to Survey	ProjectName	Capital Cost	Planning, Design, Permitting and Acquisition Funding		Construction Funding		Percent State Participation in Owning Excess Capacity
				Amount	Year of Need	Amount	Year of Need	
Mining, Crosby	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$1,298,000	not to be funded by State Programs				0%
Mining, Dawson	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$1,976,000	not to be funded by State Programs				0%
Mining, Hale	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$1,562,000	not to be funded by State Programs				0%
Mining, Lamb	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$1,019,000	not to be funded by State Programs				0%
Mining, Lubbock	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$18,678,000	not to be funded by State Programs				0%
Mining, Lynn	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$1,342,000	not to be funded by State Programs				0%
Mining, Terry	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$993,000	not to be funded by State Programs				0%
Mining, Yoakum	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$1,300,000	not to be funded by State Programs				0%
Muleshoe	Yes	LOCAL GROUNDWATER DEVELOPMENT	$631,000	$190,000	2028	$441,000	2030	0%
Plainview	Yes	AQUIFER STORAGE AND RECOVERY (ASR)	$8,857,000	$2,510,000	2025	$6,347,000	2030	0%
Plainview	Yes	REUSE	$10,349,000	$3,011,000	2030	$7,338,000	2035	0%
Ralls	No	ADDITIONAL GROUNDWATER DEVELOPMENT	$849,000	No Response Received to Date				

Sponsor Entity Name	Received Response to Survey	ProjectName	Capital Cost	Planning, Design, Permitting and Acquisition Funding		Construction Funding		Percent State Participation in Owning Excess Capacity
				Amount	Year of Need	Amount	Year of Need	
Seminole	No	LOCAL GROUNDWATER DEVELOPMENT	$37,482,000	No Response Received to Date				
Wolfforth	No	LOCAL GROUNDWATER DEVELOPMENT	$9,968,000	No Response Received to Date				

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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 2021 Llano Estacado Regional Water Plan* (Initially Prepared 2021 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 August 8, 2018. No public comments were received at the meeting or during the official comment period.

The Initially Prepared 2021 LERWP for the Llano Estacado Region was approved at the February 19, 2020, 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 2021 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 2016 LERWP is posted for public viewing and download, as well as documents from the planning process for the development of the 2021 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 September 2017, 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 January 12, 2018.

Municipal WUGs and WWPs were mailed a survey by SPAG staff in September 2019 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 2021 LERWP development meetings.

- August 22, 2017
- November 15, 2017
- January 23, 2018
- April 3, 2018
- August 8, 2018
- June 27, 2019
- September 17, 2019
- November 13, 2019
- January 22, 2020
- February 19, 2020

- November 15, 2018
- February 20, 2019
- April 24, 2019
- May 14, 2020
- September 10, 2020

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 2021 LERWP on February 19, 2020, for submittal to the TWDB. The Initially Prepared 2021 LERWP was submitted to the TWDB on March 3, 2020, and was declared administratively complete on March 5, 2020. The public hearing to receive comments on the Initially Prepared 2021 LERWP was held May 14, 2020, providing sufficient time to accept public comments according to statute to meet the November 5, 2020, deadline for submission of the adopted Final 2021 LERWP. The Initially Prepared 2021 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 2021 LERWP with responses are included in Appendix L.

10.7 Plan Adoption

The LERWPG formally adopted the 2021 LERWP on September 10, 2020, and directed SPAG and HDR to submit the 2021 LERWP to the TWDB on or before the November 5, 2020, deadline.

Figure 10.1. LERWPG Meeting on November 13, 2019

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11

Implementation and Comparison to Previous Regional Water Plans

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Chapter 11: Implementation and Comparison to Previous Regional Water Plans

[31 TAC §357.45]

In response to Senate Bill 660 (SB 660) (82nd Legislative Session), the Texas Water Development Board (TWDB) issued guidance that requires each region to report the level of implementation of previously recommended water management strategies (WMSs) and associated impediments to implementation in meeting future water needs in accordance with 31 Texas Administrative Code (TAC) §357.45(a). A summary update on the status of implementation of WMSs recommended in the 2016 Llano Estacado Regional Water Plan (LERWP) is provided below. The TWDB provided a spreadsheet for regional water planning groups (RWPGs) to gather and record this information, along with other project-related details. Furthermore, an assessment of the progress of WMSs toward conserving, developing, and managing water to meet future demands in the region is presented. Lastly, this chapter presents information comparing the previous water plan to the current planning effort.

11.1 Implementation of the 2016 Llano Estacado Regional Water Plan

The 2016 LERWP used the 2011 implementation survey developed by the TWDB to standardize reporting about the implementation of WMSs recommended in the 2011 LERWP. Information was collected using telephone and email surveys conducted over several months. These methods resulted in successfully gathering information from 59 of 60 water user groups (WUGs). The survey included 14 questions about the WMSs, including implementation status, project cost and funding, and water volume. The findings suggested a high level of engagement with WUGs implementing approximately 71 percent of WMSs to some degree.

The TWDB has not undertaken a survey similar to the 2011 implementation survey for use in the 2021 LERWP. Therefore, gaging the process of implementing WMSs relied upon other methods. As 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 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 2016 regional water plans/2017 State Water Plan. As directed by the TWDB, this workbook template is to be used for Chapter 11 of the 2021 regional water plans. This workbook is the full extent of the survey instrument for implementation and impediment data that will be provided for the 2021 regional water plans.

In order to meet reporting requirements in statute, the workbook template includes TWDB 2017 database (DB17) 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, 2020, is included in Appendix J. A finalized, populated template must be submitted with the final 2021 regional water plans.

11.2 Comparison to the 2016 Llano Estacado Regional Water Plan

The data compiled and presented within this 2021 LERWP are compared to the data presented in the 2016 LERWP in the following sections.

11.2.1 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. Recent rule revisions to 31 TAC §357.10(41) changes the definition of a municipal WUG and clarifies the basis of planning to focus on utility service areas rather than geographic census-place names. In essence, the definition of a WUG now reflects the utility rather than the city. For the 2021 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

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 11-1.

Table 11-1. Changes to WUGs and WWPs in the 2021 Plan

Entity	County	Comments
New WUGs		
Quitaque	Briscoe	Change in TWDB WUG definition
Nazareth	Castro	Change in TWDB WUG definition
Whiteface	Cochran	Change in TWDB WUG definition
Red River Authority of Texas	Motley	Change in TWDB WUG definition
Red River Authority of Texas	Dickens	Change in TWDB WUG definition
WUGs Now Included with County-Other		
Meadow	Terry	Below WUG size
Kress	Swisher	Below WUG size

11.2.2 Water Demand Projections

Water demand projections from the 2016 and 2021 LERWPs are shown in Figure 11.1. Project demands decrease in every decade except 2020 compared to the previous plan, primarily due to changes in TWDB methodology 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 11-2.

Table 11-2. Change in Water Demand by WUG from 2016 to 2021 LERWPs

Water User Group	Change in Water Demand by Decade (acre-feet per year)					
	2020	2030	2040	2050	2060	2070
Irrigation	335,860	(213,499)	(551,884)	(706,549)	(739,080)	(722,680)
Livestock	2,761	1,131	3,011	5,083	7,381	9,687
Manufacturing	(5,694)	(5,005)	(5,743)	(6,376)	(7,397)	(8,481)
Mining	858	648	789	1,109	1,389	1,557
Municipal	146	353	630	451	247	(45)
Steam-electric	(4,896)	(9,291)	(14,647)	(21,176)	(29,136)	(37,891)
TOTAL	329,035	(225,663)	(567,844)	(727,458)	(766,596)	(757,853)

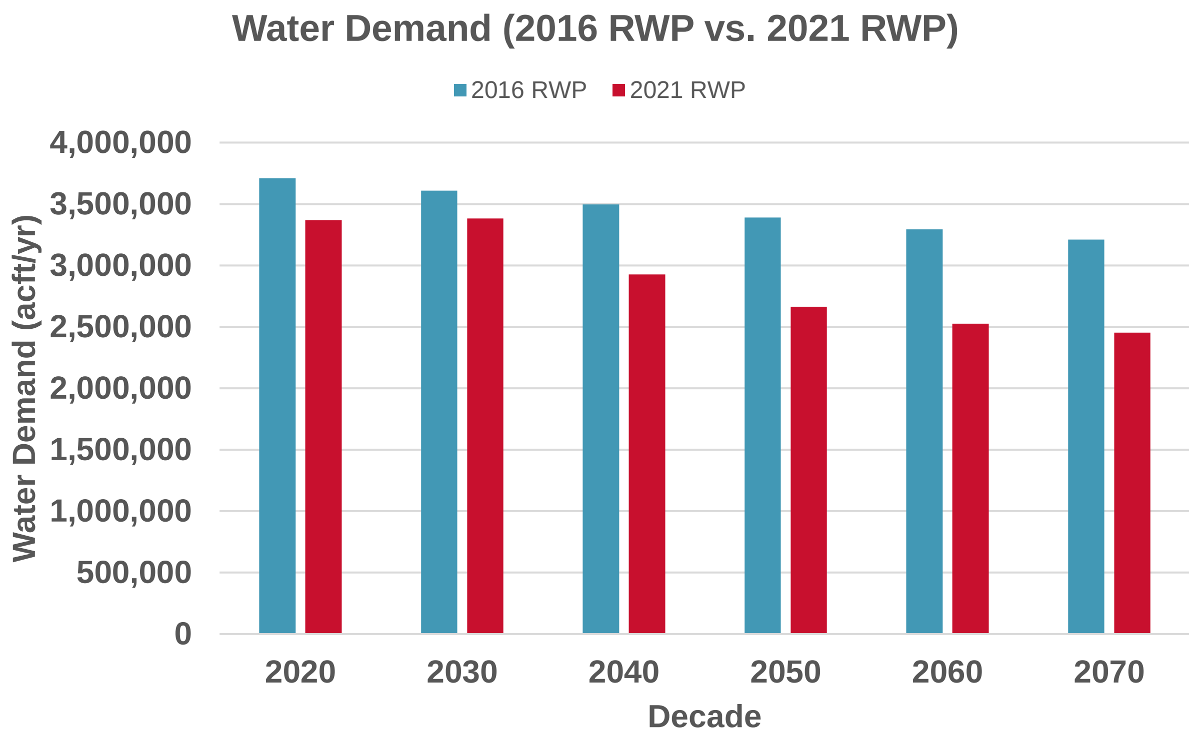

Figure 11.1. Comparison of 2016 and 2021 Water Demand Projections

11.2.3 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 2016 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 2021 LERWP, the TWDB granted a hydrologic variance to the LERWPG to use a standalone WAM for Lake Alan Henry (LAH) analyses that was developed for the City of Lubbock.

In the 2016 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 2021 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 2015.
- Well capacity is assumed to be the maximum annual pumpage during this time period.

11.2.4 Groundwater and Surface Water Source Availability

Water availability from the 2016 and 2021 LERWPs is shown in Figure 11.2. 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 11-3.

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 groundwater management area (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 Brazos WAM is updated by TCEQ, 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 11-3. Change in Water Availability from 2016 to 2021 LERWPs

Source	Change in Water Availability by Decade (acre-feet per year)					
	2020	2030	2040	2050	2060	2070
Groundwater	844,188	77,765	(252,051)	(326,020)	(286,597)	(181,680)
Reuse	(205)	(205)	355	567	814	1,071
Surface Water	(202)	(202)	(202)	(202)	(202)	(202)
TOTAL	843,781	77,358	(251,989)	(325,655)	(285,985)	(180,811)

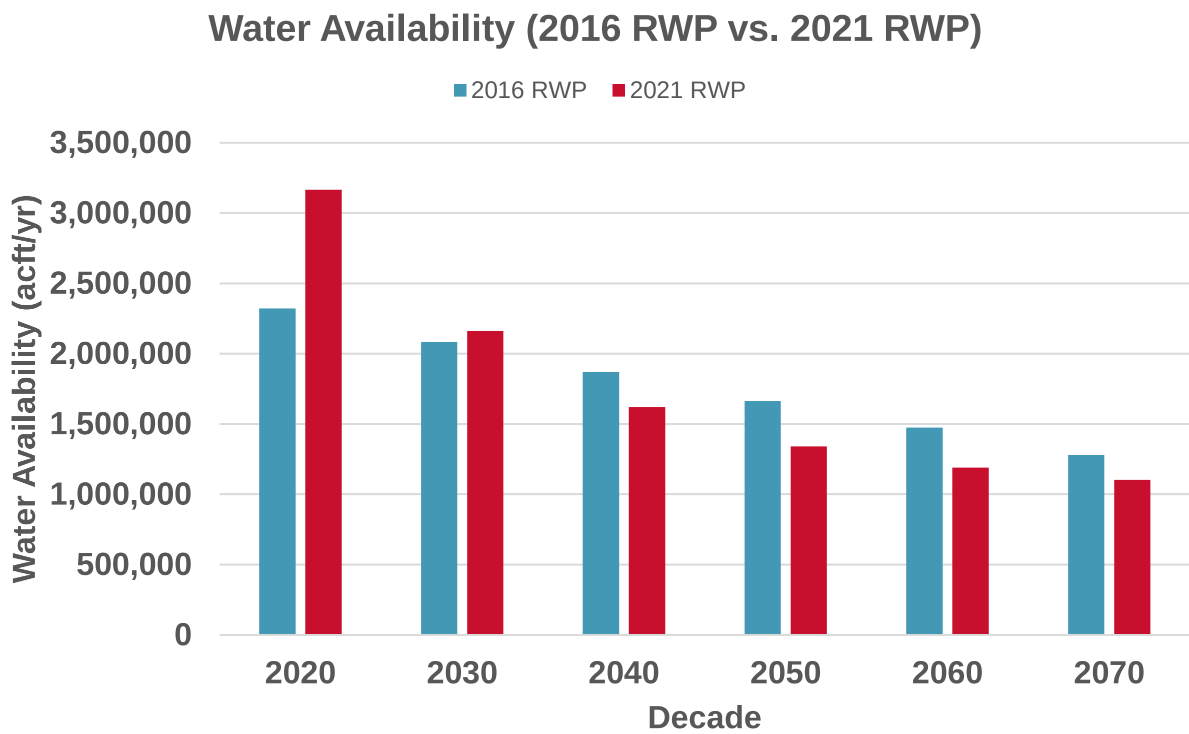

Figure 11.2. Comparison of 2016 and 2021 Water Availability Projections

11.2.5 Existing Water Supplies for Water Users

The changes in the existing water supply by WUG from the 2016 and 2021 LERWPs are shown in Figure 11.3 and Table 11-4. 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 11-4. Change in Water Supply by WUG from 2016 to 2021 LERWPs

Water User Group	Change in Water Supply by Decade (acre-feet)					
	2020	2030	2040	2050	2060	2070
Irrigation	869,991	220,135	(27,172)	(134,569)	(150,359)	(20,242)
Livestock	32,316	29,014	26,081	28,121	29,293	26,265
Manufacturing	(5,439)	(6,414)	(7,691)	(7,859)	(7,068)	(7,617)
Mining	7,310	8,338	10,175	12,159	12,734	13,096
Municipal	48,559	54,135	53,332	51,941	49,353	47,893
Steam-electric	(1,581)	(6,338)	(14,186)	(20,818)	(22,738)	(21,628)
TOTAL	951,156	298,870	40,539	(71,025)	(88,785)	37,767

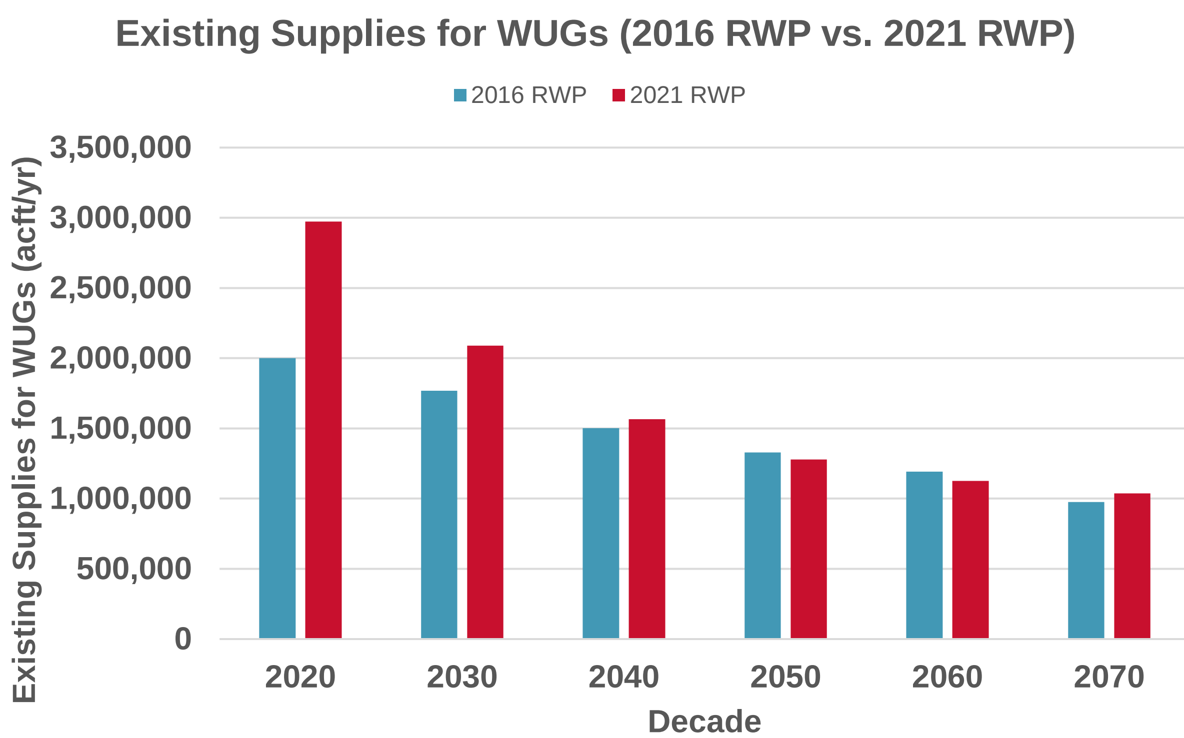

Figure 11.3. Comparison of 2016 and 2021 Existing Supplies for WUGs

11.2.6 Water User Needs

Changes in water user needs by WUG from the 2016 and 2021 LERWPs are shown in Figure 11.4 and Table 11-5. Changes are due to changes in demand projections and changes in the available supply to WUGs.

Table 11-5. Change in Water User Needs by WUG from 2016 to 2021 LERWPs

Water User Group	Change in Water User Needs by Decade (acre-feet)					
	2020	2030	2040	2050	2060	2070
Irrigation	(977,581)	(355,806)	(497,213)	(557,187)	(578,910)	(694,622)
Livestock	(12,022)	(14,383)	(12,045)	(14,232)	(15,104)	(12,189)
Manufacturing	230	1,514	2,020	1,547	(287)	(834)
Mining	197	(1,202)	(1,774)	(2,169)	(1,718)	(1,321)
Municipal	(8,888)	(15,211)	(15,519)	(17,116)	(17,861)	(19,440)
Steam-electric	(7,747)	(6,617)	(3,189)	(4,185)	(5,474)	(11,793)
TOTAL	(1,005,811)	(391,705)	(527,720)	(593,342)	(619,354)	(740,199)

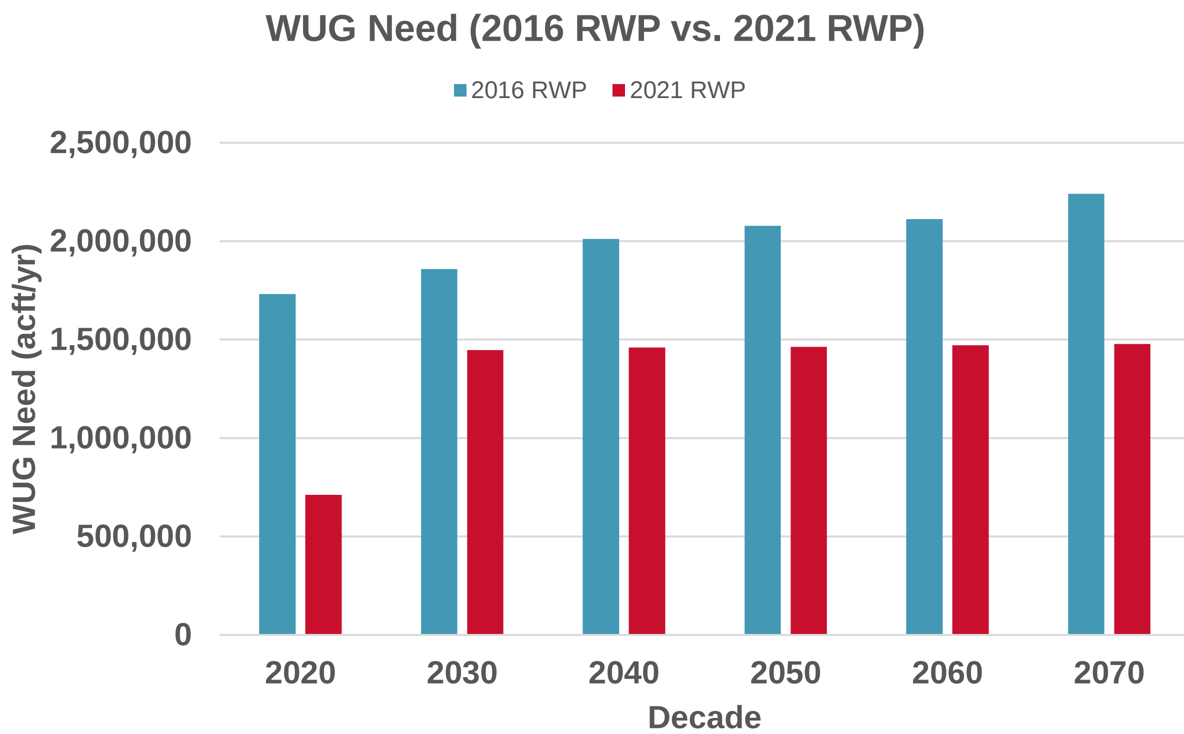

Figure 11.4. Comparison of 2016 and 2021 WUG Need

11.2.7 Recommended and Alternative Water Management Strategies

WMSs and WMS projects from the 2016 and 2021 LERWPs are compared in Table 11-6. Most of the recommended strategies from previous plans are again recommended in this plan. There were no alternative strategies in the 2016 plan.

Table 11-6. Comparison of WMSs and WMS Projects from 2016 to 2021 LERWPs

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 Reseroir (Alternative)		√
South Fork Discharge (Alternative)		√

WMS = water management strategy; CRMWA = Canadian River Municipal Water Authority

11.2.8 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. Also, the Control of Naturally Occurring Salinity conservation strategy evaluated by the Brazos G (Region G) regional planning group and included in the LERWP has potential benefits for the White River Municipal Water District (WRMWD) located in the Llano Estacado Region.

2021 Llano Estacado Regional Water Plan

November 2020

Appendices

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DB22 Reports

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Region O Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
MULESHOE	5,769	6,452	7,131	7,833	8,527	9,208
COUNTY-OTHER	2,243	2,510	2,775	3,047	3,317	3,582
BRAZOS BASIN TOTAL	**8,012**	**8,962**	**9,906**	**10,880**	**11,844**	**12,790**
BAILEY COUNTY TOTAL	**8,012**	**8,962**	**9,906**	**10,880**	**11,844**	**12,790**
QUITAQUE	420	420	420	420	420	420
SILVERTON	754	755	755	755	755	755
COUNTY-OTHER	499	498	498	498	498	498
RED BASIN TOTAL	**1,673**	**1,673**	**1,673**	**1,673**	**1,673**	**1,673**
BRISCOE COUNTY TOTAL	**1,673**	**1,673**	**1,673**	**1,673**	**1,673**	**1,673**
DIMMITT	4,825	5,237	5,533	5,806	6,019	6,191
HART MUNICIPAL WATER SYSTEM	1,194	1,296	1,369	1,437	1,489	1,532
COUNTY-OTHER	1,398	1,518	1,603	1,683	1,745	1,794
BRAZOS BASIN TOTAL	**7,417**	**8,051**	**8,505**	**8,926**	**9,253**	**9,517**
NAZARETH	352	382	404	423	439	452
COUNTY-OTHER	1,121	1,217	1,285	1,349	1,399	1,438
RED BASIN TOTAL	**1,473**	**1,599**	**1,689**	**1,772**	**1,838**	**1,890**
CASTRO COUNTY TOTAL	**8,890**	**9,650**	**10,194**	**10,698**	**11,091**	**11,407**
MORTON PWS	2,168	2,224	2,216	2,166	2,216	2,230
WHITEFACE	501	529	533	526	541	546
COUNTY-OTHER	490	557	577	581	605	615
BRAZOS BASIN TOTAL	**3,159**	**3,310**	**3,326**	**3,273**	**3,362**	**3,391**
COUNTY-OTHER	332	377	391	394	410	416
COLORADO BASIN TOTAL	**332**	**377**	**391**	**394**	**410**	**416**
COCHRAN COUNTY TOTAL	**3,491**	**3,687**	**3,717**	**3,667**	**3,772**	**3,807**
CROSBYTON	1,922	2,067	2,188	2,311	2,444	2,563
LORENZO	1,260	1,380	1,480	1,583	1,704	1,786
RALLS	2,075	2,223	2,343	2,465	2,590	2,717
COUNTY-OTHER	1,263	1,347	1,415	1,484	1,554	1,641
BRAZOS BASIN TOTAL	**6,520**	**7,017**	**7,426**	**7,843**	**8,292**	**8,707**
COUNTY-OTHER	6	6	7	7	7	8
RED BASIN TOTAL	**6**	**6**	**7**	**7**	**7**	**8**
CROSBY COUNTY TOTAL	**6,526**	**7,023**	**7,433**	**7,850**	**8,299**	**8,715**
ODONNELL	128	134	139	142	148	151
COUNTY-OTHER	30	33	35	36	38	40
BRAZOS BASIN TOTAL	**158**	**167**	**174**	**178**	**186**	**191**
LAMESA	9,755	10,098	10,333	10,377	10,678	10,874
COUNTY-OTHER	4,894	5,312	5,670	5,885	6,234	6,510
COLORADO BASIN TOTAL	**14,649**	**15,410**	**16,003**	**16,262**	**16,912**	**17,384**
DAWSON COUNTY TOTAL	**14,807**	**15,577**	**16,177**	**16,440**	**17,098**	**17,575**
COUNTY-OTHER	8	9	11	12	13	15
CANADIAN BASIN TOTAL	**8**	**9**	**11**	**12**	**13**	**15**
HEREFORD	17,150	19,799	22,694	25,978	28,558	31,379
COUNTY-OTHER	4,993	5,765	6,609	7,564	8,316	9,137
RED BASIN TOTAL	**22,143**	**25,564**	**29,303**	**33,542**	**36,874**	**40,516**
DEAF SMITH COUNTY TOTAL	**22,151**	**25,573**	**29,314**	**33,554**	**36,887**	**40,531**
SPUR	1,041	1,041	1,041	1,041	1,041	1,041
COUNTY-OTHER	894	890	886	882	878	875

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region O Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
BRAZOS BASIN TOTAL	**1,935**	**1,931**	**1,927**	**1,923**	**1,919**	**1,916**
RED RIVER AUTHORITY OF TEXAS*	45	50	55	59	64	68
COUNTY-OTHER	184	183	182	182	181	180
RED BASIN TOTAL	**229**	**233**	**237**	**241**	**245**	**248**
DICKENS COUNTY TOTAL	**2,164**	**2,164**	**2,164**	**2,164**	**2,164**	**2,164**
FLOYDADA	3,242	3,242	3,242	3,242	3,242	3,242
LOCKNEY	2,029	2,156	2,236	2,321	2,388	2,444
COUNTY-OTHER	1,070	1,270	1,396	1,534	1,641	1,730
BRAZOS BASIN TOTAL	**6,341**	**6,668**	**6,874**	**7,097**	**7,271**	**7,416**
COUNTY-OTHER	528	626	689	757	810	854
RED BASIN TOTAL	**528**	**626**	**689**	**757**	**810**	**854**
FLOYD COUNTY TOTAL	**6,869**	**7,294**	**7,563**	**7,854**	**8,081**	**8,270**
SEAGRAVES	2,558	2,700	2,871	3,060	3,164	3,273
SEMINOLE	7,102	7,893	8,834	9,855	10,648	11,475
COUNTY-OTHER	11,656	15,153	19,292	23,739	27,854	32,138
COLORADO BASIN TOTAL	**21,316**	**25,746**	**30,997**	**36,654**	**41,666**	**46,886**
GAINES COUNTY TOTAL	**21,316**	**25,746**	**30,997**	**36,654**	**41,666**	**46,886**
POST	6,012	6,452	6,841	7,098	7,466	7,770
COUNTY-OTHER	1,065	1,058	1,058	1,068	1,103	1,135
BRAZOS BASIN TOTAL	**7,077**	**7,510**	**7,899**	**8,166**	**8,569**	**8,905**
GARZA COUNTY TOTAL	**7,077**	**7,510**	**7,899**	**8,166**	**8,569**	**8,905**
ABERNATHY	2,263	2,360	2,401	2,381	2,444	2,469
HALE CENTER	2,252	2,252	2,252	2,252	2,252	2,252
PETERSBURG MUNICIPAL WATER SYSTEM	1,252	1,306	1,329	1,317	1,352	1,366
PLAINVIEW	24,624	25,685	26,123	25,905	26,587	26,874
COUNTY-OTHER	7,923	8,362	8,542	8,452	8,734	8,853
BRAZOS BASIN TOTAL	**38,314**	**39,965**	**40,647**	**40,307**	**41,369**	**41,814**
HALE COUNTY TOTAL	**38,314**	**39,965**	**40,647**	**40,307**	**41,369**	**41,814**
ANTON	1,235	1,313	1,361	1,370	1,431	1,470
LEVELLAND	14,839	15,785	16,359	16,467	17,202	17,676
COUNTY-OTHER	7,273	7,739	8,021	8,072	8,434	8,665
BRAZOS BASIN TOTAL	**23,347**	**24,837**	**25,741**	**25,909**	**27,067**	**27,811**
SUNDOWN	1,538	1,636	1,696	1,707	1,783	1,832
COUNTY-OTHER	245	261	270	272	284	292
COLORADO BASIN TOTAL	**1,783**	**1,897**	**1,966**	**1,979**	**2,067**	**2,124**
HOCKLEY COUNTY TOTAL	**25,130**	**26,734**	**27,707**	**27,888**	**29,134**	**29,935**
AMHERST	799	877	930	963	1,018	1,059
EARTH	1,099	1,125	1,131	1,118	1,134	1,137
LITTLEFIELD	6,642	6,642	6,642	6,642	6,642	6,642
OLTON	2,250	2,275	2,266	2,218	2,229	2,217
SUDAN	1,042	1,127	1,182	1,213	1,273	1,316
COUNTY-OTHER	2,783	3,129	3,287	3,265	3,495	3,604
BRAZOS BASIN TOTAL	**14,615**	**15,175**	**15,438**	**15,419**	**15,791**	**15,975**
LAMB COUNTY TOTAL	**14,615**	**15,175**	**15,438**	**15,419**	**15,791**	**15,975**
ABERNATHY	786	874	961	1,054	1,142	1,229
IDALOU	2,425	2,534	2,647	2,772	2,883	2,993
LUBBOCK	261,706	294,862	329,597	356,227	381,205	403,901
NEW DEAL	869	951	1,036	1,125	1,210	1,294

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region O Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
RANSOM CANYON	1,171	1,257	1,344	1,438	1,525	1,612
SHALLOWATER	2,820	3,192	3,562	3,956	4,334	4,709
SLATON	6,179	6,257	6,352	6,467	6,547	6,621
WOLFFORTH	4,577	5,577	6,569	7,614	8,633	9,647
COUNTY-OTHER	29,236	28,473	26,252	34,285	42,291	52,310
BRAZOS BASIN TOTAL	**309,769**	**343,977**	**378,320**	**414,938**	**449,770**	**484,316**
LUBBOCK COUNTY TOTAL	**309,769**	**343,977**	**378,320**	**414,938**	**449,770**	**484,316**
ODONNELL	765	805	807	803	843	862
TAHOKA PUBLIC WATER SYSTEM	2,832	2,978	2,987	2,973	3,122	3,190
COUNTY-OTHER	2,601	2,737	2,745	2,733	2,870	2,931
BRAZOS BASIN TOTAL	**6,198**	**6,520**	**6,539**	**6,509**	**6,835**	**6,983**
COUNTY-OTHER	81	85	85	85	89	91
COLORADO BASIN TOTAL	**81**	**85**	**85**	**85**	**89**	**91**
LYNN COUNTY TOTAL	**6,279**	**6,605**	**6,624**	**6,594**	**6,924**	**7,074**
MATADOR	643	643	643	643	643	643
RED RIVER AUTHORITY OF TEXAS*	23	26	28	31	33	35
COUNTY-OTHER	546	543	541	538	536	534
RED BASIN TOTAL	**1,212**	**1,212**	**1,212**	**1,212**	**1,212**	**1,212**
MOTLEY COUNTY TOTAL	**1,212**	**1,212**	**1,212**	**1,212**	**1,212**	**1,212**
BOVINA	2,082	2,304	2,506	2,701	2,931	3,142
FARWELL	1,507	1,668	1,813	1,956	2,122	2,274
COUNTY-OTHER	1,980	2,193	2,383	2,570	2,789	2,989
BRAZOS BASIN TOTAL	**5,569**	**6,165**	**6,702**	**7,227**	**7,842**	**8,405**
FRIONA	4,437	4,913	5,340	5,759	6,251	6,698
COUNTY-OTHER	1,418	1,570	1,706	1,841	1,998	2,141
RED BASIN TOTAL	**5,855**	**6,483**	**7,046**	**7,600**	**8,249**	**8,839**
PARMER COUNTY TOTAL	**11,424**	**12,648**	**13,748**	**14,827**	**16,091**	**17,244**
COUNTY-OTHER	384	403	409	407	427	436
BRAZOS BASIN TOTAL	**384**	**403**	**409**	**407**	**427**	**436**
HAPPY*	649	682	692	687	721	738
TULIA	4,879	5,123	5,198	5,166	5,422	5,542
COUNTY-OTHER	2,345	2,462	2,499	2,484	2,605	2,664
RED BASIN TOTAL	**7,873**	**8,267**	**8,389**	**8,337**	**8,748**	**8,944**
SWISHER COUNTY TOTAL	**8,257**	**8,670**	**8,798**	**8,744**	**9,175**	**9,380**
COUNTY-OTHER	69	72	77	74	78	82
BRAZOS BASIN TOTAL	**69**	**72**	**77**	**74**	**78**	**82**
BROWNFIELD	10,000	10,700	11,300	12,250	12,800	13,300
COUNTY-OTHER	3,530	3,685	3,944	3,784	3,969	4,153
COLORADO BASIN TOTAL	**13,530**	**14,385**	**15,244**	**16,034**	**16,769**	**17,453**
TERRY COUNTY TOTAL	**13,599**	**14,457**	**15,321**	**16,108**	**16,847**	**17,535**
DENVER CITY	5,072	5,736	6,327	6,955	7,618	8,249
PLAINS	1,702	1,926	2,124	2,335	2,557	2,769
COUNTY-OTHER	2,146	2,427	2,677	2,942	3,226	3,493
COLORADO BASIN TOTAL	**8,920**	**10,089**	**11,128**	**12,232**	**13,401**	**14,511**
YOAKUM COUNTY TOTAL	**8,920**	**10,089**	**11,128**	**12,232**	**13,401**	**14,511**
REGION O POPULATION TOTAL	**540,495**	**594,391**	**645,980**	**697,869**	**750,858**	**801,719**

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Region O Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MULESHOE	1,173	1,283	1,397	1,523	1,655	1,787
COUNTY-OTHER	277	296	320	351	381	411
LIVESTOCK	2,428	2,821	3,070	3,341	3,639	3,958
IRRIGATION	88,108	88,108	72,000	63,505	58,659	55,616
BRAZOS BASIN TOTAL	**91,986**	**92,508**	**76,787**	**68,720**	**64,334**	**61,772**
BAILEY COUNTY TOTAL	**91,986**	**92,508**	**76,787**	**68,720**	**64,334**	**61,772**
QUITAQUE	106	104	102	102	101	101
SILVERTON	128	124	121	120	120	120
COUNTY-OTHER	159	156	154	154	154	154
LIVESTOCK	286	300	315	331	347	352
IRRIGATION	26,417	26,417	20,687	17,833	16,225	15,231
RED BASIN TOTAL	**27,096**	**27,101**	**21,379**	**18,540**	**16,947**	**15,958**
BRISCOE COUNTY TOTAL	**27,096**	**27,101**	**21,379**	**18,540**	**16,947**	**15,958**
DIMMITT	1,091	1,159	1,205	1,254	1,299	1,335
HART MUNICIPAL WATER SYSTEM	175	183	188	197	203	209
COUNTY-OTHER	204	213	221	231	240	246
LIVESTOCK	4,974	5,616	6,053	6,528	7,043	7,594
IRRIGATION	246,911	246,911	195,321	164,462	151,177	144,884
BRAZOS BASIN TOTAL	**253,355**	**254,082**	**202,988**	**172,672**	**159,962**	**154,268**
NAZARETH	134	144	150	157	163	168
COUNTY-OTHER	164	171	177	186	192	198
MANUFACTURING	61	66	66	66	66	66
LIVESTOCK	1,747	1,973	2,126	2,292	2,474	2,667
IRRIGATION	132,952	132,952	105,172	88,556	81,402	78,014
RED BASIN TOTAL	**135,058**	**135,306**	**107,691**	**91,257**	**84,297**	**81,113**
CASTRO COUNTY TOTAL	**388,413**	**389,388**	**310,679**	**263,929**	**244,259**	**235,381**
MORTON PWS	477	477	471	459	469	472
WHITEFACE	118	122	121	120	123	124
COUNTY-OTHER	182	204	211	212	221	224
MINING	8	11	11	8	6	4
LIVESTOCK	70	73	75	78	81	81
IRRIGATION	67,626	67,626	57,664	51,479	46,346	42,821
BRAZOS BASIN TOTAL	**68,481**	**68,513**	**58,553**	**52,356**	**47,246**	**43,726**
COUNTY-OTHER	124	139	143	144	150	152
MINING	146	197	199	155	109	77
LIVESTOCK	32	33	34	35	36	37
IRRIGATION	31,823	31,823	27,136	24,225	21,810	20,151
COLORADO BASIN TOTAL	**32,125**	**32,192**	**27,512**	**24,559**	**22,105**	**20,417**
COCHRAN COUNTY TOTAL	**100,606**	**100,705**	**86,065**	**76,915**	**69,351**	**64,143**
CROSBYTON	301	313	323	340	359	376
LORENZO	231	246	258	275	296	310
RALLS	311	322	331	345	362	379
COUNTY-OTHER	149	153	160	167	175	184
MANUFACTURING	2	3	3	3	3	3
MINING	626	617	549	477	413	358
LIVESTOCK	167	175	184	192	202	204
IRRIGATION	103,321	103,321	103,321	81,768	70,915	65,013

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Region O Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
BRAZOS BASIN TOTAL	**105,108**	**105,150**	**105,129**	**83,567**	**72,725**	**66,827**
COUNTY-OTHER	1	1	1	1	1	1
MINING	368	363	322	280	243	210
LIVESTOCK	4	4	4	5	5	5
IRRIGATION	4,262	4,262	4,262	3,373	2,925	2,682
RED BASIN TOTAL	**4,635**	**4,630**	**4,589**	**3,659**	**3,174**	**2,898**
CROSBY COUNTY TOTAL	**109,743**	**109,780**	**109,718**	**87,226**	**75,899**	**69,725**
ODONNELL	18	18	18	18	19	20
COUNTY-OTHER	4	4	4	4	4	5
LIVESTOCK	1	1	1	1	1	1
IRRIGATION	1,045	1,045	1,045	903	827	781
BRAZOS BASIN TOTAL	**1,068**	**1,068**	**1,068**	**926**	**851**	**807**
LAMESA	2,240	2,268	2,279	2,284	2,346	2,389
COUNTY-OTHER	602	628	651	666	704	734
MINING	1,812	1,812	1,812	1,812	1,812	1,812
LIVESTOCK	52	54	57	60	63	64
IRRIGATION	105,267	105,267	105,267	90,896	83,299	78,662
COLORADO BASIN TOTAL	**109,973**	**110,029**	**110,066**	**95,718**	**88,224**	**83,661**
DAWSON COUNTY TOTAL	**111,041**	**111,097**	**111,134**	**96,644**	**89,075**	**84,468**
COUNTY-OTHER	1	1	1	1	1	2
LIVESTOCK	112	122	130	138	147	157
IRRIGATION	2,101	2,101	1,628	1,383	1,255	1,183
CANADIAN BASIN TOTAL	**2,214**	**2,224**	**1,759**	**1,522**	**1,403**	**1,342**
HEREFORD	3,857	4,354	4,917	5,589	6,136	6,739
COUNTY-OTHER	589	650	723	820	899	986
MANUFACTURING	1,002	1,107	1,107	1,107	1,107	1,107
LIVESTOCK	11,058	12,035	12,803	13,628	14,514	15,447
IRRIGATION	207,915	207,915	161,073	136,891	124,191	117,036
RED BASIN TOTAL	**224,421**	**226,061**	**180,623**	**158,035**	**146,847**	**141,315**
DEAF SMITH COUNTY TOTAL	**226,635**	**228,285**	**182,382**	**159,557**	**148,250**	**142,657**
SPUR	180	174	172	172	171	171
COUNTY-OTHER	120	115	111	110	109	109
MINING	10	10	10	10	10	10
LIVESTOCK	238	250	262	275	290	293
IRRIGATION	5,155	5,155	5,155	5,155	5,155	5,155
BRAZOS BASIN TOTAL	**5,703**	**5,704**	**5,710**	**5,722**	**5,735**	**5,738**
RED RIVER AUTHORITY OF TEXAS*	11	12	13	14	15	16
COUNTY-OTHER	25	24	23	23	23	23
MINING	2	2	2	2	2	2
LIVESTOCK	149	156	164	172	180	182
IRRIGATION	3,884	3,884	3,884	3,884	3,884	3,884
RED BASIN TOTAL	**4,071**	**4,078**	**4,086**	**4,095**	**4,104**	**4,107**
DICKENS COUNTY TOTAL	**9,774**	**9,782**	**9,796**	**9,817**	**9,839**	**9,845**
FLOYDADA	572	554	546	545	544	544
LOCKNEY	277	283	285	295	303	310
COUNTY-OTHER	129	145	158	173	185	195
MINING	214	217	215	214	213	214
LIVESTOCK	894	910	928	947	966	971

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Region O Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
IRRIGATION	46,380	46,380	36,899	31,963	29,122	27,444
BRAZOS BASIN TOTAL	**48,466**	**48,489**	**39,031**	**34,137**	**31,333**	**29,678**
COUNTY-OTHER	63	71	78	86	91	96
MINING	272	275	274	272	271	271
LIVESTOCK	274	279	284	290	296	297
IRRIGATION	82,457	82,457	65,601	56,826	51,774	48,791
RED BASIN TOTAL	**83,066**	**83,082**	**66,237**	**57,474**	**52,432**	**49,455**
FLOYD COUNTY TOTAL	**131,532**	**131,571**	**105,268**	**91,611**	**83,765**	**79,133**
SEAGRAVES	423	433	450	474	489	506
SEMINOLE	2,348	2,571	2,847	3,160	3,411	3,675
COUNTY-OTHER	1,400	1,760	2,202	2,688	3,148	3,630
MANUFACTURING	1,512	1,587	1,587	1,587	1,587	1,587
MINING	1,829	2,400	2,071	1,527	1,051	776
LIVESTOCK	123	126	129	133	136	137
IRRIGATION	362,482	362,482	328,442	306,787	291,887	282,438
COLORADO BASIN TOTAL	**370,117**	**371,359**	**337,728**	**316,356**	**301,709**	**292,749**
GAINES COUNTY TOTAL	**370,117**	**371,359**	**337,728**	**316,356**	**301,709**	**292,749**
POST	792	827	860	884	927	964
COUNTY-OTHER	135	128	125	126	129	133
MANUFACTURING	2	2	2	2	2	2
MINING	395	544	438	334	234	164
LIVESTOCK	148	155	162	170	179	181
IRRIGATION	10,353	10,353	10,353	10,353	10,353	10,353
BRAZOS BASIN TOTAL	**11,825**	**12,009**	**11,940**	**11,869**	**11,824**	**11,797**
GARZA COUNTY TOTAL	**11,825**	**12,009**	**11,940**	**11,869**	**11,824**	**11,797**
ABERNATHY	536	547	549	540	553	559
HALE CENTER	281	271	264	260	259	259
PETERSBURG MUNICIPAL WATER SYSTEM	321	329	329	325	333	336
PLAINVIEW	4,587	4,664	4,650	4,562	4,672	4,722
COUNTY-OTHER	1,031	1,048	1,040	1,013	1,044	1,058
MANUFACTURING	4,383	5,076	5,076	5,076	5,076	5,076
MINING	1,168	1,152	1,022	886	766	662
STEAM ELECTRIC POWER	31	31	31	31	31	31
LIVESTOCK	2,752	3,111	3,325	3,561	3,820	4,098
IRRIGATION	307,440	307,440	263,617	241,892	231,023	225,295
BRAZOS BASIN TOTAL	**322,530**	**323,669**	**279,903**	**258,146**	**247,577**	**242,096**
IRRIGATION	3,102	3,102	2,660	2,441	2,331	2,273
RED BASIN TOTAL	**3,102**	**3,102**	**2,660**	**2,441**	**2,331**	**2,273**
HALE COUNTY TOTAL	**325,632**	**326,771**	**282,563**	**260,587**	**249,908**	**244,369**
ANTON	160	164	165	165	171	176
LEVELLAND	2,441	2,520	2,553	2,547	2,654	2,727
COUNTY-OTHER	891	914	922	915	953	979
MANUFACTURING	576	691	691	691	691	691
MINING	16	16	15	15	14	13
LIVESTOCK	113	118	123	128	133	134
IRRIGATION	122,709	122,709	90,961	77,949	71,808	68,479
BRAZOS BASIN TOTAL	**126,906**	**127,132**	**95,430**	**82,410**	**76,424**	**73,199**
SUNDOWN	417	435	447	449	469	482

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Region O Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
COUNTY-OTHER	30	31	31	31	32	33
MINING	2	2	2	2	2	2
LIVESTOCK	20	20	21	22	23	23
IRRIGATION	9,157	9,157	6,788	5,817	5,358	5,110
COLORADO BASIN TOTAL	**9,626**	**9,645**	**7,289**	**6,321**	**5,884**	**5,650**
HOCKLEY COUNTY TOTAL	**136,532**	**136,777**	**102,719**	**88,731**	**82,308**	**78,849**
AMHERST	102	107	110	113	119	124
EARTH	191	190	186	183	186	186
LITTLEFIELD	987	956	927	916	914	914
OLTON	466	461	451	437	438	436
SUDAN	250	264	273	278	292	301
COUNTY-OTHER	401	434	451	447	477	492
MANUFACTURING	807	940	940	940	940	940
MINING	586	579	513	445	385	333
STEAM ELECTRIC POWER	13,450	13,450	13,450	13,450	13,450	13,450
LIVESTOCK	3,940	4,529	4,910	5,325	5,780	6,271
IRRIGATION	259,451	259,451	218,589	203,951	197,509	194,185
BRAZOS BASIN TOTAL	**280,631**	**281,361**	**240,800**	**226,485**	**220,490**	**217,632**
LAMB COUNTY TOTAL	**280,631**	**281,361**	**240,800**	**226,485**	**220,490**	**217,632**
ABERNATHY	186	203	220	239	258	278
IDALOU	434	441	451	467	485	503
LUBBOCK	46,775	51,386	56,443	60,464	64,576	68,389
NEW DEAL	113	120	128	137	147	158
RANSOM CANYON	336	355	376	400	424	448
SHALLOWATER	422	464	507	558	610	662
SLATON	745	725	712	711	717	725
WOLFFORTH	765	912	1,061	1,223	1,384	1,546
COUNTY-OTHER	3,797	3,580	3,229	4,169	5,129	6,339
MANUFACTURING	856	1,011	1,011	1,011	1,011	1,011
MINING	6,354	6,425	5,913	5,302	4,763	4,314
STEAM ELECTRIC POWER	5,694	5,694	5,694	5,694	5,694	5,694
LIVESTOCK	1,088	1,138	1,173	1,212	1,253	1,287
IRRIGATION	144,866	144,866	132,596	124,312	118,397	114,260
BRAZOS BASIN TOTAL	**212,431**	**217,320**	**209,514**	**205,899**	**204,848**	**205,614**
LUBBOCK COUNTY TOTAL	**212,431**	**217,320**	**209,514**	**205,899**	**204,848**	**205,614**
ODONNELL	106	107	105	105	109	112
TAHOKA PUBLIC WATER SYSTEM	476	486	477	470	492	503
COUNTY-OTHER	302	305	296	289	303	309
MINING	1,084	1,234	1,167	960	768	614
LIVESTOCK	60	63	66	69	72	73
IRRIGATION	82,991	82,991	82,991	82,991	82,991	82,991
BRAZOS BASIN TOTAL	**85,019**	**85,186**	**85,102**	**84,884**	**84,735**	**84,602**
COUNTY-OTHER	9	9	9	9	9	10
MINING	82	93	88	73	58	46
LIVESTOCK	5	5	5	5	6	6
IRRIGATION	5,930	5,930	5,930	5,930	5,930	5,930

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Region O Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
COLORADO BASIN TOTAL	**6,026**	**6,037**	**6,032**	**6,017**	**6,003**	**5,992**
LYNN COUNTY TOTAL	**91,045**	**91,223**	**91,134**	**90,901**	**90,738**	**90,594**
MATADOR	224	221	219	218	218	218
RED RIVER AUTHORITY OF TEXAS*	6	6	7	7	8	8
COUNTY-OTHER	98	94	92	92	91	91
MINING	240	213	205	198	179	161
LIVESTOCK	276	290	305	320	336	340
IRRIGATION	9,426	9,426	9,426	9,426	9,426	9,426
RED BASIN TOTAL	**10,270**	**10,250**	**10,254**	**10,261**	**10,258**	**10,244**
MOTLEY COUNTY TOTAL	**10,270**	**10,250**	**10,254**	**10,261**	**10,258**	**10,244**
BOVINA	373	402	429	458	496	531
FARWELL	393	426	457	490	531	569
COUNTY-OTHER	385	415	443	475	514	551
LIVESTOCK	5,871	6,654	7,173	7,739	8,355	9,020
IRRIGATION	191,424	191,424	165,947	153,526	146,303	142,274
BRAZOS BASIN TOTAL	**198,446**	**199,321**	**174,449**	**162,688**	**156,199**	**152,945**
FRIONA	801	864	922	985	1,067	1,143
COUNTY-OTHER	276	298	317	340	368	394
MANUFACTURING	1,666	1,841	1,841	1,841	1,841	1,841
LIVESTOCK	1,468	1,664	1,794	1,935	2,089	2,256
IRRIGATION	47,801	47,801	41,439	38,338	36,534	35,528
RED BASIN TOTAL	**52,012**	**52,468**	**46,313**	**43,439**	**41,899**	**41,162**
PARMER COUNTY TOTAL	**250,458**	**251,789**	**220,762**	**206,127**	**198,098**	**194,107**
COUNTY-OTHER	50	51	50	50	52	53
LIVESTOCK	136	143	150	158	166	173
IRRIGATION	24,372	24,372	19,808	17,581	16,340	15,578
BRAZOS BASIN TOTAL	**24,558**	**24,566**	**20,008**	**17,789**	**16,558**	**15,804**
HAPPY*	99	100	100	98	102	105
TULIA	865	883	876	863	903	923
COUNTY-OTHER	307	308	306	303	317	324
LIVESTOCK	2,592	2,721	2,857	2,999	3,148	3,296
IRRIGATION	111,024	111,024	90,233	80,087	74,435	70,962
RED BASIN TOTAL	**114,887**	**115,036**	**94,372**	**84,350**	**78,905**	**75,610**
SWISHER COUNTY TOTAL	**139,445**	**139,602**	**114,380**	**102,139**	**95,463**	**91,414**
COUNTY-OTHER	9	9	9	9	9	9
MINING	25	37	38	29	21	15
LIVESTOCK	19	20	22	23	25	26
IRRIGATION	8,639	8,639	7,295	6,735	6,445	6,276
BRAZOS BASIN TOTAL	**8,692**	**8,705**	**7,364**	**6,796**	**6,500**	**6,326**
BROWNFIELD	1,604	1,665	1,718	1,841	1,919	1,993
COUNTY-OTHER	436	435	456	436	456	478
MANUFACTURING	14	17	17	17	17	17
MINING	330	488	505	387	272	191
LIVESTOCK	401	441	470	503	537	560
IRRIGATION	164,146	164,146	138,606	127,969	122,446	119,251
COLORADO BASIN TOTAL	**166,931**	**167,192**	**141,772**	**131,153**	**125,647**	**122,490**
TERRY COUNTY TOTAL	**175,623**	**175,897**	**149,136**	**137,949**	**132,147**	**128,816**

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

Region O Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
DENVER CITY	1,423	1,579	1,720	1,888	2,066	2,236
PLAINS	438	486	529	578	632	685
COUNTY-OTHER	263	287	310	336	368	398
MINING	1,300	1,334	1,147	957	783	641
STEAM ELECTRIC POWER	1,910	1,910	1,910	1,910	1,910	1,910
LIVESTOCK	91	96	101	106	111	113
IRRIGATION	161,693	161,693	138,141	127,049	121,210	117,681
COLORADO BASIN TOTAL	**167,118**	**167,385**	**143,858**	**132,824**	**127,080**	**123,664**
YOAKUM COUNTY TOTAL	**167,118**	**167,385**	**143,858**	**132,824**	**127,080**	**123,664**
REGION O DEMAND TOTAL	**3,367,953**	**3,381,960**	**2,927,996**	**2,663,087**	**2,526,590**	**2,452,931**

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

Region O Water User Group (WUG) Category Summary

MUNICIPAL	2020	2030	2040	2050	2060	2070
POPULATION	445,261	491,921	538,163	575,363	612,430	645,875
DEMAND (acre-feet per year)	82,286	88,710	95,415	101,302	107,715	113,672
EXISTING SUPPLIES (acre-feet per year)	115,797	115,646	115,084	113,284	109,674	107,658
NEEDS (acre-feet per year)*	4,345	9,335	14,966	20,923	28,664	35,051

COUNTY-OTHER	2020	2030	2040	2050	2060	2070
POPULATION	95,234	102,470	107,817	122,506	138,428	155,844
DEMAND (acre-feet per year)	12,613	13,077	13,424	15,057	16,929	19,001
EXISTING SUPPLIES (acre-feet per year)	18,011	18,011	18,011	18,011	18,011	18,011
NEEDS (acre-feet per year)*	0	10	452	938	1,398	1,880

MANUFACTURING	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	10,881	12,341	12,341	12,341	12,341	12,341
EXISTING SUPPLIES (acre-feet per year)	5,982	5,982	5,982	5,982	5,982	5,982
NEEDS (acre-feet per year)*	5,454	6,482	6,482	6,482	6,482	6,482

MINING	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	16,869	18,021	16,518	14,345	12,375	10,890
EXISTING SUPPLIES (acre-feet per year)	15,097	15,097	15,097	15,097	15,097	15,097
NEEDS (acre-feet per year)*	10,118	10,503	9,517	8,145	6,908	6,016

STEAM ELECTRIC POWER	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	21,085	21,085	21,085	21,085	21,085	21,085
EXISTING SUPPLIES (acre-feet per year)	27,795	27,795	27,795	25,555	25,555	25,555
NEEDS (acre-feet per year)*	0	0	0	0	0	0

LIVESTOCK	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	41,589	46,096	49,276	52,721	56,453	60,304
EXISTING SUPPLIES (acre-feet per year)	60,219	60,219	60,219	60,219	60,219	59,897
NEEDS (acre-feet per year)*	112	122	844	2,041	3,689	5,442

IRRIGATION	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	3,182,630	3,182,630	2,719,937	2,446,236	2,299,692	2,215,638
EXISTING SUPPLIES (acre-feet per year)	2,708,897	1,824,924	1,300,856	1,019,366	868,900	782,286
NEEDS (acre-feet per year)*	705,992	1,440,091	1,450,917	1,446,461	1,445,719	1,445,026

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Category Summary 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 category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

Region O Source Availability

GROUNDWATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY *	2020	2030	2040	2050	2060	2070
DOCKUM AQUIFER	BAILEY	BRAZOS	FRESH	833	833	833	833	833	833
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	425	425	425	425	425	425
DOCKUM AQUIFER	COCHRAN	BRAZOS	FRESH	104	104	104	104	104	104
DOCKUM AQUIFER	COCHRAN	COLORADO	FRESH	868	868	868	868	868	868
DOCKUM AQUIFER	CROSBY	BRAZOS	FRESH	3,858	3,858	3,858	3,858	3,858	3,858
DOCKUM AQUIFER	CROSBY	RED	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	DEAF SMITH	CANADIAN	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	DEAF SMITH	RED	FRESH	4,401	4,401	4,401	4,401	4,401	4,401
DOCKUM AQUIFER	DICKENS	BRAZOS	FRESH	100	100	100	100	100	100
DOCKUM AQUIFER	DICKENS	RED	FRESH	100	100	100	100	100	100
DOCKUM AQUIFER	FLOYD	BRAZOS	FRESH	2,976	2,976	2,976	2,976	2,976	2,976
DOCKUM AQUIFER	FLOYD	RED	FRESH	250	250	250	250	250	250
DOCKUM AQUIFER	GAINES	COLORADO	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	GARZA	BRAZOS	BRACKISH	911	911	911	911	911	911
DOCKUM AQUIFER	HALE	BRAZOS	FRESH	1,092	1,092	1,092	1,092	1,092	1,092
DOCKUM AQUIFER	HALE	RED	FRESH	29	29	29	29	29	29
DOCKUM AQUIFER	HOCKLEY	BRAZOS	FRESH	890	890	890	890	890	890
DOCKUM AQUIFER	HOCKLEY	COLORADO	FRESH	167	167	167	167	167	167
DOCKUM AQUIFER	LAMB	BRAZOS	FRESH	923	923	923	923	923	923
DOCKUM AQUIFER	LUBBOCK	BRAZOS	FRESH	1,086	1,086	1,086	1,086	1,086	1,086
DOCKUM AQUIFER	LYNN	BRAZOS	FRESH	791	791	791	791	791	791
DOCKUM AQUIFER	LYNN	COLORADO	FRESH	121	121	121	121	121	121
DOCKUM AQUIFER	MOTLEY	RED	FRESH	93	93	93	92	92	92
DOCKUM AQUIFER	PARMER	BRAZOS	FRESH	3,152	3,152	3,152	3,152	2,392	2,291
DOCKUM AQUIFER	PARMER	RED	FRESH	2,298	2,298	2,298	2,298	2,298	2,298
DOCKUM AQUIFER	SWISHER	BRAZOS	FRESH	25	25	25	25	25	25
DOCKUM AQUIFER	SWISHER	RED	FRESH	1,551	1,551	1,551	1,551	1,551	1,551
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	BAILEY	BRAZOS	FRESH	97,679	67,307	51,199	42,704	37,858	34,815
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	BRISCOE	RED	FRESH	29,022	17,637	11,907	9,053	7,445	6,451
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	CASTRO	BRAZOS	FRESH	159,730	112,038	61,892	32,048	19,950	14,535
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	CASTRO	RED	FRESH	107,563	72,432	43,208	25,577	17,236	12,970
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	COCHRAN	BRAZOS	FRESH	26,117	21,555	18,919	17,399	16,483	15,900
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	COCHRAN	COLORADO	FRESH	75,645	57,597	45,584	38,008	31,376	26,775
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	CROSBY	BRAZOS	FRESH	162,630	108,077	68,110	46,363	35,547	29,723
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	CROSBY	RED	FRESH	3,693	3,503	3,068	2,373	1,888	1,567
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	DAWSON	BRAZOS	FRESH	1,699	1,456	1,329	1,256	1,210	1,178
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	DAWSON	COLORADO	FRESH	171,153	122,020	95,467	81,027	73,400	68,749

* 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.

Region O Source Availability

GROUNDWATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	DEAF SMITH	RED	FRESH	206,336	137,403	90,088	65,661	52,833	45,606
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	FLOYD	BRAZOS	FRESH	144,643	69,038	43,219	30,165	23,203	19,428
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	FLOYD	RED	FRESH	25,808	25,101	24,583	23,926	22,995	22,109
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	GAINES	COLORADO	FRESH	277,954	218,338	184,298	162,643	147,743	138,294
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	GARZA	BRAZOS	FRESH	16,297	13,648	12,395	11,657	11,180	10,855
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	219,639	114,473	70,305	48,453	37,543	31,804
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	HALE	RED	FRESH	472	455	358	266	197	150
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	HOCKLEY	BRAZOS	FRESH	130,832	85,716	66,206	56,994	52,150	49,382
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	HOCKLEY	COLORADO	FRESH	46,599	26,171	11,564	6,793	5,037	4,228
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	LAMB	BRAZOS	FRESH	223,477	112,082	71,220	56,582	50,140	46,816
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	LUBBOCK	BRAZOS	FRESH	151,056	121,404	109,134	100,850	94,935	90,798
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	LYNN	BRAZOS	FRESH	104,528	88,796	79,406	73,546	69,934	67,598
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	LYNN	COLORADO	FRESH	8,079	7,355	6,088	5,057	4,414	4,042
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	PARMER	BRAZOS	FRESH	78,257	50,870	34,925	26,034	20,971	17,881
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	PARMER	RED	FRESH	73,758	40,228	24,334	17,703	14,499	12,655
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	SWISHER	BRAZOS	FRESH	25,301	10,833	6,160	4,109	3,092	2,534
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	SWISHER	RED	FRESH	103,982	60,806	40,124	29,802	23,926	20,249
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	TERRY	BRAZOS	FRESH	8,367	7,167	6,548	6,142	5,864	5,670
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	TERRY	COLORADO	FRESH	182,401	125,610	99,345	88,554	83,019	79,849
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	YOAKUM	COLORADO	FRESH	138,940	92,952	69,400	58,308	52,469	48,940
OGALLALA AQUIFER	DICKENS	BRAZOS	FRESH	500	500	500	500	500	500
OGALLALA AQUIFER	DICKENS	RED	FRESH	800	800	800	800	800	800
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	313	313	313	313	313	313

* 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.

Region O Source Availability

GROUNDWATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
SEYMOUR AQUIFER	MOTLEY	RED	FRESH	4,843	6,679	4,843	4,830	3,972	3,961
GROUNDWATER SOURCE AVAILABILITY TOTAL				**3,091,566**	**2,083,813**	**1,540,292**	**1,258,948**	**1,106,814**	**1,019,716**

REUSE SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
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
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
REUSE SOURCE AVAILABILITY TOTAL				**48,945**	**51,353**	**53,806**	**55,497**	**56,998**	**58,252**

SURFACE WATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ALAN HENRY LAKE/RESERVOIR	RESERVOIR**	BRAZOS	FRESH	21,400	20,940	20,480	20,020	19,560	19,100
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	4,530	4,530	4,530	4,530	4,530	4,530
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
SURFACE WATER SOURCE AVAILABILITY TOTAL				**26,048**	**25,588**	**25,128**	**24,668**	**24,208**	**23,748**

REGION O SOURCE AVAILABILITY TOTAL	**3,166,559**	**2,160,754**	**1,619,226**	**1,339,113**	**1,188,020**	**1,101,716**

* 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.

Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
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	411	411	411	411	411	411
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | BAILEY COUNTY	3,077	3,077	3,077	3,077	3,077	3,077
IRRIGATION	O	DIRECT REUSE	825	825	825	825	825	825
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | BAILEY COUNTY	71,985	41,613	25,505	17,010	12,164	9,121
		BRAZOS BASIN TOTAL	**79,354**	**48,982**	**32,874**	**24,379**	**19,533**	**16,490**
		BAILEY COUNTY TOTAL	**79,354**	**48,982**	**32,874**	**24,379**	**19,533**	**16,490**
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	199	199	199	199	199	199
COUNTY-OTHER	O	RED RUN-OF-RIVER	20	20	20	20	20	20
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | BRISCOE COUNTY	115	115	115	115	115	115
LIVESTOCK	O	OTHER AQUIFER | BRISCOE COUNTY	238	238	238	238	238	238
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | BRISCOE COUNTY	28,589	17,104	11,374	8,520	6,912	5,918
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	313	313	313	313	313	313
		RED BASIN TOTAL	**34,686**	**23,201**	**17,471**	**14,617**	**13,009**	**12,015**
		BRISCOE COUNTY TOTAL	**34,686**	**23,201**	**17,471**	**14,617**	**13,009**	**12,015**
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	255	255	255	255	255	255
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CASTRO COUNTY	7,596	7,596	7,596	7,596	7,596	7,596
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	147,397	99,705	49,559	19,715	7,617	2,202
		BRAZOS BASIN TOTAL	**163,761**	**116,069**	**65,923**	**36,079**	**23,981**	**18,566**
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	205	205	205	205	205	205
MANUFACTURING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CASTRO COUNTY	95	95	95	95	95	95
LIVESTOCK	O	DOCKUM AQUIFER | CASTRO COUNTY	425	425	425	425	425	425
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CASTRO COUNTY	3,318	3,318	3,318	3,318	3,318	3,318
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CASTRO COUNTY	103,393	68,262	39,038	21,407	13,066	8,800
		RED BASIN TOTAL	**107,988**	**72,857**	**43,633**	**26,002**	**17,661**	**13,395**
		CASTRO COUNTY TOTAL	**271,749**	**188,926**	**109,556**	**62,081**	**41,642**	**31,961**
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	313	313	313	313	313	313

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Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | COCHRAN COUNTY	228	228	228	228	228	228
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | COCHRAN COUNTY	90	90	90	90	90	90
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | COCHRAN COUNTY	307	307	307	307	307	307
IRRIGATION	O	DIRECT REUSE	267	267	267	267	267	267
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | COCHRAN COUNTY	24,581	20,019	17,383	15,863	14,947	14,364
		BRAZOS BASIN TOTAL	**26,384**	**21,822**	**19,186**	**17,666**	**16,750**	**16,167**
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | COCHRAN COUNTY	155	155	155	155	155	155
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | COCHRAN COUNTY	222	222	222	222	222	222
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | COCHRAN COUNTY	367	367	367	367	367	367
IRRIGATION	O	DIRECT REUSE	27	27	27	27	27	27
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | COCHRAN COUNTY	49,785	49,785	44,840	37,264	30,632	26,031
		COLORADO BASIN TOTAL	**50,556**	**50,556**	**45,611**	**38,035**	**31,403**	**26,802**
		COCHRAN COUNTY TOTAL	**76,940**	**72,378**	**64,797**	**55,701**	**48,153**	**42,969**
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
RALLS	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CROSBY COUNTY	233	233	233	233	233	233
COUNTY-OTHER	O	DOCKUM AQUIFER | CROSBY COUNTY	2	2	2	2	2	2
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CROSBY COUNTY	183	183	183	183	183	183
COUNTY-OTHER	O	OTHER AQUIFER | CROSBY COUNTY	2	2	2	2	2	2
MANUFACTURING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CROSBY COUNTY	3	3	3	3	3	3
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CROSBY COUNTY	1,183	1,183	1,183	1,183	1,183	1,183
LIVESTOCK	O	DOCKUM AQUIFER | CROSBY COUNTY	84	84	84	84	84	84
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CROSBY COUNTY	66	66	66	66	66	66
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	150,766	104,079	64,112	42,365	31,549	25,725
IRRIGATION	O	OTHER AQUIFER | CROSBY COUNTY	8,405	8,405	8,405	8,405	8,405	8,405
		BRAZOS BASIN TOTAL	**166,451**	**119,764**	**79,797**	**58,050**	**47,234**	**41,410**
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CROSBY COUNTY	1	1	1	1	1	1
MINING		NO WATER SUPPLY ASSOCIATED WITH WUG	0	0	0	0	0	0
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CROSBY COUNTY	6	6	6	6	6	6
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CROSBY COUNTY	3,206	3,016	2,581	1,886	1,401	1,080
		RED BASIN TOTAL	**3,213**	**3,023**	**2,588**	**1,893**	**1,408**	**1,087**
		CROSBY COUNTY TOTAL	**169,664**	**122,787**	**82,385**	**59,943**	**48,642**	**42,497**

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Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
ODONNELL	A	MEREDITH LAKE/RESERVOIR	4	4	4	4	4	4
ODONNELL	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | DAWSON COUNTY	17	17	17	17	17	17
ODONNELL	A	OGALLALA AQUIFER | ROBERTS COUNTY	12	11	10	8	8	8
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | DAWSON COUNTY	5	5	5	5	5	5
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	1,578	1,335	1,208	1,135	1,089	1,057
		BRAZOS BASIN TOTAL	**1,617**	**1,373**	**1,245**	**1,170**	**1,124**	**1,092**
LAMESA	A	MEREDITH LAKE/RESERVOIR	429	438	490	560	555	554
LAMESA	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | DAWSON COUNTY	723	723	723	723	723	723
LAMESA	A	OGALLALA AQUIFER | ROBERTS COUNTY	1,130	1,157	1,208	1,264	1,128	1,127
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | DAWSON COUNTY	745	745	745	745	745	745
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | DAWSON COUNTY	266	266	266	266	266	266
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | DAWSON COUNTY	200	200	200	200	200	200
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | DAWSON COUNTY	155,257	118,414	91,860	77,421	69,794	65,143
		COLORADO BASIN TOTAL	**158,750**	**121,943**	**95,492**	**81,179**	**73,411**	**68,758**
		DAWSON COUNTY TOTAL	**160,367**	**123,316**	**96,737**	**82,349**	**74,535**	**69,850**
COUNTY-OTHER	O	DOCKUM AQUIFER | DEAF SMITH COUNTY	2	2	2	2	2	2
LIVESTOCK	O	DOCKUM AQUIFER | DEAF SMITH COUNTY	0	0	0	0	0	0
IRRIGATION		NO WATER SUPPLY ASSOCIATED WITH WUG	0	0	0	0	0	0
		CANADIAN BASIN TOTAL	**2**	**2**	**2**	**2**	**2**	**2**
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	986	986	986	986	986	986
MANUFACTURING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | DEAF SMITH COUNTY	4	4	4	4	4	4
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | DEAF SMITH COUNTY	12,089	12,089	12,089	12,089	12,089	12,089
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	188,370	119,437	72,122	47,695	34,917	27,740
		RED BASIN TOTAL	**211,018**	**142,085**	**94,770**	**70,343**	**57,565**	**50,388**
		DEAF SMITH COUNTY TOTAL	**211,020**	**142,087**	**94,772**	**70,345**	**57,567**	**50,390**
SPUR	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CROSBY COUNTY	224	224	224	224	224	224
COUNTY-OTHER	O	OGALLALA AQUIFER | DICKENS COUNTY	12	12	12	12	12	12
COUNTY-OTHER	O	OTHER AQUIFER | DICKENS COUNTY	138	138	138	138	138	138
MINING	O	OGALLALA AQUIFER | DICKENS COUNTY	18	18	18	18	18	18
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

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Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
IRRIGATION	O	OGALLALA AQUIFER | DICKENS COUNTY	378	378	378	378	378	378
IRRIGATION	O	OTHER AQUIFER | DICKENS COUNTY	5,518	5,518	5,518	5,518	5,518	5,518
		BRAZOS BASIN TOTAL	**6,611**	**6,611**	**6,611**	**6,611**	**6,611**	**6,611**
RED RIVER AUTHORITY OF TEXAS*	O	OTHER AQUIFER | DICKENS COUNTY	11	12	13	14	15	16
COUNTY-OTHER	O	OGALLALA AQUIFER | DICKENS COUNTY	9	9	9	9	9	9
COUNTY-OTHER	O	OTHER AQUIFER | DICKENS COUNTY	22	22	22	22	22	22
MINING	O	OGALLALA AQUIFER | DICKENS COUNTY	11	11	11	11	11	11
LIVESTOCK	O	DOCKUM AQUIFER | DICKENS COUNTY	24	24	24	24	24	24
LIVESTOCK	O	OGALLALA AQUIFER | DICKENS COUNTY	12	12	12	12	12	12
LIVESTOCK	O	OTHER AQUIFER | DICKENS COUNTY	150	150	150	150	150	150
IRRIGATION	O	DOCKUM AQUIFER | DICKENS COUNTY	25	25	25	25	25	25
IRRIGATION	O	OGALLALA AQUIFER | DICKENS COUNTY	768	768	768	768	768	768
IRRIGATION	O	OTHER AQUIFER | DICKENS COUNTY	3,665	3,665	3,665	3,665	3,665	3,665
		RED BASIN TOTAL	**4,697**	**4,698**	**4,699**	**4,700**	**4,701**	**4,702**
		DICKENS COUNTY TOTAL	**11,308**	**11,309**	**11,310**	**11,311**	**11,312**	**11,313**
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
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	196	196	196	196	196	196
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | FLOYD COUNTY	217	217	217	217	217	217
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | FLOYD COUNTY	971	971	971	971	971	971
IRRIGATION	O	DIRECT REUSE	449	449	449	449	449	449
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | FLOYD COUNTY	68,225	65,389	39,570	26,516	19,554	15,779
		BRAZOS BASIN TOTAL	**72,553**	**69,717**	**43,898**	**30,844**	**23,882**	**20,107**
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | FLOYD COUNTY	99	99	99	99	99	99
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | FLOYD COUNTY	275	275	275	275	275	275
LIVESTOCK	O	DOCKUM AQUIFER | FLOYD COUNTY	250	250	250	250	250	250
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | FLOYD COUNTY	337	337	337	337	337	337
LIVESTOCK	O	OTHER AQUIFER | FLOYD COUNTY	81	81	81	81	81	81
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | FLOYD COUNTY	25,097	24,390	23,872	23,215	22,284	21,398
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
		RED BASIN TOTAL	**41,561**	**40,854**	**40,336**	**39,679**	**38,748**	**37,862**
		FLOYD COUNTY TOTAL	**114,114**	**110,571**	**84,234**	**70,523**	**62,630**	**57,969**
SEAGRAVES	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | GAINES COUNTY	969	969	969	969	969	969
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	1,750	1,750	1,750	1,750	1,750	1,750

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Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
MANUFACTURING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | GAINES COUNTY	544	544	544	544	544	544
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | GAINES COUNTY	7,729	7,729	7,729	7,729	7,729	7,729
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | GAINES COUNTY	203	203	203	203	203	203
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | GAINES COUNTY	256,924	195,378	161,338	139,683	124,783	115,334
		COLORADO BASIN TOTAL	**269,916**	**208,370**	**174,330**	**152,675**	**137,775**	**128,326**
		GAINES COUNTY TOTAL	**269,916**	**208,370**	**174,330**	**152,675**	**137,775**	**128,326**
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	306	306	306	306	306	306
COUNTY-OTHER	O	ALAN HENRY LAKE/RESERVOIR	25	25	25	25	25	25
COUNTY-OTHER	O	DOCKUM AQUIFER | GARZA COUNTY	30	30	30	30	30	30
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | GARZA COUNTY	116	116	116	116	116	116
MANUFACTURING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CROSBY COUNTY	2	2	2	2	2	2
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | GARZA COUNTY	544	544	544	544	544	544
LIVESTOCK	O	DOCKUM AQUIFER | GARZA COUNTY	152	152	152	152	152	152
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | GARZA COUNTY	12	12	12	12	12	12
LIVESTOCK	O	OTHER AQUIFER | GARZA COUNTY	20	20	20	20	20	20
IRRIGATION	O	DOCKUM AQUIFER | GARZA COUNTY	234	234	234	234	234	234
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | GARZA COUNTY	13,384	12,976	11,723	10,985	10,508	10,183
IRRIGATION	O	OTHER AQUIFER | GARZA COUNTY	1,410	1,410	1,410	1,410	1,410	1,410
		BRAZOS BASIN TOTAL	**16,893**	**16,485**	**15,232**	**14,494**	**14,017**	**13,692**
		GARZA COUNTY TOTAL	**16,893**	**16,485**	**15,232**	**14,494**	**14,017**	**13,692**
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	613	675	692	712	707	705
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	1,614	1,780	1,707	1,608	1,436	1,434
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HALE COUNTY	1,289	1,289	1,289	1,289	1,289	1,289
MANUFACTURING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HALE COUNTY	1,416	1,416	1,416	1,416	1,416	1,416
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HALE COUNTY	215	215	215	215	215	215
STEAM ELECTRIC POWER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HALE COUNTY	31	31	31	31	31	31
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HALE COUNTY	4,098	4,098	4,098	4,098	4,098	4,098
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	198,011	92,845	48,677	26,825	15,915	10,176

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Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
		BRAZOS BASIN TOTAL	**221,899**	**116,937**	**72,684**	**50,715**	**39,607**	**33,838**
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HALE COUNTY	472	455	358	266	197	150
		RED BASIN TOTAL	**472**	**455**	**358**	**266**	**197**	**150**
		HALE COUNTY TOTAL	**222,371**	**117,392**	**73,042**	**50,981**	**39,804**	**33,988**
ANTON	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HOCKLEY COUNTY	835	835	835	835	835	835
LEVELLAND	A	MEREDITH LAKE/RESERVOIR	564	540	532	527	540	553
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	1,486	1,424	1,313	1,189	1,096	1,124
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HOCKLEY COUNTY	1,114	1,114	1,114	1,114	1,114	1,114
MANUFACTURING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HOCKLEY COUNTY	700	700	700	700	700	700
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HOCKLEY COUNTY	1,311	1,311	1,311	1,311	1,311	1,311
LIVESTOCK	O	DOCKUM AQUIFER | HOCKLEY COUNTY	28	28	28	28	28	28
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HOCKLEY COUNTY	321	321	321	321	321	321
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	123,387	78,271	58,761	49,549	44,705	41,937
		BRAZOS BASIN TOTAL	**134,269**	**89,067**	**69,438**	**60,097**	**55,173**	**52,446**
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	38	38	38	38	38	38
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HOCKLEY COUNTY	236	236	236	236	236	236
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HOCKLEY COUNTY	59	59	59	59	59	59
IRRIGATION	O	DIRECT REUSE	162	162	162	162	162	162
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HOCKLEY COUNTY	13,825	13,825	10,371	5,600	3,844	3,035
		COLORADO BASIN TOTAL	**15,180**	**15,180**	**11,726**	**6,955**	**5,199**	**4,390**
		HOCKLEY COUNTY TOTAL	**149,449**	**104,247**	**81,164**	**67,052**	**60,372**	**56,836**
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	575	575	575	575	575	575
MANUFACTURING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LAMB COUNTY	1,000	1,000	1,000	1,000	1,000	1,000
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LAMB COUNTY	108	108	108	108	108	108
STEAM ELECTRIC POWER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LAMB COUNTY	15,666	15,666	15,666	15,666	15,666	15,666

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Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LAMB COUNTY	5,225	5,225	5,225	5,225	5,225	5,225
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	176,876	65,481	24,619	9,981	3,539	215
		BRAZOS BASIN TOTAL	**211,722**	**100,327**	**59,465**	**44,827**	**38,385**	**35,061**
		LAMB COUNTY TOTAL	**211,722**	**100,327**	**59,465**	**44,827**	**38,385**	**35,061**
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	7,630	7,630	7,630	7,630	7,630	7,630
LUBBOCK	A	MEREDITH LAKE/RESERVOIR	8,723	8,769	9,264	9,565	9,494	9,470
LUBBOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | BAILEY COUNTY	1,906	1,735	1,488	1,203	880	0
LUBBOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LAMB COUNTY	2,156	1,985	1,738	1,453	1,130	0
LUBBOCK	A	OGALLALA AQUIFER | ROBERTS COUNTY	22,644	22,795	22,505	21,257	18,941	18,919
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	153	153	153	153	153	153
RANSOM CANYON	O	ALAN HENRY LAKE/RESERVOIR	143	143	143	143	143	143
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	142	142
RANSOM CANYON	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LAMB COUNTY	142	142	142	142	142	142
RANSOM CANYON	A	OGALLALA AQUIFER | ROBERTS COUNTY	142	142	142	142	142	142
SHALLOWATER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | BAILEY COUNTY	250	250	250	250	250	250
SHALLOWATER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LUBBOCK COUNTY	416	416	416	416	416	416
SLATON	A	MEREDITH LAKE/RESERVOIR	344	322	310	301	298	298
SLATON	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LUBBOCK COUNTY	1,287	1,287	1,287	1,287	1,287	1,287
SLATON	A	OGALLALA AQUIFER | ROBERTS COUNTY	448	389	305	221	147	146
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	202	202
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | BAILEY COUNTY	202	202	202	202	202	202
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LAMB COUNTY	202	202	202	202	202	202
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LUBBOCK COUNTY	5,534	5,534	5,534	5,534	5,534	5,534
COUNTY-OTHER	A	OGALLALA AQUIFER | ROBERTS COUNTY	200	200	200	200	200	200
MANUFACTURING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LUBBOCK COUNTY	335	335	335	335	335	335
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LUBBOCK COUNTY	982	982	982	982	982	982
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	1,290	1,290	1,290	1,290	1,290	1,290

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Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
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	132,014	102,362	89,292	81,008	75,093	70,956
		BRAZOS BASIN TOTAL	**209,843**	**173,269**	**159,843**	**147,747**	**138,743**	**132,575**
		LUBBOCK COUNTY TOTAL	**209,843**	**173,269**	**159,843**	**147,747**	**138,743**	**132,575**
ODONNELL	A	MEREDITH LAKE/RESERVOIR	26	24	22	21	22	23
ODONNELL	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | DAWSON COUNTY	98	98	98	98	98	98
ODONNELL	A	OGALLALA AQUIFER | ROBERTS COUNTY	68	63	55	49	45	46
TAHOKA PUBLIC WATER SYSTEM	A	MEREDITH LAKE/RESERVOIR	117	109	102	96	99	101
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	307	288	251	216	202	206
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LYNN COUNTY	378	378	378	378	378	378
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LYNN COUNTY	449	449	449	449	449	449
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LYNN COUNTY	158	158	158	158	158	158
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	102,302	86,570	77,180	71,320	67,708	65,372
		BRAZOS BASIN TOTAL	**104,690**	**88,924**	**79,480**	**73,572**	**69,946**	**67,618**
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LYNN COUNTY	11	11	11	11	11	11
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LYNN COUNTY	93	93	93	93	93	93
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LYNN COUNTY	9	9	9	9	9	9
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LYNN COUNTY	7,045	7,045	5,975	4,944	4,301	3,929
		COLORADO BASIN TOTAL	**7,158**	**7,158**	**6,088**	**5,057**	**4,414**	**4,042**
		LYNN COUNTY TOTAL	**111,848**	**96,082**	**85,568**	**78,629**	**74,360**	**71,660**
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	6	6	7	7	8	8
COUNTY-OTHER	O	OTHER AQUIFER | MOTLEY COUNTY	83	83	83	83	83	83
COUNTY-OTHER	O	SEYMOUR AQUIFER | MOTLEY COUNTY	39	39	39	39	39	39
MINING	O	OGALLALA AQUIFER | MOTLEY COUNTY	104	104	104	104	104	104
MINING	O	SEYMOUR AQUIFER | MOTLEY COUNTY	140	140	140	140	140	140
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	33	33	33	32	32	32
IRRIGATION	O	OGALLALA AQUIFER | MOTLEY COUNTY	248	248	248	248	248	248
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
		RED BASIN TOTAL	**13,628**	**13,628**	**13,629**	**13,628**	**13,629**	**13,629**

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Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
		MOTLEY COUNTY TOTAL	**13,628**	**13,628**	**13,629**	**13,628**	**13,629**	**13,629**
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
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | PARMER COUNTY	551	551	551	551	551	551
LIVESTOCK	O	DOCKUM AQUIFER | PARMER COUNTY	900	900	900	900	900	900
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | PARMER COUNTY	8,163	8,163	8,163	8,163	8,163	8,163
IRRIGATION	O	DIRECT REUSE	401	401	401	401	401	401
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | PARMER COUNTY	68,114	40,727	24,782	15,891	10,828	7,738
		BRAZOS BASIN TOTAL	**79,558**	**52,171**	**36,226**	**27,335**	**22,272**	**19,182**
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	395	395	395	395	395	395
MANUFACTURING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | PARMER COUNTY	1,866	1,866	1,866	1,866	1,866	1,866
LIVESTOCK	O	DOCKUM AQUIFER | PARMER COUNTY	325	325	325	325	325	325
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | PARMER COUNTY	1,941	1,941	1,941	1,941	1,941	1,941
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	67,393	33,863	17,969	11,338	8,134	6,290
IRRIGATION	O	RED RUN-OF-RIVER	0	0	0	0	0	0
		RED BASIN TOTAL	**76,569**	**43,039**	**27,145**	**20,514**	**17,310**	**15,466**
		PARMER COUNTY TOTAL	**156,127**	**95,210**	**63,371**	**47,849**	**39,582**	**34,648**
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | SWISHER COUNTY	63	63	63	63	63	63
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | SWISHER COUNTY	2,793	2,793	2,793	2,793	2,793	2,471
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | SWISHER COUNTY	22,445	7,977	3,304	1,253	236	0
		BRAZOS BASIN TOTAL	**25,301**	**10,833**	**6,160**	**4,109**	**3,092**	**2,534**
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	384	384	384	384	384	384
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | SWISHER COUNTY	3,296	3,296	3,296	3,296	3,296	3,296
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | SWISHER COUNTY	99,773	56,597	35,915	25,593	19,717	16,040
		RED BASIN TOTAL	**105,733**	**62,556**	**41,873**	**31,550**	**25,673**	**21,994**
		SWISHER COUNTY TOTAL	**131,034**	**73,389**	**48,033**	**35,659**	**28,765**	**24,528**
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | TERRY COUNTY	11	11	11	11	11	11
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | TERRY COUNTY	40	40	40	40	40	40
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | TERRY COUNTY	28	28	28	28	28	28

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Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | TERRY COUNTY	8,288	7,088	6,469	6,063	5,785	5,591
		BRAZOS BASIN TOTAL	**8,367**	**7,167**	**6,548**	**6,142**	**5,864**	**5,670**
BROWNFIELD	A	MEREDITH LAKE/RESERVOIR	368	349	351	356	353	353
BROWNFIELD	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | TERRY COUNTY	632	632	632	632	632	632
BROWNFIELD	A	OGALLALA AQUIFER | ROBERTS COUNTY	969	920	867	804	718	717
COUNTY-OTHER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | TERRY COUNTY	545	545	545	545	545	545
MANUFACTURING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | TERRY COUNTY	17	17	17	17	17	17
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | TERRY COUNTY	100	100	100	100	100	100
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | TERRY COUNTY	562	562	562	562	562	562
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | TERRY COUNTY	179,905	123,114	96,849	85,898	80,363	77,193
		COLORADO BASIN TOTAL	**183,098**	**126,239**	**99,923**	**88,914**	**83,290**	**80,119**
		TERRY COUNTY TOTAL	**191,465**	**133,406**	**106,471**	**95,056**	**89,154**	**85,789**
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	399	399	399	399	399	399
MINING	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | YOAKUM COUNTY	764	764	764	764	764	764
STEAM ELECTRIC POWER	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | YOAKUM COUNTY	2,000	2,000	2,000	2,000	2,000	2,000
LIVESTOCK	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | YOAKUM COUNTY	191	191	191	191	191	191
IRRIGATION	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | YOAKUM COUNTY	128,495	82,507	58,955	47,863	42,024	38,495
		COLORADO BASIN TOTAL	**138,300**	**92,312**	**68,760**	**57,668**	**51,829**	**48,300**
		YOAKUM COUNTY TOTAL	**138,300**	**92,312**	**68,760**	**57,668**	**51,829**	**48,300**
		REGION O EXISTING WATER SUPPLY TOTAL	**2,951,798**	**2,067,674**	**1,543,044**	**1,257,514**	**1,103,438**	**1,014,486**

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Region O Water User Group (WUG) Needs/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.

	(NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
BAILEY COUNTY - BRAZOS BASIN						
MULESHOE	1,883	1,773	1,659	1,533	1,401	1,269
COUNTY-OTHER	134	115	91	60	30	0
LIVESTOCK	649	256	7	(264)	(562)	(881)
IRRIGATION	(15,298)	(45,670)	(45,670)	(45,670)	(45,670)	(45,670)
BRISCOE COUNTY - RED BASIN						
QUITAQUE	212	214	216	216	217	217
SILVERTON	0	4	7	8	8	8
COUNTY-OTHER	60	63	65	65	65	65
LIVESTOCK	67	53	38	22	6	1
IRRIGATION	7,251	(4,234)	(4,234)	(4,234)	(4,234)	(4,234)
CASTRO COUNTY - BRAZOS BASIN						
DIMMITT	2,832	2,764	2,718	2,669	2,624	2,588
HART MUNICIPAL WATER SYSTEM	384	376	371	362	356	350
COUNTY-OTHER	51	42	34	24	15	9
LIVESTOCK	2,622	1,980	1,543	1,068	553	2
IRRIGATION	(95,483)	(143,175)	(141,731)	(140,716)	(139,529)	(138,651)
CASTRO COUNTY - RED BASIN						
NAZARETH	418	408	402	395	389	384
COUNTY-OTHER	41	34	28	19	13	7
MANUFACTURING	34	29	29	29	29	29
LIVESTOCK	1,996	1,770	1,617	1,451	1,269	1,076
IRRIGATION	(29,559)	(64,690)	(66,134)	(67,149)	(68,336)	(69,214)
COCHRAN COUNTY - BRAZOS BASIN						
MORTON PWS	121	121	127	139	129	126
WHITEFACE	195	191	192	193	190	189
COUNTY-OTHER	46	24	17	16	7	4
MINING	82	79	79	82	84	86
LIVESTOCK	237	234	232	229	226	226
IRRIGATION	(42,778)	(47,340)	(40,014)	(35,349)	(31,132)	(28,190)
COCHRAN COUNTY - COLORADO BASIN						
COUNTY-OTHER	31	16	12	11	5	3
MINING	76	25	23	67	113	145
LIVESTOCK	335	334	333	332	331	330
IRRIGATION	17,989	17,989	17,731	13,066	8,849	5,907
CROSBY COUNTY - BRAZOS BASIN						
CROSBYTON	81	69	59	42	23	6
LORENZO	673	658	646	629	608	594
RALLS	(78)	(89)	(98)	(112)	(129)	(146)
COUNTY-OTHER	38	34	27	20	12	3
MANUFACTURING	1	0	0	0	0	0
MINING	557	566	634	706	770	825
LIVESTOCK	38	30	21	13	3	1
IRRIGATION	60,033	13,346	(26,621)	(26,815)	(26,778)	(26,700)

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Region O Water User Group (WUG) Needs/Surplus

CROSBY COUNTY - RED BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	(368)	(363)	(322)	(280)	(243)	(210)
LIVESTOCK	2	2	2	1	1	1
IRRIGATION	(1,056)	(1,246)	(1,681)	(1,487)	(1,524)	(1,602)
DAWSON COUNTY - BRAZOS BASIN						
ODONNELL	15	14	13	11	10	9
COUNTY-OTHER	1	1	1	1	1	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	533	290	163	232	262	276
DAWSON COUNTY - COLORADO BASIN						
LAMESA	42	50	142	263	60	15
COUNTY-OTHER	143	117	94	79	41	11
MINING	(1,546)	(1,546)	(1,546)	(1,546)	(1,546)	(1,546)
LIVESTOCK	148	146	143	140	137	136
IRRIGATION	49,990	13,147	(13,407)	(13,475)	(13,505)	(13,519)
DEAF SMITH COUNTY - CANADIAN BASIN						
COUNTY-OTHER	1	1	1	1	1	0
LIVESTOCK	(112)	(122)	(130)	(138)	(147)	(157)
IRRIGATION	(2,101)	(2,101)	(1,628)	(1,383)	(1,255)	(1,183)
DEAF SMITH COUNTY - RED BASIN						
HEREFORD	2,902	2,405	1,842	1,170	623	20
COUNTY-OTHER	397	336	263	166	87	0
MANUFACTURING	(998)	(1,103)	(1,103)	(1,103)	(1,103)	(1,103)
LIVESTOCK	1,031	54	(714)	(1,539)	(2,425)	(3,358)
IRRIGATION	(16,735)	(85,668)	(86,141)	(86,386)	(86,464)	(86,486)
DICKENS COUNTY - BRAZOS BASIN						
SPUR	44	50	52	52	53	53
COUNTY-OTHER	30	35	39	40	41	41
MINING	8	8	8	8	8	8
LIVESTOCK	63	51	39	26	11	8
IRRIGATION	763	763	763	763	763	763
DICKENS COUNTY - RED BASIN						
RED RIVER AUTHORITY OF TEXAS*	0	0	0	0	0	0
COUNTY-OTHER	6	7	8	8	8	8
MINING	9	9	9	9	9	9
LIVESTOCK	37	30	22	14	6	4
IRRIGATION	574	574	574	574	574	574
FLOYD COUNTY - BRAZOS BASIN						
FLOYDADA	1,384	1,402	1,410	1,411	1,412	1,412
LOCKNEY	262	256	254	244	236	229
COUNTY-OTHER	67	51	38	23	11	1
MINING	3	0	2	3	4	3
LIVESTOCK	77	61	43	24	5	0
IRRIGATION	22,294	19,458	3,120	(4,998)	(9,119)	(11,216)
FLOYD COUNTY - RED BASIN						
COUNTY-OTHER	36	28	21	13	8	3
MINING	3	0	1	3	4	4
LIVESTOCK	394	389	384	378	372	371
IRRIGATION	(41,938)	(42,645)	(26,307)	(18,189)	(14,068)	(11,971)

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Region O Water User Group (WUG) Needs/Surplus

GAINES COUNTY - COLORADO BASIN						
SEAGRAVES	546	536	519	495	480	463
SEMINOLE	(551)	(774)	(1,050)	(1,363)	(1,614)	(1,878)
COUNTY-OTHER	350	(10)	(452)	(938)	(1,398)	(1,880)
MANUFACTURING	(968)	(1,043)	(1,043)	(1,043)	(1,043)	(1,043)
MINING	5,900	5,329	5,658	6,202	6,678	6,953
LIVESTOCK	80	77	74	70	67	66
IRRIGATION	(105,558)	(167,104)	(167,104)	(167,104)	(167,104)	(167,104)
GARZA COUNTY - BRAZOS BASIN						
POST	172	137	104	80	37	0
COUNTY-OTHER	36	43	46	45	42	38
MANUFACTURING	0	0	0	0	0	0
MINING	149	0	106	210	310	380
LIVESTOCK	36	29	22	14	5	3
IRRIGATION	4,675	4,267	3,014	2,276	1,799	1,474
HALE COUNTY - BRAZOS BASIN						
ABERNATHY	843	808	777	748	714	682
HALE CENTER	675	685	692	696	697	697
PETERSBURG MUNICIPAL WATER SYSTEM	273	265	265	269	261	258
PLAINVIEW	3,846	3,997	3,955	3,964	3,677	3,623
COUNTY-OTHER	258	241	249	276	245	231
MANUFACTURING	(2,967)	(3,660)	(3,660)	(3,660)	(3,660)	(3,660)
MINING	(953)	(937)	(807)	(671)	(551)	(447)
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	1,346	987	773	537	278	0
IRRIGATION	(103,952)	(209,118)	(209,463)	(209,590)	(209,631)	(209,642)
HALE COUNTY - RED BASIN						
IRRIGATION	(2,630)	(2,647)	(2,302)	(2,175)	(2,134)	(2,123)
HOCKLEY COUNTY - BRAZOS BASIN						
ANTON	675	671	670	670	664	659
LEVELLAND	2,773	2,608	2,456	2,333	2,146	2,114
COUNTY-OTHER	223	200	192	199	161	135
MANUFACTURING	124	9	9	9	9	9
MINING	1,295	1,295	1,296	1,296	1,297	1,298
LIVESTOCK	236	231	226	221	216	215
IRRIGATION	2,037	(43,079)	(30,841)	(27,041)	(25,744)	(25,183)
HOCKLEY COUNTY - COLORADO BASIN						
SUNDOWN	443	425	413	411	391	378
COUNTY-OTHER	8	7	7	7	6	5
MINING	234	234	234	234	234	234
LIVESTOCK	39	39	38	37	36	36
IRRIGATION	4,830	4,830	3,745	(55)	(1,352)	(1,913)
LAMB COUNTY - BRAZOS BASIN						
AMHERST	132	127	124	121	115	110
EARTH	499	500	504	507	504	504
LITTLEFIELD	1,391	1,422	1,451	1,462	1,464	1,464
OLTON	886	891	901	915	914	916
SUDAN	169	155	146	141	127	118
COUNTY-OTHER	174	141	124	128	98	83
MANUFACTURING	193	60	60	60	60	60

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Region O Water User Group (WUG) Needs/Surplus

MINING	(478)	(471)	(405)	(337)	(277)	(225)
STEAM ELECTRIC POWER	2,216	2,216	2,216	2,216	2,216	2,216
LIVESTOCK	1,285	696	315	(100)	(555)	(1,046)
IRRIGATION	(75,376)	(186,771)	(186,771)	(186,771)	(186,771)	(186,771)
LUBBOCK COUNTY - BRAZOS BASIN						
ABERNATHY	293	300	312	331	333	339
IDALOU	872	865	855	839	821	803
LUBBOCK	(3,716)	(8,472)	(13,818)	(19,356)	(26,501)	(32,370)
NEW DEAL	373	366	358	349	339	328
RANSOM CANYON	233	214	193	169	145	121
SHALLOWATER	244	202	159	108	56	4
SLATON	1,334	1,273	1,190	1,098	1,015	1,006
WOLFFORTH	415	268	119	(43)	(204)	(366)
COUNTY-OTHER	2,543	2,760	3,111	2,171	1,211	1
MANUFACTURING	(521)	(676)	(676)	(676)	(676)	(676)
MINING	(5,372)	(5,443)	(4,931)	(4,320)	(3,781)	(3,332)
STEAM ELECTRIC POWER	4,404	4,404	4,404	2,164	2,164	2,164
LIVESTOCK	202	152	117	78	37	3
IRRIGATION	(3,892)	(40,264)	(41,064)	(41,064)	(41,064)	(41,064)
LYNN COUNTY - BRAZOS BASIN						
ODONNELL	86	78	70	63	56	55
TAHOKA PUBLIC WATER SYSTEM	389	352	317	283	250	245
COUNTY-OTHER	76	73	82	89	75	69
MINING	(635)	(785)	(718)	(511)	(319)	(165)
LIVESTOCK	98	95	92	89	86	85
IRRIGATION	19,657	3,925	(5,465)	(11,325)	(14,937)	(17,273)
LYNN COUNTY - COLORADO BASIN						
COUNTY-OTHER	2	2	2	2	2	1
MINING	11	0	5	20	35	47
LIVESTOCK	4	4	4	4	3	3
IRRIGATION	1,115	1,115	45	(986)	(1,629)	(2,001)
MOTLEY COUNTY - RED BASIN						
MATADOR	550	553	555	556	556	556
RED RIVER AUTHORITY OF TEXAS*	0	0	0	0	0	0
COUNTY-OTHER	24	28	30	30	31	31
MINING	4	31	39	46	65	83
LIVESTOCK	99	85	70	55	39	35
IRRIGATION	2,681	2,681	2,681	2,680	2,680	2,680
PARMER COUNTY - BRAZOS BASIN						
BOVINA	198	169	142	113	75	40
FARWELL	465	432	401	368	327	289
COUNTY-OTHER	166	136	108	76	37	0
LIVESTOCK	3,192	2,409	1,890	1,324	708	43
IRRIGATION	(122,909)	(150,296)	(140,764)	(137,234)	(135,074)	(134,135)
PARMER COUNTY - RED BASIN						
FRIONA	1,362	1,299	1,241	1,178	1,096	1,020
COUNTY-OTHER	119	97	78	55	27	1
MANUFACTURING	200	25	25	25	25	25
LIVESTOCK	798	602	472	331	177	10
IRRIGATION	22,078	(11,452)	(20,984)	(24,514)	(25,914)	(26,752)

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Region O Water User Group (WUG) Needs/Surplus

SWISHER COUNTY - BRAZOS BASIN						
COUNTY-OTHER	13	12	13	13	11	10
LIVESTOCK	2,657	2,650	2,643	2,635	2,627	2,298
IRRIGATION	(1,927)	(16,395)	(16,504)	(16,328)	(16,104)	(15,578)
SWISHER COUNTY - RED BASIN						
HAPPY*	377	375	374	375	370	365
TULIA	939	921	928	941	901	881
COUNTY-OTHER	77	76	78	81	67	60
LIVESTOCK	704	575	439	297	148	0
IRRIGATION	(11,251)	(54,427)	(54,318)	(54,494)	(54,718)	(54,922)
TERRY COUNTY - BRAZOS BASIN						
COUNTY-OTHER	2	2	2	2	2	2
MINING	15	3	2	11	19	25
LIVESTOCK	9	8	6	5	3	2
IRRIGATION	(351)	(1,551)	(826)	(672)	(660)	(685)
TERRY COUNTY - COLORADO BASIN						
BROWNFIELD	365	236	132	(49)	(216)	(291)
COUNTY-OTHER	109	110	89	109	89	67
MANUFACTURING	3	0	0	0	0	0
MINING	(230)	(388)	(405)	(287)	(172)	(91)
LIVESTOCK	161	121	92	59	25	2
IRRIGATION	15,759	(41,032)	(41,757)	(42,071)	(42,083)	(42,058)
YOAKUM COUNTY - COLORADO BASIN						
DENVER CITY	3,890	3,734	3,593	3,425	3,247	3,077
PLAINS	700	652	609	560	506	453
COUNTY-OTHER	136	112	89	63	31	1
MINING	(536)	(570)	(383)	(193)	(19)	123
STEAM ELECTRIC POWER	90	90	90	90	90	90
LIVESTOCK	100	95	90	85	80	78
IRRIGATION	(33,198)	(79,186)	(79,186)	(79,186)	(79,186)	(79,186)

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Region O Water User Group (WUG) Second-Tier Identified Water Needs

Second-tier needs are WUG split needs adjusted to include the implementation of recommended demand reduction and direct reuse water management strategies.

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
BAILEY COUNTY - BRAZOS BASIN						
MULESHOE	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	264	562	881
IRRIGATION	12,655	41,265	40,630	41,225	41,564	41,777
BRISCOE COUNTY - RED BASIN						
QUITAQUE	0	0	0	0	0	0
SILVERTON	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	2,913	2,786	2,986	3,098	3,168
CASTRO COUNTY - BRAZOS BASIN						
DIMMITT	0	0	0	0	0	0
HART MUNICIPAL WATER SYSTEM	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	88,076	130,829	128,059	129,204	128,947	128,509
CASTRO COUNTY - RED BASIN						
NAZARETH	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	25,570	58,042	58,772	60,950	62,638	63,753
COCHRAN COUNTY - BRAZOS BASIN						
MORTON PWS	0	0	0	0	0	0
WHITEFACE	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	40,749	43,959	35,978	31,745	27,888	25,193
COCHRAN COUNTY - COLORADO BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
CROSBY COUNTY - BRAZOS BASIN						
CROSBYTON	0	0	0	0	0	0
LORENZO	0	0	0	0	0	0
RALLS	72	89	98	112	129	146
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	19,389	21,091	21,814	22,149

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Region O Water User Group (WUG) Second-Tier Identified Water Needs

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
CROSBY COUNTY - RED BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	364	352	306	266	231	200
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	928	1,033	1,383	1,251	1,319	1,414
DAWSON COUNTY - BRAZOS BASIN						
ODONNELL	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
DAWSON COUNTY - COLORADO BASIN						
LAMESA	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	1,528	1,492	1,455	1,455	1,455	1,455
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	6,038	7,112	7,674	8,013
DEAF SMITH COUNTY - CANADIAN BASIN						
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	112	122	130	138	147	157
IRRIGATION	2,038	1,996	1,514	1,286	1,167	1,100
DEAF SMITH COUNTY - RED BASIN						
HEREFORD	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	988	1,070	1,048	1,048	1,048	1,048
LIVESTOCK	0	0	714	1,539	2,425	3,358
IRRIGATION	10,498	75,272	74,866	76,804	77,771	78,293
DICKENS COUNTY - BRAZOS BASIN						
SPUR	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
DICKENS COUNTY - RED BASIN						
RED RIVER AUTHORITY OF TEXAS*	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
FLOYD COUNTY - BRAZOS BASIN						
FLOYDADA	0	0	0	0	0	0
LOCKNEY	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	2,761	7,080	9,295
FLOYD COUNTY - RED BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0

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Region O Water User Group (WUG) Second-Tier Identified Water Needs

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
FLOYD COUNTY - RED BASIN						
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	39,464	38,522	21,715	14,211	10,444	8,556
GAINES COUNTY - COLORADO BASIN						
SEAGRAVES	0	0	0	0	0	0
SEMINOLE	431	666	946	1,248	1,477	1,713
COUNTY-OTHER	0	10	452	938	1,398	1,880
MANUFACTURING	953	995	964	964	964	964
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	94,684	148,980	144,113	145,629	146,672	147,333
GARZA COUNTY - BRAZOS BASIN						
POST	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
HALE COUNTY - BRAZOS BASIN						
ABERNATHY	0	0	0	0	0	0
HALE CENTER	0	0	0	0	0	0
PETERSBURG MUNICIPAL WATER SYSTEM	0	0	0	0	0	0
PLAINVIEW	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	2,923	3,508	3,406	3,406	3,406	3,406
MINING	941	902	756	627	513	414
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	94,729	193,746	191,010	192,658	193,459	193,871
HALE COUNTY - RED BASIN						
IRRIGATION	2,537	2,492	2,116	2,004	1,971	1,964
HOCKLEY COUNTY - BRAZOS BASIN						
ANTON	0	0	0	0	0	0
LEVELLAND	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	36,944	24,474	21,585	20,717	20,389
HOCKLEY COUNTY - COLORADO BASIN						
SUNDOWN	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	977	1,555
LAMB COUNTY - BRAZOS BASIN						
AMHERST	0	0	0	0	0	0
EARTH	0	0	0	0	0	0

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Region O Water User Group (WUG) Second-Tier Identified Water Needs

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
LAMB COUNTY - BRAZOS BASIN						
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
MANUFACTURING	0	0	0	0	0	0
MINING	472	454	379	315	258	208
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	100	555	1,046
IRRIGATION	67,592	173,798	171,470	172,494	172,945	173,178
LUBBOCK COUNTY - BRAZOS BASIN						
ABERNATHY	0	0	0	0	0	0
IDALOU	0	0	0	0	0	0
LUBBOCK	2,427	8,079	13,818	19,356	26,501	24,306
NEW DEAL	0	0	0	0	0	0
RANSOM CANYON	0	0	0	0	0	0
SHALLOWATER	0	0	0	0	0	0
SLATON	0	0	0	0	0	0
WOLFFORTH	0	0	0	39	195	349
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	512	646	625	625	625	625
MINING	5,308	5,250	4,635	4,055	3,543	3,116
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	33,021	31,782	32,362	32,776	33,066
LYNN COUNTY - BRAZOS BASIN						
ODONNELL	0	0	0	0	0	0
TAHOKA PUBLIC WATER SYSTEM	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	624	748	659	463	281	134
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	5,516	9,128	11,464
LYNN COUNTY - COLORADO BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	571	1,214	1,586
MOTLEY COUNTY - RED BASIN						
MATADOR	0	0	0	0	0	0
RED RIVER AUTHORITY OF TEXAS*	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
PARMER COUNTY - BRAZOS BASIN						
BOVINA	0	0	0	0	0	0
FARWELL	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region O Water User Group (WUG) Second-Tier Identified Water Needs

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
PARMER COUNTY - BRAZOS BASIN						
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	117,166	140,725	129,148	126,487	124,833	124,176
PARMER COUNTY - RED BASIN						
FRIONA	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	9,062	18,083	21,830	23,357	24,265
SWISHER COUNTY - BRAZOS BASIN						
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	1,196	15,176	15,117	15,097	14,960	14,488
SWISHER COUNTY - RED BASIN						
HAPPY*	0	0	0	0	0	0
TULIA	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	7,920	48,876	48,002	48,888	49,508	49,955
TERRY COUNTY - BRAZOS BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	92	1,119	315	201	209	246
TERRY COUNTY - COLORADO BASIN						
BROWNFIELD	0	0	0	49	216	291
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	226	373	380	267	158	82
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	32,825	32,055	33,113	33,512	33,710
YOAKUM COUNTY - COLORADO BASIN						
DENVER CITY	0	0	0	0	0	0
PLAINS	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	523	530	326	145	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	28,347	71,101	69,516	70,293	70,701	70,948

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region O Water User Group (WUG) Second-Tier Identified Water Needs Summary

Second-tier needs are WUG split needs adjusted to include the implementation of recommended demand reduction and direct reuse water management strategies.

WUG CATEGORY	NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MUNICIPAL	2,930	8,834	14,862	20,804	28,518	26,805
COUNTY-OTHER	0	10	452	938	1,398	1,880
MANUFACTURING	5,376	6,219	6,043	6,043	6,043	6,043
MINING	9,986	10,101	8,896	7,593	6,439	5,609
STEAM ELECTRIC POWER	0	0	0	0	0	0
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

Region O Source Water Balance (Availability - WUG Supply)

GROUNDWATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
DOCKUM AQUIFER	BAILEY	BRAZOS	FRESH	833	833	833	833	833	833
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	0	0	0	0	0	0
DOCKUM AQUIFER	COCHRAN	BRAZOS	FRESH	104	104	104	104	104	104
DOCKUM AQUIFER	COCHRAN	COLORADO	FRESH	868	868	868	868	868	868
DOCKUM AQUIFER	CROSBY	BRAZOS	FRESH	172	172	172	172	172	172
DOCKUM AQUIFER	CROSBY	RED	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	DEAF SMITH	CANADIAN	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	DEAF SMITH	RED	FRESH	977	977	977	977	977	977
DOCKUM AQUIFER	DICKENS	BRAZOS	FRESH	43	43	43	43	43	43
DOCKUM AQUIFER	DICKENS	RED	FRESH	51	51	51	51	51	51
DOCKUM AQUIFER	FLOYD	BRAZOS	FRESH	2,976	2,976	2,976	2,976	2,976	2,976
DOCKUM AQUIFER	FLOYD	RED	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	GAINES	COLORADO	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	GARZA	BRAZOS	BRACKISH	495	495	495	495	495	495
DOCKUM AQUIFER	HALE	BRAZOS	FRESH	1,092	1,092	1,092	1,092	1,092	1,092
DOCKUM AQUIFER	HALE	RED	FRESH	29	29	29	29	29	29
DOCKUM AQUIFER	HOCKLEY	BRAZOS	FRESH	862	862	862	862	862	862
DOCKUM AQUIFER	HOCKLEY	COLORADO	FRESH	167	167	167	167	167	167
DOCKUM AQUIFER	LAMB	BRAZOS	FRESH	923	923	923	923	923	923
DOCKUM AQUIFER	LUBBOCK	BRAZOS	FRESH	1,086	1,086	1,086	1,086	1,086	1,086
DOCKUM AQUIFER	LYNN	BRAZOS	FRESH	791	791	791	791	791	791
DOCKUM AQUIFER	LYNN	COLORADO	FRESH	121	121	121	121	121	121
DOCKUM AQUIFER	MOTLEY	RED	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	PARMER	BRAZOS	FRESH	2,252	2,252	2,252	2,252	1,492	1,391
DOCKUM AQUIFER	PARMER	RED	FRESH	1,973	1,973	1,973	1,973	1,973	1,973
DOCKUM AQUIFER	SWISHER	BRAZOS	FRESH	25	25	25	25	25	25
DOCKUM AQUIFER	SWISHER	RED	FRESH	0	0	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	BAILEY	BRAZOS	FRESH	16,650	16,821	17,068	17,353	17,676	18,556
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	BRISCOE	RED	FRESH	0	100	100	100	100	100
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	CASTRO	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	CASTRO	RED	FRESH	0	0	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	COCHRAN	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	COCHRAN	COLORADO	FRESH	25,116	7,068	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	CROSBY	BRAZOS	FRESH	8,026	160	160	160	160	160
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	CROSBY	RED	FRESH	480	480	480	480	480	480
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	DAWSON	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	DAWSON	COLORADO	FRESH	13,890	1,600	1,601	1,600	1,600	1,600

* 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.

Region O Source Water Balance (Availability - WUG Supply)

GROUNDWATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	DEAF SMITH	RED	FRESH	1,250	1,250	1,250	1,250	1,250	1,250
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	FLOYD	BRAZOS	FRESH	72,769	0	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	FLOYD	RED	FRESH	0	0	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	GAINES	COLORADO	FRESH	3,307	5,187	5,130	5,039	4,961	4,893
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	GARZA	BRAZOS	FRESH	2,241	0	0	0	0	0
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	4,965	4,965	4,965	4,965	4,965	4,965
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	HALE	RED	FRESH	0	0	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	HOCKLEY	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	HOCKLEY	COLORADO	FRESH	31,581	11,153	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	LAMB	BRAZOS	FRESH	16,454	16,625	16,872	17,157	17,480	18,610
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	LUBBOCK	BRAZOS	FRESH	6,361	6,361	7,161	7,161	7,161	7,161
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	LYNN	BRAZOS	FRESH	800	800	800	800	800	800
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	LYNN	COLORADO	FRESH	921	197	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	PARMER	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	PARMER	RED	FRESH	0	0	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	SWISHER	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	SWISHER	RED	FRESH	0	0	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	TERRY	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	TERRY	COLORADO	FRESH	640	640	640	800	800	800
OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS	YOAKUM	COLORADO	FRESH	640	640	640	640	640	640
OGALLALA AQUIFER	DICKENS	BRAZOS	FRESH	56	56	56	56	56	56
OGALLALA AQUIFER	DICKENS	RED	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER	MOTLEY	RED	FRESH	38	38	38	38	38	38
OTHER AQUIFER	BRISCOE	RED	FRESH	873	873	873	873	873	873
OTHER AQUIFER	CROSBY	BRAZOS	BRACKISH	538	538	538	538	538	538
OTHER AQUIFER	DICKENS	BRAZOS	BRACKISH	114	114	114	114	114	114
OTHER AQUIFER	DICKENS	RED	BRACKISH	88	89	88	88	87	86
OTHER AQUIFER	FLOYD	RED	FRESH	515	515	515	515	515	515
OTHER AQUIFER	GARZA	BRAZOS	FRESH	570	570	570	570	570	570
OTHER AQUIFER	MOTLEY	RED	BRACKISH	684	684	683	683	682	682
SEYMOUR AQUIFER	BRISCOE	RED	BRACKISH	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.

Region O Source Water Balance (Availability - WUG Supply)

GROUNDWATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY*	2020	2030	2040	2050	2060	2070
SEYMOUR AQUIFER	MOTLEY	RED	FRESH	3,999	5,835	3,999	3,986	3,128	3,117
GROUNDWATER SOURCE WATER BALANCE TOTAL				**229,406**	**99,199**	**80,181**	**80,806**	**79,754**	**81,583**

REUSE SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY*	2020	2030	2040	2050	2060	2070
DIRECT REUSE	BAILEY	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	CASTRO	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	COCHRAN	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	COCHRAN	COLORADO	FRESH	0	0	0	0	0	0
DIRECT REUSE	CROSBY	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	DEAF SMITH	RED	FRESH	0	0	0	0	0	0
DIRECT REUSE	FLOYD	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	HALE	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	HOCKLEY	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	HOCKLEY	COLORADO	FRESH	0	0	0	0	0	0
DIRECT REUSE	LAMB	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	LUBBOCK	BRAZOS	FRESH	3,483	12,611	15,064	18,995	20,496	21,750
DIRECT REUSE	LYNN	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	PARMER	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	PARMER	RED	FRESH	0	0	0	0	0	0
REUSE SOURCE WATER BALANCE TOTAL				**3,483**	**12,611**	**15,064**	**18,995**	**20,496**	**21,750**

SURFACE WATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY*	2020	2030	2040	2050	2060	2070
ALAN HENRY LAKE/RESERVOIR	RESERVOIR**	BRAZOS	FRESH	13,400	12,940	12,480	12,020	11,560	11,100
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	3,962	3,962	3,962	3,962	3,962	3,962
RED RUN-OF-RIVER	BRISCOE	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	FLOYD	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	MOTLEY	RED	FRESH	0	0	0	0	0	0
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
SURFACE WATER SOURCE WATER BALANCE TOTAL				**17,362**	**16,902**	**16,442**	**15,982**	**15,522**	**15,062**

REGION O SOURCE WATER BALANCE TOTAL	**250,251**	**128,712**	**111,687**	**115,783**	**115,772**	**118,395**

* 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.

Region O Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
BAILEY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	280	411	46.8%	265	411	55.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	277	277	0.0%	411	411	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	146	0	-100.0%
BAILEY COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	36,926	72,810	97.2%	12,715	9,946	-21.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	119,268	88,108	-26.1%	105,752	55,616	-47.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	82,342	15,298	-81.4%	93,037	45,670	-50.9%
BAILEY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,286	3,077	139.3%	753	3,077	308.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,335	2,428	4.0%	3,204	3,958	23.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	1,049	0	-100.0%	2,451	881	-64.1%
BAILEY COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	133	0	-100.0%	64	0	-100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	316	0	-100.0%	388	0	-100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	183	0	-100.0%	324	0	-100.0%
BAILEY COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,125	3,056	171.6%	1,200	3,056	154.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,174	1,173	-0.1%	1,787	1,787	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	49	0	-100.0%	587	0	-100.0%
BRISCOE COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	295	219	-25.8%	295	219	-25.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	297	159	-46.5%	288	154	-46.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	2	0	-100.0%	0	0	0.0%
BRISCOE COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	33,335	33,668	1.0%	10,993	10,997	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	37,260	26,417	-29.1%	31,052	15,231	-51.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	3,925	0	-100.0%	20,059	4,234	-78.9%
BRISCOE COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	273	353	29.3%	273	353	29.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	302	286	-5.3%	348	352	1.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	29	0	-100.0%	75	0	-100.0%
BRISCOE COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	71	446	528.2%	71	446	528.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	126	234	85.7%	119	221	85.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	55	0	-100.0%	48	0	-100.0%
CASTRO COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	420	460	9.5%	520	460	-11.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	411	368	-10.5%	496	444	-10.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
CASTRO COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	125,052	254,821	103.8%	33,519	15,033	-55.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	387,976	379,863	-2.1%	320,029	222,898	-30.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	262,924	125,042	-52.4%	286,510	207,865	-27.4%

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Region O Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
CASTRO COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	3,656	11,339	210.1%	2,429	11,339	366.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	5,848	6,721	14.9%	7,851	10,261	30.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	2,897	0	-100.0%	5,606	0	-100.0%
CASTRO COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	962	95	-90.1%	1,059	95	-91.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	980	61	-93.8%	1,319	66	-95.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	85	0	-100.0%	260	0	-100.0%
CASTRO COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,244	5,034	304.7%	1,203	5,034	318.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,276	1,400	9.7%	1,557	1,712	10.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	43	0	-100.0%	354	0	-100.0%
COCHRAN COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	485	383	-21.0%	560	383	-31.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	500	306	-38.8%	583	376	-35.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	16	0	-100.0%	23	0	-100.0%
COCHRAN COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	35,366	74,660	111.1%	21,693	40,689	87.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	102,229	99,449	-2.7%	84,214	62,972	-25.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	66,863	42,778	-36.0%	62,521	28,190	-54.9%
COCHRAN COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	149	674	352.3%	242	674	178.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	536	102	-81.0%	684	118	-82.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	387	0	-100.0%	442	0	-100.0%
COCHRAN COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	152	312	105.3%	80	312	290.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	154	154	0.0%	81	81	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	6	0	-100.0%	4	0	-100.0%
COCHRAN COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	350	911	160.3%	350	911	160.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	473	595	25.8%	469	596	27.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	123	0	-100.0%	119	0	-100.0%
CROSBY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	238	188	-21.0%	248	188	-24.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	155	150	-3.2%	192	185	-3.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
CROSBY COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	110,280	166,560	51.0%	89,800	39,393	-56.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	117,362	107,583	-8.3%	95,864	67,695	-29.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	7,082	1,056	-85.1%	6,064	28,302	366.7%
CROSBY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	155	211	36.1%	155	211	36.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	262	171	-34.7%	294	209	-28.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	107	0	-100.0%	139	0	-100.0%

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	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
CROSBY COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	6	3	-50.0%	6	3	-50.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	3	2	-33.3%	3	3	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
CROSBY COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	650	1,183	82.0%	360	1,183	228.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	994	994	0.0%	568	568	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	348	368	5.7%	210	210	0.0%
CROSBY COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	952	1,519	59.6%	1,093	1,519	39.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	838	843	0.6%	1,058	1,065	0.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	78	100.0%	40	146	265.0%
DAWSON COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	633	750	18.5%	582	750	28.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	588	606	3.1%	721	739	2.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	149	0	-100.0%
DAWSON COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	108,203	156,835	44.9%	76,137	66,200	-13.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	106,630	106,312	-0.3%	80,286	79,443	-1.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	4,149	13,519	225.8%
DAWSON COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	149	201	34.9%	159	201	26.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	139	53	-61.9%	159	65	-59.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	2	0	-100.0%	2	0	-100.0%
DAWSON COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	129	0	-100.0%	168	0	-100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	129	0	-100.0%	175	0	-100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	7	0	-100.0%
DAWSON COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	779	266	-65.9%	0	266	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	954	1,812	89.9%	255	1,812	610.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	175	1,546	783.4%	255	1,546	506.3%
DAWSON COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,039	2,315	13.5%	1,213	2,433	100.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,293	2,258	-1.5%	2,445	2,409	-1.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	264	0	-100.0%	1,232	0	-100.0%
DEAF SMITH COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	603	988	63.8%	941	988	5.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	541	590	9.1%	904	988	9.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
DEAF SMITH COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	109,276	191,180	75.0%	36,547	30,550	-16.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	193,410	210,016	8.6%	164,985	118,219	-28.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	84,134	18,836	-77.6%	128,438	87,669	-31.7%

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	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
DEAF SMITH COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	8,080	12,089	49.6%	15,673	12,089	-22.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	12,555	11,170	-11.0%	16,471	15,604	-5.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	4,475	112	-97.5%	798	3,515	340.5%
DEAF SMITH COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,600	4	-99.8%	1,800	4	-99.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,834	1,002	-73.9%	4,438	1,107	-75.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	2,234	998	-55.3%	2,638	1,103	-58.2%
DEAF SMITH COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	4,000	6,759	69.0%	6,756	6,759	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,953	3,857	-2.4%	6,907	6,739	-2.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	151	0	-100.0%
DICKENS COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	294	181	-38.4%	277	181	-34.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	153	145	-5.2%	142	132	-7.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
DICKENS COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	9,608	10,376	8.0%	9,233	10,376	12.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	9,363	9,039	-3.5%	8,060	9,039	12.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
DICKENS COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	305	487	59.7%	305	487	59.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	375	387	3.2%	422	475	12.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	70	0	-100.0%	117	0	-100.0%
DICKENS COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	12	29	141.7%	12	29	141.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	12	12	0.0%	12	12	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
DICKENS COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	178	235	32.0%	170	240	41.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	178	191	7.3%	170	187	10.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
FLOYD COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	292	295	1.0%	253	295	16.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	200	192	-4.0%	224	291	29.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
FLOYD COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	122,428	109,193	-10.8%	92,461	53,048	-42.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	147,725	128,837	-12.8%	120,941	76,235	-37.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	26,565	41,938	57.9%	29,390	23,187	-21.1%
FLOYD COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	798	1,639	105.4%	948	1,639	72.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	738	1,168	58.3%	942	1,268	34.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	23	0	-100.0%

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	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
FLOYD COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	486	492	1.2%	485	492	1.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	486	486	0.0%	485	485	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
FLOYD COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	978	2,495	155.1%	898	2,495	177.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	840	849	1.1%	958	854	-10.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	35	0	-100.0%	67	0	-100.0%
GAINES COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,150	1,750	52.2%	2,020	1,750	-13.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,403	1,400	-0.2%	3,633	3,630	-0.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	253	0	-100.0%	1,613	1,880	16.6%
GAINES COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	231,255	256,924	11.1%	25,401	115,334	354.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	379,779	362,482	-4.6%	292,238	282,438	-3.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	148,524	105,558	-28.9%	266,837	167,104	-37.4%
GAINES COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	240	203	-15.4%	158	203	28.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	238	123	-48.3%	304	137	-54.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	146	0	-100.0%
GAINES COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,968	544	-72.4%	494	544	10.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,278	1,512	-33.6%	2,874	1,587	-44.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	310	968	212.3%	2,380	1,043	-56.2%
GAINES COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,627	7,729	375.0%	313	7,729	2369.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,829	1,829	0.0%	776	776	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	202	0	-100.0%	463	0	-100.0%
GAINES COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,220	2,766	24.6%	2,470	2,766	12.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,767	2,771	0.1%	4,177	4,181	0.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	548	551	0.5%	1,707	1,878	10.0%
GARZA COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	195	171	-12.3%	154	171	11.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	135	135	0.0%	133	133	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
GARZA COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	11,675	15,028	28.7%	8,775	11,827	34.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	11,621	10,353	-10.9%	8,655	10,353	19.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
GARZA COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	68	184	170.6%	68	184	170.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	299	148	-50.5%	346	181	-47.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	231	0	-100.0%	278	0	-100.0%

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GARZA COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2	2	0.0%	2	2	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	2	2	0.0%	2	2	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
GARZA COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	395	544	37.7%	164	544	231.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	395	395	0.0%	164	164	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
GARZA COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,098	964	-12.2%	1,271	964	-24.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	792	792	0.0%	965	964	-0.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HALE COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,190	1,289	8.3%	1,200	1,289	7.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,171	1,031	-12.0%	1,173	1,058	-9.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HALE COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	131,321	203,960	55.3%	108,113	15,803	-85.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	369,812	310,542	-16.0%	313,161	227,568	-27.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	238,491	106,582	-55.3%	205,048	211,765	3.3%
HALE COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,107	4,098	270.2%	1,016	4,098	303.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,045	2,752	34.6%	2,821	4,098	45.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	938	0	-100.0%	1,805	0	-100.0%
HALE COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,603	1,416	-11.7%	3,600	1,416	-60.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,830	4,383	54.9%	3,510	5,076	44.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	1,227	2,967	141.8%	0	3,660	100.0%
HALE COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	14	215	1435.7%	0	215	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,168	1,168	0.0%	662	662	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	1,154	953	-17.4%	662	447	-32.5%
HALE COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	6,744	11,362	68.5%	5,842	11,136	90.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	5,520	5,725	3.7%	5,687	5,876	3.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	80	0	-100.0%	51	0	-100.0%
HALE COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	26	31	19.2%	139	31	-77.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	60	31	-48.3%	139	31	-77.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	34	0	-100.0%	0	0	0.0%
HOCKLEY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,048	1,152	9.9%	1,052	1,152	9.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	922	921	-0.1%	1,013	1,012	-0.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%

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	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
HOCKLEY COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	83,565	138,733	66.0%	52,686	46,493	-11.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	131,207	131,866	0.5%	107,813	73,589	-31.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	47,642	0	-100.0%	55,127	27,096	-50.8%
HOCKLEY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	468	408	-12.8%	625	408	-34.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	238	133	-44.1%	304	157	-48.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	35	0	-100.0%	45	0	-100.0%
HOCKLEY COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,185	700	-40.9%	1,200	700	-41.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,185	576	-51.4%	1,203	691	-42.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	3	0	-100.0%
HOCKLEY COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,707	1,547	-9.4%	0	1,547	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	18	18	0.0%	15	15	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	15	0	-100.0%
HOCKLEY COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	3,357	6,909	105.8%	2,349	6,536	178.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,019	3,018	0.0%	3,383	3,385	0.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	18	0	-100.0%	1,111	0	-100.0%
LAMB COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	450	575	27.8%	600	575	-4.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	435	401	-7.8%	596	492	-17.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LAMB COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	126,104	184,075	46.0%	28,179	7,414	-73.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	325,356	259,451	-20.3%	268,045	194,185	-27.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	199,252	75,376	-62.2%	239,866	186,771	-22.1%
LAMB COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,080	5,225	151.2%	788	5,225	563.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,969	3,940	32.7%	3,427	6,271	83.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	889	0	-100.0%	2,639	1,046	-60.4%
LAMB COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	336	1,000	197.6%	635	1,000	57.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	616	807	31.0%	781	940	20.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	280	0	-100.0%	146	0	-100.0%
LAMB COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	16	108	575.0%	0	108	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	586	586	0.0%	333	333	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	570	478	-16.1%	333	225	-32.4%
LAMB COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,128	5,073	138.4%	1,928	5,073	163.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,966	1,996	1.5%	1,860	1,961	5.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	24	0	-100.0%

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	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
LAMB COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	11,436	15,666	37.0%	37,407	15,666	-58.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	17,663	13,450	-23.9%	40,391	13,450	-66.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	6,227	0	-100.0%	2,984	0	-100.0%
LUBBOCK COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	4,656	6,340	36.2%	6,906	6,340	-8.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	4,647	3,797	-18.3%	6,847	6,339	-7.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LUBBOCK COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	114,222	140,974	23.4%	53,637	73,196	36.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	169,242	144,866	-14.4%	127,582	114,260	-10.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	55,020	3,892	-92.9%	73,945	41,064	-44.5%
LUBBOCK COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	800	1,290	61.3%	1,050	1,290	22.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	780	1,088	39.5%	1,021	1,287	26.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LUBBOCK COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,929	335	-82.6%	3,005	335	-88.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,161	856	-60.4%	3,148	1,011	-67.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	232	521	124.6%	143	676	372.7%
LUBBOCK COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	93	982	955.9%	0	982	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	6,354	6,354	0.0%	4,314	4,314	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	6,261	5,372	-14.2%	4,314	3,332	-22.8%
LUBBOCK COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	38,356	49,824	29.9%	27,138	42,574	56.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	48,610	49,776	2.4%	72,004	72,709	1.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	10,565	3,716	-64.8%	45,022	32,736	-27.3%
LUBBOCK COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	15,682	10,098	-35.6%	8,961	7,858	-12.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	4,540	5,694	25.4%	9,906	5,694	-42.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	945	0	-100.0%
LYNN COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	316	389	23.1%	255	389	52.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	311	311	0.0%	319	319	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	69	0	-100.0%
LYNN COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	84,592	109,693	29.7%	64,587	69,647	7.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	84,566	88,921	5.1%	64,515	88,921	37.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	19,274	100.0%
LYNN COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	159	167	5.0%	159	167	5.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	141	65	-53.9%	165	79	-52.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	1	0	-100.0%	6	0	-100.0%

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	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
LYNN COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	483	542	12.2%	483	542	12.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,166	1,166	0.0%	660	660	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	683	635	-7.0%	177	165	-6.8%
LYNN COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	647	1,057	63.4%	382	915	139.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	583	582	-0.2%	616	615	-0.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	234	0	-100.0%
MOTLEY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	110	122	10.9%	105	122	16.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	109	98	-10.1%	103	91	-11.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
MOTLEY COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	9,701	12,107	24.8%	9,706	12,106	24.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	9,439	9,426	-0.1%	8,123	9,426	16.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
MOTLEY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	320	375	17.2%	320	375	17.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	481	276	-42.6%	529	340	-35.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	161	0	-100.0%	209	0	-100.0%
MOTLEY COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	6	0	-100.0%	6	0	-100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	6	0	-100.0%	6	0	-100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
MOTLEY COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	104	244	134.6%	104	244	134.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	240	240	0.0%	161	161	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	136	0	-100.0%	57	0	-100.0%
MOTLEY COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	219	780	256.2%	219	782	257.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	213	230	8.0%	207	226	9.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
PARMER COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	625	946	51.4%	810	946	16.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	631	661	4.8%	902	945	4.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	12	0	-100.0%	92	0	-100.0%
PARMER COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	57,086	138,394	142.4%	14,451	16,915	17.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	329,806	239,225	-27.5%	312,736	177,802	-43.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	272,720	122,909	-54.9%	298,285	160,887	-46.1%
PARMER COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	5,125	11,329	121.1%	5,475	11,329	106.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	5,634	7,339	30.3%	7,593	11,276	48.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	582	0	-100.0%	2,149	0	-100.0%

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	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
PARMER COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,560	1,866	19.6%	1,560	1,866	19.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,233	1,666	-25.4%	2,973	1,841	-38.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	673	0	-100.0%	1,413	0	-100.0%
PARMER COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,556	3,592	130.8%	1,855	3,592	93.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,598	1,567	-1.9%	2,286	2,243	-1.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	45	0	-100.0%	431	0	-100.0%
SWISHER COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	220	447	103.2%	230	447	94.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	214	357	66.8%	226	377	66.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
SWISHER COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	99,462	122,218	22.9%	45,034	16,040	-64.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	196,895	135,396	-31.2%	198,581	86,540	-56.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	97,433	13,178	-86.5%	153,547	70,500	-54.1%
SWISHER COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,370	6,089	156.9%	3,020	5,767	91.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,362	2,728	15.5%	3,015	3,469	15.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
SWISHER COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,077	2,280	111.7%	968	2,274	134.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,104	964	-12.7%	1,174	1,028	-12.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	172	0	-100.0%	235	0	-100.0%
TERRY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	339	556	64.0%	389	556	42.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	320	445	39.1%	383	487	27.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
TERRY COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	144,022	188,193	30.7%	3,381	82,784	2348.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	143,461	172,785	20.4%	110,848	125,527	13.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	351	100.0%	107,467	42,743	-60.2%
TERRY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	315	590	87.3%	16	590	3587.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	270	420	55.6%	395	586	48.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	379	0	-100.0%
TERRY COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2	17	750.0%	0	17	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	2	14	600.0%	2	17	750.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	2	0	-100.0%
TERRY COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	355	140	-60.6%	0	140	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	355	355	0.0%	206	206	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	230	100.0%	206	91	-55.8%

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	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
TERRY COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,897	1,969	3.8%	981	1,702	73.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,888	1,604	-15.0%	2,285	1,993	-12.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	1,304	291	-77.7%
YOAKUM COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	270	399	47.8%	405	399	-1.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	267	263	-1.5%	403	398	-1.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
YOAKUM COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	55,427	128,495	131.8%	5,480	38,495	602.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	146,083	161,693	10.7%	114,838	117,681	2.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	90,656	33,198	-63.4%	109,358	79,186	-27.6%
YOAKUM COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	0	191	100.0%	0	191	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	281	91	-67.6%	322	113	-64.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	281	0	-100.0%	322	0	-100.0%
YOAKUM COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	914	764	-16.4%	0	764	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,300	1,300	0.0%	641	641	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	386	536	38.9%	641	0	-100.0%
YOAKUM COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	902	6,451	615.2%	1,350	6,451	377.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,855	1,861	0.3%	2,912	2,921	0.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	953	0	-100.0%	1,562	0	-100.0%
YOAKUM COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,232	2,000	-10.4%	676	2,000	195.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,718	1,910	-48.6%	8,540	1,910	-77.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	1,486	0	-100.0%	7,864	0	-100.0%
REGION O						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,000,640	2,951,798	47.5%	976,717	1,014,486	3.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,710,638	3,367,953	-9.2%	3,210,784	2,452,931	-23.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	1,731,832	726,021	-58.1%	2,240,096	1,499,897	-33.0%

*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 2016 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 Needs totals.

Region O Source Data Comparison to 2016 Regional Water Plan (RWP)

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
BAILEY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	41,563	98,512	137.0%	15,443	35,648	130.8%
REUSE AVAILABILITY TOTAL (acre-feet per year)	825	825	0.0%	825	825	0.0%
BRISCOE COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	34,751	35,335	1.7%	12,406	12,764	2.9%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	80	96	20.0%	80	96	20.0%
CASTRO COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	127,304	267,718	110.3%	114,768	27,930	-75.7%
REUSE AVAILABILITY TOTAL (acre-feet per year)	4,031	4,031	0.0%	4,031	4,031	0.0%
COCHRAN COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	36,472	102,734	181.7%	22,895	43,647	90.6%
REUSE AVAILABILITY TOTAL (acre-feet per year)	294	294	0.0%	294	294	0.0%
CROSBY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	145,791	179,181	22.9%	145,791	44,148	-69.7%
REUSE AVAILABILITY TOTAL (acre-feet per year)	583	583	0.0%	583	583	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	10	0	-100.0%	10	0	-100.0%
DAWSON COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	199,242	172,852	-13.2%	77,569	69,927	-9.9%
DEAF SMITH COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	122,952	210,737	71.4%	59,107	50,007	-15.4%
REUSE AVAILABILITY TOTAL (acre-feet per year)	2,810	2,810	0.0%	2,810	2,810	0.0%
DICKENS COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	24,049	11,500	-52.2%	23,195	11,500	-50.4%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	130	0	-100.0%	130	0	-100.0%
FLOYD COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	164,266	189,677	15.5%	132,633	60,763	-54.2%
REUSE AVAILABILITY TOTAL (acre-feet per year)	449	449	0.0%	449	449	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	10	18	80.0%	10	18	80.0%
GAINES COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	286,312	277,954	-2.9%	34,378	138,294	302.3%
GARZA COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	20,954	19,208	-8.3%	18,833	13,766	-26.9%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	30	0	-100.0%	30	0	-100.0%
HALE COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	134,877	221,232	64.0%	115,203	33,075	-71.3%
REUSE AVAILABILITY TOTAL (acre-feet per year)	5,477	5,477	0.0%	5,477	5,477	0.0%
HOCKLEY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	93,049	178,488	91.8%	64,265	54,667	-14.9%
REUSE AVAILABILITY TOTAL (acre-feet per year)	1,521	1,521	0.0%	1,521	1,521	0.0%
LAMB COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	137,468	224,400	63.2%	70,998	47,739	-32.8%
REUSE AVAILABILITY TOTAL (acre-feet per year)	7,199	7,199	0.0%	7,199	7,199	0.0%
LUBBOCK COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	120,749	152,142	26.0%	86,132	91,884	6.7%
REUSE AVAILABILITY TOTAL (acre-feet per year)	22,728	22,523	-0.9%	30,759	31,830	3.5%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	20	0	-100.0%	20	0	-100.0%
LYNN COUNTY						

* Since reservoir sources can exist across multiple counties, the county field value, 'reservoir' is applied to all reservoir sources.

Region O Source Data Comparison to 2016 Regional Water Plan (RWP)

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	103,995	113,519	9.2%	82,501	72,552	-12.1%
REUSE AVAILABILITY TOTAL (acre-feet per year)	346	346	0.0%	346	346	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	30	0	-100.0%	30	0	-100.0%
MOTLEY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	23,572	18,345	-22.2%	22,733	17,462	-23.2%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	10	4	-60.0%	10	4	-60.0%
PARMER COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	63,067	157,465	149.7%	35,142	35,125	0.0%
REUSE AVAILABILITY TOTAL (acre-feet per year)	2,887	2,887	0.0%	2,887	2,887	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	10	0	-100.0%	10	0	-100.0%
RESERVOIR* COUNTY						
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	25,120	25,930	3.2%	23,240	23,630	1.7%
SWISHER COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	108,103	130,859	21.1%	52,961	24,359	-54.0%
TERRY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	197,204	190,768	-3.3%	5,096	85,519	1578.2%
YOAKUM COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	61,638	138,940	125.4%	9,347	48,940	423.6%
REGION O						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	2,247,378	3,091,566	37.6%	1,201,396	1,019,716	-15.1%
REUSE AVAILABILITY TOTAL (acre-feet per year)	49,150	48,945	-0.4%	57,181	58,252	1.9%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	25,450	26,048	2.3%	23,570	23,748	0.8%

* Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

Region O Water User Group (WUG) Unmet Needs

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. In order to display only unmet needs associated with the WUG split, these surplus volumes are updated to a zero and the unmet needs water volumes are shown as absolute values.

	WUG UNMET NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
BAILEY COUNTY - BRAZOS BASIN						
LIVESTOCK	0	0	0	264	562	881
IRRIGATION	12,655	41,265	40,630	41,225	41,564	41,777
BRISCOE COUNTY - RED BASIN						
IRRIGATION	0	2,913	2,786	2,986	3,098	3,168
CASTRO COUNTY - BRAZOS BASIN						
IRRIGATION	88,076	130,829	128,059	129,204	128,947	128,509
CASTRO COUNTY - RED BASIN						
IRRIGATION	25,570	58,042	58,772	60,950	62,638	63,753
COCHRAN COUNTY - BRAZOS BASIN						
IRRIGATION	40,749	43,959	35,978	31,745	27,888	25,193
CROSBY COUNTY - BRAZOS BASIN						
IRRIGATION	0	0	19,389	21,091	21,814	22,149
CROSBY COUNTY - RED BASIN						
IRRIGATION	928	1,033	1,383	1,251	1,319	1,414
DAWSON COUNTY - COLORADO BASIN						
IRRIGATION	0	0	6,038	7,112	7,674	8,013
DEAF SMITH COUNTY - CANADIAN BASIN						
LIVESTOCK	112	122	130	138	147	157
IRRIGATION	2,038	1,996	1,514	1,286	1,167	1,100
DEAF SMITH COUNTY - RED BASIN						
LIVESTOCK	0	0	714	1,539	2,425	3,358
IRRIGATION	10,498	75,272	74,866	76,804	77,771	78,293
FLOYD COUNTY - BRAZOS BASIN						
IRRIGATION	0	0	0	2,761	7,080	9,295
FLOYD COUNTY - RED BASIN						
IRRIGATION	39,464	38,522	21,715	14,211	10,444	8,556
GAINES COUNTY - COLORADO BASIN						
IRRIGATION	94,684	148,980	144,113	145,629	146,672	147,333
HALE COUNTY - BRAZOS BASIN						
IRRIGATION	94,729	193,746	191,010	192,658	193,459	193,871
HALE COUNTY - RED BASIN						
IRRIGATION	2,537	2,492	2,116	2,004	1,971	1,964
HOCKLEY COUNTY - BRAZOS BASIN						
IRRIGATION	0	36,944	24,474	21,585	20,717	20,389
HOCKLEY COUNTY - COLORADO BASIN						
IRRIGATION	0	0	0	0	977	1,555
LAMB COUNTY - BRAZOS BASIN						
LIVESTOCK	0	0	0	100	555	1,046
IRRIGATION	67,592	173,798	171,470	172,494	172,945	173,178
LUBBOCK COUNTY - BRAZOS BASIN						
IRRIGATION	0	33,021	31,782	32,362	32,776	33,066

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region O Water User Group (WUG) Unmet Needs

	WUG UNMET NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
LYNN COUNTY - BRAZOS BASIN						
IRRIGATION	0	0	0	5,516	9,128	11,464
LYNN COUNTY - COLORADO BASIN						
IRRIGATION	0	0	0	571	1,214	1,586
PARMER COUNTY - BRAZOS BASIN						
IRRIGATION	117,166	140,725	129,148	126,487	124,833	124,176
PARMER COUNTY - RED BASIN						
IRRIGATION	0	9,062	18,083	21,830	23,357	24,265
SWISHER COUNTY - BRAZOS BASIN						
IRRIGATION	1,196	15,176	15,117	15,097	14,960	14,488
SWISHER COUNTY - RED BASIN						
IRRIGATION	7,920	48,876	48,002	48,888	49,508	49,955
TERRY COUNTY - BRAZOS BASIN						
IRRIGATION	92	1,119	315	201	209	246
TERRY COUNTY - COLORADO BASIN						
IRRIGATION	0	32,825	32,055	33,113	33,512	33,710
YOAKUM COUNTY - COLORADO BASIN						
IRRIGATION	28,347	71,101	69,516	70,293	70,701	70,948

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Region O Water User Group (WUG) Unmet Needs Summary

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs Summary report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future 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 category level, calculated surpluses are updated to zero so that only the WUGs with unmet needs in the decade are included with the Needs totals. Unmet needs water volumes are shown as absolute values.

WUG CATEGORY	NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MUNICIPAL	0	0	0	0	0	0
COUNTY-OTHER	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
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

Region O Recommended Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
ABERNATHY	O	HALE COUNTY - ABERNATHY MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	29	18	13	10	13	18
BOVINA	O	PARMER COUNTY - BOVINA MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	N/A	9	1	0	0	0	0
BROWNFIELD	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	186	205	314	314	271
BROWNFIELD	A	PWPA ASR	O | OGALLALA AQUIFER ASR | LUBBOCK COUNTY	N/A	$159	0	100	200	200	200	200
BROWNFIELD	A	REPLACE WELL CAPACITY	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$123	0	0	27	75	165	210
BROWNFIELD	O	TERRY COUNTY - BROWNFIELD ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | TERRY COUNTY	N/A	$56	0	0	0	160	160	160
BROWNFIELD	O	TERRY COUNTY - BROWNFIELD MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$326	N/A	30	0	0	0	0	0
COUNTY-OTHER, BRISCOE	O	BRISCOE COUNTY-OTHER MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	8	6	5	6	6	7
COUNTY-OTHER, COCHRAN	O	COCHRAN COUNTY-OTHER MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	15	14	15	16	19	20
COUNTY-OTHER, GAINES	O	GAINES COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | GAINES COUNTY	N/A	$56	0	1,930	1,930	1,930	1,930	1,930
COUNTY-OTHER, PARMER	O	PARMER COUNTY-OTHER MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	N/A	18	4	0	0	0	0
DENVER CITY	O	YOAKUM COUNTY - DENVER CITY MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$326	$326	62	47	39	49	62	77
DIMMITT	O	CASTRO COUNTY - DIMMITT MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$326	$326	39	23	11	7	13	19
FARWELL	O	PARMER COUNTY - FARWELL MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	16	11	8	8	11	15
FLOYDADA	O	FLOYD COUNTY - FLOYDADA MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	N/A	12	0	0	0	0	0
FRIONA	O	PARMER COUNTY - FRIONA MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$326	N/A	21	4	0	0	0	0
HEREFORD	O	DEAF SMITH COUNTY - HEREFORD MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$326	$326	135	79	42	36	62	98
IDALOU	O	LUBBOCK COUNTY - IDALOU MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	N/A	13	3	0	0	0	0
IRRIGATION, BAILEY	O	BAILEY COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	2,643	4,405	5,040	4,445	4,106	3,893
IRRIGATION, BRISCOE	O	BRISCOE COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	793	1,321	1,448	1,248	1,136	1,066

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Region O Recommended Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
IRRIGATION, CASTRO	O	CASTRO COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	11,396	18,994	21,034	17,711	16,280	15,603
IRRIGATION, COCHRAN	O	COCHRAN COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	2,984	4,972	5,936	5,300	4,771	4,407
IRRIGATION, CROSBY	O	CROSBY COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	3,228	5,379	7,530	5,960	5,169	4,739
IRRIGATION, DAWSON	O	DAWSON COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	3,189	5,315	7,442	6,426	5,889	5,561
IRRIGATION, DEAF SMITH	O	DEAF SMITH COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	6,300	10,501	11,389	9,679	8,781	8,276
IRRIGATION, FLOYD	O	FLOYD COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	3,865	6,442	7,175	6,215	5,663	5,336
IRRIGATION, GAINES	O	GAINES COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	10,874	18,124	22,991	21,475	20,432	19,771
IRRIGATION, HALE	O	HALE COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	9,316	15,527	18,639	17,103	16,335	15,930
IRRIGATION, HOCKLEY	O	HOCKLEY COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	3,956	6,593	6,842	5,863	5,402	5,152
IRRIGATION, LAMB	O	LAMB COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	7,784	12,973	15,301	14,277	13,826	13,593
IRRIGATION, LUBBOCK	O	LUBBOCK COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	4,346	7,243	9,282	8,702	8,288	7,998
IRRIGATION, LYNN	O	LYNN COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	2,668	4,447	6,224	6,224	6,224	6,224
IRRIGATION, PARMER	O	PARMER COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	7,177	11,961	14,517	13,431	12,798	12,446
IRRIGATION, SWISHER	O	SWISHER COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	4,062	6,770	7,703	6,837	6,354	6,057
IRRIGATION, TERRY	O	TERRY COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	5,183	8,639	10,213	9,429	9,022	8,787
IRRIGATION, YOAKUM	O	YOAKUM COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION	$450	$450	4,851	8,085	9,670	8,893	8,485	8,238
LAMESA	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	260	465	708	707	640
LAMESA	A	PWPA ASR	O | OGALLALA AQUIFER ASR | LUBBOCK COUNTY	N/A	$159	0	100	100	100	100	100
LAMESA	A	REPLACE WELL CAPACITY	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$123	0	0	38	118	259	329
LAMESA	O	DAWSON COUNTY - LAMESA MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$326	$326	83	46	17	24	32	44
LEVELLAND	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	343	298	530	527	441
LEVELLAND	A	PWPA ASR	O | OGALLALA AQUIFER ASR | LUBBOCK COUNTY	N/A	$159	0	100	500	500	500	500
LEVELLAND	A	REPLACE WELL CAPACITY	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$123	0	0	41	111	252	328

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Region O Recommended Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
LEVELLAND	O	HOCKLEY COUNTY - LEVELLAND MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$326	N/A	45	0	0	0	0	0
LITTLEFIELD	O	LAMB COUNTY - LITTLEFIELD ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LAMB COUNTY	N/A	$67	0	240	240	240	240	240
LORENZO	O	CROSBY COUNTY - LORENZO MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	N/A	6	0	0	0	0	0
LUBBOCK	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	7,201	10,679	13,812	13,792	12,642
LUBBOCK	A	REPLACE WELL CAPACITY	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$123	0	0	711	2,024	4,431	5,627
LUBBOCK	O	LUBBOCK COUNTY - LUBBOCK BAILEY COUNTY WELL FIELD CAPACITY MAINTENANCE	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | BAILEY COUNTY	$3067	$327	2,431	2,431	2,431	2,431	2,431	2,431
LUBBOCK	O	LUBBOCK COUNTY - LUBBOCK CRMWA AQUIFER STORAGE AND RECOVERY	O | OGALLALA AQUIFER ASR | LUBBOCK COUNTY	N/A	$906	0	0	0	0	10,920	10,920
LUBBOCK	O	LUBBOCK COUNTY - LUBBOCK DIRECT POTABLE REUSE TO NORTH WATER TREATMENT PLANT	O | DIRECT NON-POTABLE REUSE	N/A	$1421	0	0	0	0	0	8,064
LUBBOCK	O	LUBBOCK COUNTY - LUBBOCK JIM BERTRAM LAKE 7	O | LAKE 7 (JIM BERTRAM LAKE/RESERVOIR SYSTEM)	N/A	$518	0	0	11,975	11,975	11,975	11,975
LUBBOCK	O	LUBBOCK COUNTY - LUBBOCK LAKE ALAN HENRY PHASE 2	O | ALAN HENRY LAKE/RESERVOIR	N/A	$783	0	5,100	5,100	5,100	5,100	5,100
LUBBOCK	O	LUBBOCK COUNTY - LUBBOCK MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$288	N/A	1,289	393	0	0	0	0
MANUFACTURING, DEAF SMITH	O	DEAF SMITH COUNTY - MANUFACTURING ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | DEAF SMITH COUNTY	$226	$45	1,250	1,250	1,250	1,250	1,250	1,250
MANUFACTURING, DEAF SMITH	O	DEAF SMITH COUNTY - MANUFACTURING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	10	33	55	55	55	55
MANUFACTURING, GAINES	O	GAINES COUNTY - MANUFACTURING ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | GAINES COUNTY	$231	$51	1,200	1,200	1,200	1,200	1,200	1,200
MANUFACTURING, GAINES	O	GAINES COUNTY - MANUFACTURING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	15	48	79	79	79	79
MANUFACTURING, HALE	O	HALE COUNTY - MANUFACTURING ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HALE COUNTY	$207	$50	4,000	4,000	4,000	4,000	4,000	4,000
MANUFACTURING, HALE	O	HALE COUNTY - MANUFACTURING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	44	152	254	254	254	254
MANUFACTURING, LUBBOCK	O	LUBBOCK COUNTY - MANUFACTURING ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LUBBOCK COUNTY	$291	$50	800	800	800	800	800	800

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region O Recommended Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
MANUFACTURING, LUBBOCK	O	LUBBOCK COUNTY - MANUFACTURING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	9	30	51	51	51	51
MATADOR	O	MOTLEY COUNTY - MATADOR MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	12	10	9	9	10	11
MINING, CROSBY	O	CROSBY COUNTY - MINING ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CROSBY COUNTY	$244	$54	480	480	480	480	480	480
MINING, CROSBY	O	CROSBY COUNTY - MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	10	29	44	38	33	28
MINING, DAWSON	O	DAWSON COUNTY - MINING ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | DAWSON COUNTY	$121	$34	1,600	1,600	1,600	1,600	1,600	1,600
MINING, DAWSON	O	DAWSON COUNTY - MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	18	54	91	91	91	91
MINING, HALE	O	HALE COUNTY - MINING ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | HALE COUNTY	$166	$52	965	965	965	965	965	965
MINING, HALE	O	HALE COUNTY - MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	12	35	51	44	38	33
MINING, LAMB	O	LAMB COUNTY - MINING ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LAMB COUNTY	$202	$52	480	480	480	480	480	480
MINING, LAMB	O	LAMB COUNTY - MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	6	17	26	22	19	17
MINING, LUBBOCK	O	LUBBOCK COUNTY - MINING ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LUBBOCK COUNTY	$265	$28	5,560	5,560	5,560	5,560	5,560	5,560
MINING, LUBBOCK	O	LUBBOCK COUNTY - MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	64	193	296	265	238	216
MINING, LYNN	O	LYNN COUNTY - MINING ADDITIONAL GROUNDWATER SUPPLY	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LYNN COUNTY	$143	$25	800	800	800	800	800	800
MINING, LYNN	O	LYNN COUNTY - MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	12	40	63	52	41	33
MINING, TERRY	O	TERRY COUNTY - MINING ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | TERRY COUNTY	$148	$39	640	640	640	640	640	640
MINING, TERRY	O	TERRY COUNTY - MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	4	16	27	21	15	10
MINING, YOAKUM	O	YOAKUM COUNTY - MINING ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | YOAKUM COUNTY	$192	$48	640	640	640	640	640	640
MINING, YOAKUM	O	YOAKUM COUNTY - MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	13	40	57	48	39	32
MORTON PWS	O	COCHRAN COUNTY - MORTON MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	15	6	4	5	7	9

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Region O Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
MULESHOE	O	BAILEY COUNTY - MULESHOE LOCAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | BAILEY COUNTY	N/A	$21	0	240	240	240	240	240
MULESHOE	O	BAILEY COUNTY - MULESHOE MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$326	$326	40	22	10	7	13	23
NAZARETH	O	CASTRO COUNTY - NAZARETH MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	7	7	6	7	8	9
ODONNELL	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	23	30	36	38	36
ODONNELL	A	REPLACE WELL CAPACITY	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$123	0	0	2	5	12	16
OLTON	O	LAMB COUNTY - OLTON MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	17	9	3	1	2	5
PETERSBURG MUNICIPAL WATER SYSTEM	O	HALE COUNTY - PETERSBURG MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	13	10	6	6	7	9
PLAINS	O	YOAKUM COUNTY - PLAINS MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	18	13	10	10	13	18
PLAINVIEW	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	354	298	530	527	441
PLAINVIEW	A	PWPA ASR	O | OGALLALA AQUIFER ASR | LUBBOCK COUNTY	N/A	$159	0	200	500	500	500	500
PLAINVIEW	A	REPLACE WELL CAPACITY	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$123	0	0	53	151	330	419
PLAINVIEW	O	HALE COUNTY - PLAINVIEW ASR	O | OGALLALA AQUIFER ASR | HALE COUNTY	N/A	$798	0	987	987	987	987	987
PLAINVIEW	O	HALE COUNTY - PLAINVIEW MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$326	N/A	130	38	0	0	0	0
PLAINVIEW	O	HALE COUNTY - PLAINVIEW REUSE	O | DIRECT NON-POTABLE REUSE	N/A	$1211	0	0	560	560	560	560
QUITAQUE	O	BRISCOE COUNTY - QUITAQUE MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	5	3	2	2	2	2
RALLS	O	CROSBY COUNTY - RALLS ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | CROSBY COUNTY	$450	$75	160	160	160	160	160	160
RALLS	O	CROSBY COUNTY - RALLS MUNICIPAL CONSERVATION	DEMAND REDUCTION	$347	N/A	6	0	0	0	0	0
RANSOM CANYON	O	LUBBOCK COUNTY - RANSOM CANYON MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	17	14	13	14	17	20
SEAGRAVES	O	GAINES COUNTY - SEAGRAVES MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	N/A	10	0	0	0	0	0
SEMINOLE	O	GAINES COUNTY - SEMINOLE LOCAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | GAINES COUNTY	$2135	$395	1,225	1,225	1,725	1,725	1,725	1,725
SEMINOLE	O	GAINES COUNTY - SEMINOLE MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$326	$326	120	108	104	115	137	165

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Region O Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
SILVERTON	O	BRISCOE COUNTY - SILVERTON MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	N/A	3	0	0	0	0	0
SLATON	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	264	357	435	433	397
SLATON	A	REPLACE WELL CAPACITY	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$123	0	0	24	64	139	177
SPUR	O	DICKENS COUNTY - SPUR MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	N/A	3	0	0	0	0	0
SUDAN	O	LAMB COUNTY - SUDAN MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	10	6	3	3	5	5
SUNDOWN	O	HOCKLEY COUNTY - SUNDOWN MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	17	11	10	11	14	17
TAHOKA PUBLIC WATER SYSTEM	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	90	117	138	144	135
TAHOKA PUBLIC WATER SYSTEM	A	REPLACE WELL CAPACITY	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$123	0	0	8	20	46	60
TAHOKA PUBLIC WATER SYSTEM	O	LYNN COUNTY - TAHOKA MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	N/A	10	0	0	0	0	0
TULIA	O	SWISHER COUNTY - TULIA MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$326	N/A	22	2	0	0	0	0
WHITEFACE	O	COCHRAN COUNTY - WHITEFACE MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$347	$347	4	2	1	2	2	3
WOLFFORTH	O	LUBBOCK COUNTY - WOLFFORTH LOCAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LUBBOCK COUNTY	N/A	$794	0	0	800	800	800	800
WOLFFORTH	O	LUBBOCK COUNTY - WOLFFORTH MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION	$326	$326	21	10	4	4	9	17

	2020	2030	2040	2050	2060	2070
REGION O RECOMMENDED WMS SUPPLY TOTAL	119,393	199,247	249,021	235,684	239,437	241,763

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Region O Recommended Projects Associated with Water Management Strategies

SPONSOR NAME	SPONSOR IS WWP?	ONLINE DECADE	PROJECT NAME	PROJECT DESCRIPTION	CAPITAL COST
BROWNFIELD	NO	2050	TERRY COUNTY - BROWNFIELD ADDITIONAL GROUNDWATER DEVELOPMENT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$633,000
COUNTY-OTHER, GAINES	NO	2030	GAINES COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$4,159,000
LITTLEFIELD	YES	2030	LAMB COUNTY - LITTLEFIELD ADDITIONAL GROUNDWATER DEVELOPMENT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$902,000
LUBBOCK	YES	2020	LUBBOCK COUNTY - LUBBOCK BAILEY COUNTY WELL FIELD CAPACITY MAINTENANCE	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$94,704,000
LUBBOCK	YES	2060	LUBBOCK COUNTY - LUBBOCK CRMWA AQUIFER STORAGE AND RECOVERY	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK; NEW WATER RIGHT/PERMIT NO IBT	$103,917,000
LUBBOCK	YES	2070	LUBBOCK COUNTY - LUBBOCK DIRECT POTABLE REUSE TO NORTH WATER TREATMENT PLANT	CONVEYANCE/TRANSMISSION PIPELINE; INJECTION WELL; PUMP STATION; WATER TREATMENT PLANT EXPANSION	$125,890,000
LUBBOCK	YES	2040	LUBBOCK COUNTY - LUBBOCK JIM BERTRAM LAKE 7	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; RESERVOIR CONSTRUCTION; WATER TREATMENT PLANT EXPANSION; NEW SURFACE WATER INTAKE	$251,043,000
LUBBOCK	YES	2030	LUBBOCK COUNTY - LUBBOCK LAKE ALAN HENRY PHASE 2	PUMP STATION; WATER TREATMENT PLANT EXPANSION	$103,152,000
MANUFACTURING, DEAF SMITH	NO	2020	DEAF SMITH COUNTY MANUFACTURING ADDITIONAL GROUNDWATER DEVELOPMENT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$3,222,000
MANUFACTURING, GAINES	NO	2020	GAINES COUNTY - MANUFACTURING ADDITIONAL GROUNDWATER DEVELOPMENT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$3,066,000
MANUFACTURING, HALE	NO	2020	HALE COUNTY - MANUFACTURING ADDITIONAL GROUNDWATER DEVELOPMENT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$8,932,000
MANUFACTURING, LUBBOCK	NO	2020	LUBBOCK COUNTY - MANUFACTURING ADDITIONAL GROUNDWATER DEVELOPMENT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$2,742,000
MINING, CROSBY	NO	2020	CROSBY COUNTY - MINING ADDITIONAL GROUNDWATER DEVELOPMENT	MULTIPLE WELLS/WELL FIELD	$1,298,000
MINING, DAWSON	NO	2020	DAWSON COUNTY MINING ADDITIONAL GROUNDWATER DEVELOPMENT	MULTIPLE WELLS/WELL FIELD	$1,976,000
MINING, HALE	NO	2020	HALE COUNTY - MINING ADDITIONAL GROUNDWATER DEVELOPMENT	MULTIPLE WELLS/WELL FIELD	$1,562,000
MINING, LAMB	NO	2020	LAMB COUNTY - MINING ADDITIONAL GROUNDWATER DEVELOPMENT	MULTIPLE WELLS/WELL FIELD	$1,019,000
MINING, LUBBOCK	NO	2020	LUBBOCK COUNTY - MINING ADDITIONAL GROUNDWATER DEVELOPMENT	MULTIPLE WELLS/WELL FIELD	$18,678,000
MINING, LYNN	NO	2020	LYNN COUNTY - MINING ADDITIONAL GROUNDWATER DEVELOPMENT	MULTIPLE WELLS/WELL FIELD	$1,342,000
MINING, TERRY	NO	2020	TERRY COUNTY - MINING ADDITIONAL GROUNDWATER DEVELOPMENT	MULTIPLE WELLS/WELL FIELD	$993,000
MINING, YOAKUM	NO	2020	YOAKUM COUNTY - MINING ADDITIONAL GROUNDWATER DEVELOPMENT	MULTIPLE WELLS/WELL FIELD	$1,300,000
MULESHOE	NO	2030	BAILEY COUNTY - MULESHOE LOCAL GROUNDWATER DEVELOPMENT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$631,000
PLAINVIEW	NO	2030	PLAINVIEW AQUIFER STORAGE AND RECOVERY (ASR)	CONVEYANCE/TRANSMISSION PIPELINE; INJECTION WELL; MULTIPLE WELLS/WELL FIELD; PUMP STATION	$8,857,000
PLAINVIEW	NO	2040	PLAINVIEW REUSE	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION	$10,349,000
RALLS	NO	2020	CROSBY COUNTY - RALLS ADDITIONAL GROUNDWATER DEVELOPMENT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$849,000
SEMINOLE	NO	2020	GAINES COUNTY - SEMINOLE LOCAL GROUNDWATER DEVELOPMENT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER RIGHT/PERMIT NO IBT; PUMP STATION	$42,649,000
WOLFFORTH	NO	2040	LUBBOCK COUNTY - WOLFFORTH LOCAL GROUNDWATER DEVELOPMENT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; PUMP STATION; STORAGE TANK	$13,961,000

REGION O RECOMMENDED CAPITAL COST TOTAL	**$807,826,000**

Region O Alternative Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
COUNTY-OTHER, HOCKLEY	O	CITY OF SMYER ADDITIONAL CRMWA SUPPLY FROM LEVELLAND	A | MEREDITH LAKE/RESERVOIR	N/A	$486	0	150	150	150	150	150
COUNTY-OTHER, HOCKLEY	O	CITY OF SMYER ADDITIONAL CRMWA SUPPLY FROM LEVELLAND	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$486	0	150	150	150	150	150
LOCKNEY	O	CITY OF LOCKNEY - ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | FLOYD COUNTY	$459	$459	320	320	320	320	320	320
LUBBOCK	O	LUBBOCK COUNTY - LUBBOCK BRACKISH SUPPLEMENTAL WATER SUPPLY FOR BAILEY COUNTY WELL FIELD	O | DOCKUM AQUIFER | LUBBOCK COUNTY	N/A	$1105	0	2,240	2,240	2,240	2,240	2,240
LUBBOCK	O	LUBBOCK COUNTY - LUBBOCK DIRECT POTABLE REUSE TO SOUTH WATER TREATMENT PLANT	O | DIRECT NON-POTABLE REUSE	N/A	$1777	0	0	0	0	0	8,064
LUBBOCK	O	LUBBOCK COUNTY - LUBBOCK NORTH FORK DIVERSION AT CR 7300	O | BRAZOS INDIRECT REUSE	N/A	$1538	0	0	8,030	8,030	8,030	8,030
LUBBOCK	O	LUBBOCK COUNTY - LUBBOCK NORTH FORK DIVERSION TO LAKE ALAN HENRY PUMP STATION	O | BRAZOS INDIRECT REUSE	N/A	$365	0	0	7,510	7,510	7,510	7,510
LUBBOCK	O	LUBBOCK COUNTY - LUBBOCK POST RESERVOIR	O | POST LAKE/RESERVOIR	N/A	$1062	0	0	0	0	8,962	8,962
LUBBOCK	O	LUBBOCK COUNTY - LUBBOCK SOUTH FORK DISCHARGE	O | BRAZOS INDIRECT REUSE	N/A	$318	0	8,183	8,183	8,183	8,183	8,183
NEW DEAL	O	CITY OF NEW DEAL - ADDITIONAL GROUNDWATER DEVELOPMENT	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | LUBBOCK COUNTY	$165	$165	242	242	242	242	242	242
SEMINOLE	O	GAINES COUNTY - SEMINOLE GROUNDWATER DESALINATION	O | DOCKUM AQUIFER | GAINES COUNTY	N/A	$3172	0	0	500	500	500	500
REGION O ALTERNATIVE WMS SUPPLY TOTAL						562	11,285	27,325	27,325	36,287	44,351

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Region O Alternative Projects Associated with Water Management Strategies

SPONSOR NAME	SPONSOR IS WWP?	ONLINE DECADE	PROJECT NAME	PROJECT DESCRIPTION	CAPITAL COST
COUNTY-OTHER, HOCKLEY	YES	2030	CITY OF SMYER ADDITIONAL CRMWA SUPPLY FROM LEVELLAND	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; STORAGE TANK	$5,577,000
LOCKNEY	YES	2020	CITY OF LOCKNEY - ADDITIONAL GROUNDWATER DEVELOPMENT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; PUMP STATION	$1,750,000
LUBBOCK	YES	2030	LUBBOCK COUNTY - BRACKISH SUPPLEMENTAL WATER SUPPLY FOR BAILEY COUNTY WELL FIELD	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$51,911,000
LUBBOCK	YES	2070	LUBBOCK COUNTY - LUBBOCK DIRECT POTABLE REUSE TO SOUTH WATER TREATMENT PLANT	CONVEYANCE/TRANSMISSION PIPELINE; INJECTION WELL; PUMP STATION; WATER TREATMENT PLANT EXPANSION; NEW WATER TREATMENT PLANT	$149,975,000
LUBBOCK	YES	2040	LUBBOCK COUNTY - LUBBOCK NORTH FORK DIVERSION AT CR 7300	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; PUMP STATION; WATER TREATMENT PLANT EXPANSION	$177,504,000
LUBBOCK	YES	2040	LUBBOCK COUNTY - LUBBOCK NORTH FORK DIVERSION TO LAKE ALAN HENRY PUMP STATION	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; PUMP STATION; WATER TREATMENT PLANT EXPANSION; NEW WATER RIGHT/PERMIT NO IBT	$49,712,000
LUBBOCK	YES	2060	LUBBOCK COUNTY - LUBBOCK POST RESERVOIR	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; RESERVOIR CONSTRUCTION; WATER TREATMENT PLANT EXPANSION; NEW SURFACE WATER INTAKE; WATER RIGHT/PERMIT AMENDMENT NO IBT; WATER RIGHT/PERMIT LEASE OR PURCHASE	$110,790,000
LUBBOCK	YES	2030	LUBBOCK COUNTY - LUBBOCK SOUTH FORK DISCHARGE	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; PUMP STATION; WATER TREATMENT PLANT EXPANSION; DIVERSION AND CONTROL STRUCTURE; WATER RIGHT/PERMIT AMENDMENT NO IBT	$52,536,000
NEW DEAL	YES	2020	CITY OF NEW DEAL - ADDITIONAL GROUNDWATER DEVELOPMENT	CONVEYANCE/TRANSMISSION PIPELINE; SINGLE WELL; PUMP STATION	$398,000
SEMINOLE	YES	2040	GAINES COUNTY - SEMINOLE GROUNDWATER DESALINATION	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER RIGHT/PERMIT NO IBT; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK; INJECTION WELL	$35,679,000

REGION O ALTERNATIVE CAPITAL COST TOTAL	**$635,832,000**

Region O Water User Group (WUG) Management Supply Factor

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. To calculate the Management Supply Factor for each WUG as a whole, not split by region-county-basin, the combined total of existing and future supply is divided by the total projected demand. If a WUG is split by more than one planning region, the whole WUG's management supply factor will show up in each of its planning region's management supply factor reports.

	WUG MANAGEMENT SUPPLY FACTOR					
WUG NAME	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ABERNATHY	2.6	2.5	2.4	2.4	2.3	2.2
AMHERST	2.3	2.2	2.1	2.1	2.0	1.9
ANTON	5.2	5.1	5.1	5.1	4.9	4.7
BOVINA	1.6	1.4	1.3	1.2	1.2	1.1
BROWNFIELD	1.2	1.3	1.3	1.4	1.3	1.3
COUNTY-OTHER, BAILEY	1.5	1.4	1.3	1.2	1.1	1.0
COUNTY-OTHER, BRISCOE	1.4	1.4	1.5	1.5	1.5	1.5
COUNTY-OTHER, CASTRO	1.3	1.2	1.2	1.1	1.1	1.0
COUNTY-OTHER, COCHRAN	1.3	1.2	1.1	1.1	1.1	1.1
COUNTY-OTHER, CROSBY	1.3	1.2	1.2	1.1	1.1	1.0
COUNTY-OTHER, DAWSON	1.2	1.2	1.1	1.1	1.1	1.0
COUNTY-OTHER, DEAF SMITH	1.7	1.5	1.4	1.2	1.1	1.0
COUNTY-OTHER, DICKENS	1.2	1.3	1.4	1.4	1.4	1.4
COUNTY-OTHER, FLOYD	1.5	1.4	1.3	1.1	1.1	1.0
COUNTY-OTHER, GAINES	1.3	2.1	1.7	1.4	1.2	1.0
COUNTY-OTHER, GARZA	1.3	1.3	1.4	1.4	1.3	1.3
COUNTY-OTHER, HALE	1.3	1.2	1.2	1.3	1.2	1.2
COUNTY-OTHER, HOCKLEY	1.3	1.2	1.2	1.2	1.2	1.1
COUNTY-OTHER, LAMB	1.4	1.3	1.3	1.3	1.2	1.2
COUNTY-OTHER, LUBBOCK	1.7	1.8	2.0	1.5	1.2	1.0
COUNTY-OTHER, LYNN	1.3	1.2	1.3	1.3	1.2	1.2
COUNTY-OTHER, MOTLEY	1.2	1.3	1.3	1.3	1.3	1.3
COUNTY-OTHER, PARMER	1.5	1.3	1.2	1.2	1.1	1.0
COUNTY-OTHER, SWISHER	1.3	1.2	1.3	1.3	1.2	1.2
COUNTY-OTHER, TERRY	1.2	1.3	1.2	1.2	1.2	1.1
COUNTY-OTHER, YOAKUM	1.5	1.4	1.3	1.2	1.1	1.0
CROSBYTON	1.3	1.2	1.2	1.1	1.1	1.0
DENVER CITY	3.8	3.4	3.1	2.8	2.6	2.4
DIMMITT	3.6	3.4	3.3	3.1	3.0	3.0
EARTH	3.6	3.6	3.7	3.8	3.7	3.7
FARWELL	2.2	2.0	1.9	1.8	1.6	1.5
FLOYDADA	3.4	3.5	3.6	3.6	3.6	3.6
FRIONA	2.7	2.5	2.3	2.2	2.0	1.9
HALE CENTER	3.4	3.5	3.6	3.7	3.7	3.7
HAPPY*	4.5	4.4	4.3	4.4	4.2	4.0
HART MUNICIPAL WATER SYSTEM	3.2	3.1	3.0	2.8	2.8	2.7
HEREFORD	1.8	1.6	1.4	1.2	1.1	1.0
IDALOU	3.0	3.0	2.9	2.8	2.7	2.6
IRRIGATION, BAILEY	0.9	0.5	0.4	0.4	0.3	0.2
IRRIGATION, BRISCOE	1.3	0.9	0.9	0.8	0.8	0.8
IRRIGATION, CASTRO	0.7	0.5	0.4	0.2	0.2	0.1
IRRIGATION, COCHRAN	0.8	0.8	0.8	0.8	0.7	0.7
IRRIGATION, CROSBY	1.6	1.2	0.8	0.7	0.7	0.7
IRRIGATION, DAWSON	1.5	1.2	0.9	0.9	0.9	0.9

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

Region O Water User Group (WUG) Management Supply Factor

	WUG MANAGEMENT SUPPLY FACTOR					
WUG NAME	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
IRRIGATION, DEAF SMITH	0.9	0.6	0.5	0.4	0.4	0.3
IRRIGATION, DICKENS	1.1	1.1	1.1	1.1	1.1	1.1
IRRIGATION, FLOYD	0.9	0.9	0.8	0.8	0.8	0.8
IRRIGATION, GAINES	0.7	0.6	0.6	0.5	0.5	0.5
IRRIGATION, GARZA	1.5	1.4	1.3	1.2	1.2	1.1
IRRIGATION, HALE	0.7	0.4	0.3	0.2	0.2	0.1
IRRIGATION, HOCKLEY	1.1	0.8	0.8	0.7	0.7	0.7
IRRIGATION, LAMB	0.7	0.3	0.2	0.2	0.1	0.1
IRRIGATION, LUBBOCK	1.0	0.8	0.8	0.7	0.7	0.7
IRRIGATION, LYNN	1.3	1.1	1.0	0.9	0.9	0.9
IRRIGATION, MOTLEY	1.3	1.3	1.3	1.3	1.3	1.3
IRRIGATION, PARMER	0.6	0.4	0.3	0.2	0.2	0.2
IRRIGATION, SWISHER	0.9	0.5	0.4	0.3	0.3	0.3
IRRIGATION, TERRY	1.1	0.8	0.8	0.8	0.7	0.7
IRRIGATION, YOAKUM	0.8	0.6	0.5	0.4	0.4	0.4
LAMESA	1.1	1.2	1.3	1.5	1.5	1.5
LEVELLAND	2.2	2.2	2.3	2.4	2.3	2.2
LITTLEFIELD	2.4	2.7	2.8	2.9	2.9	2.9
LIVESTOCK, BAILEY	1.3	1.1	1.0	0.9	0.8	0.8
LIVESTOCK, BRISCOE	1.2	1.2	1.1	1.1	1.0	1.0
LIVESTOCK, CASTRO	1.7	1.5	1.4	1.3	1.2	1.1
LIVESTOCK, COCHRAN	6.6	6.4	6.2	6.0	5.8	5.7
LIVESTOCK, CROSBY	1.2	1.2	1.1	1.1	1.0	1.0
LIVESTOCK, DAWSON	3.8	3.7	3.5	3.3	3.1	3.1
LIVESTOCK, DEAF SMITH	1.1	1.0	0.9	0.9	0.8	0.8
LIVESTOCK, DICKENS	1.3	1.2	1.1	1.1	1.0	1.0
LIVESTOCK, FLOYD	1.4	1.4	1.4	1.3	1.3	1.3
LIVESTOCK, GAINES	1.7	1.6	1.6	1.5	1.5	1.5
LIVESTOCK, GARZA	1.2	1.2	1.1	1.1	1.0	1.0
LIVESTOCK, HALE	1.5	1.3	1.2	1.2	1.1	1.0
LIVESTOCK, HOCKLEY	3.1	3.0	2.8	2.7	2.6	2.6
LIVESTOCK, LAMB	1.3	1.2	1.1	1.0	0.9	0.8
LIVESTOCK, LUBBOCK	1.2	1.1	1.1	1.1	1.0	1.0
LIVESTOCK, LYNN	2.6	2.5	2.4	2.3	2.1	2.1
LIVESTOCK, MOTLEY	1.4	1.3	1.2	1.2	1.1	1.1
LIVESTOCK, PARMER	1.5	1.4	1.3	1.2	1.1	1.0
LIVESTOCK, SWISHER	2.2	2.1	2.0	1.9	1.8	1.7
LIVESTOCK, TERRY	1.4	1.3	1.2	1.1	1.0	1.0
LIVESTOCK, YOAKUM	2.1	2.0	1.9	1.8	1.7	1.7
LOCKNEY	1.9	1.9	1.9	1.8	1.8	1.7
LORENZO	3.9	3.7	3.5	3.3	3.1	2.9
LUBBOCK	1.0	1.1	1.3	1.3	1.3	1.4
MANUFACTURING, CASTRO	1.6	1.4	1.4	1.4	1.4	1.4
MANUFACTURING, CROSBY	1.5	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, DEAF SMITH	1.3	1.2	1.2	1.2	1.2	1.2
MANUFACTURING, GAINES	1.2	1.1	1.1	1.1	1.1	1.1
MANUFACTURING, GARZA	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, HALE	1.2	1.1	1.1	1.1	1.1	1.1

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

Region O Water User Group (WUG) Management Supply Factor

	WUG MANAGEMENT SUPPLY FACTOR					
WUG NAME	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
MANUFACTURING, HOCKLEY	1.2	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, LAMB	1.2	1.1	1.1	1.1	1.1	1.1
MANUFACTURING, LUBBOCK	1.3	1.2	1.2	1.2	1.2	1.2
MANUFACTURING, PARMER	1.1	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, TERRY	1.2	1.0	1.0	1.0	1.0	1.0
MATADOR	3.5	3.5	3.6	3.6	3.6	3.6
MINING, COCHRAN	2.0	1.5	1.5	1.9	2.7	3.9
MINING, CROSBY	1.7	1.7	2.0	2.2	2.6	3.0
MINING, DAWSON	1.0	1.1	1.1	1.1	1.1	1.1
MINING, DICKENS	2.4	2.4	2.4	2.4	2.4	2.4
MINING, FLOYD	1.0	1.0	1.0	1.0	1.0	1.0
MINING, GAINES	4.2	3.2	3.7	5.1	7.4	10.0
MINING, GARZA	1.4	1.0	1.2	1.6	2.3	3.3
MINING, HALE	1.0	1.1	1.2	1.4	1.6	1.8
MINING, HOCKLEY	85.9	85.9	91.0	91.0	96.7	103.1
MINING, LAMB	1.0	1.0	1.2	1.4	1.6	1.8
MINING, LUBBOCK	1.0	1.0	1.2	1.3	1.4	1.6
MINING, LYNN	1.2	1.0	1.1	1.3	1.7	2.1
MINING, MOTLEY	1.0	1.1	1.2	1.2	1.4	1.5
MINING, TERRY	2.2	1.5	1.5	1.9	2.7	3.8
MINING, YOAKUM	1.1	1.1	1.3	1.5	1.8	2.2
MORTON PWS	1.3	1.3	1.3	1.3	1.3	1.3
MULESHOE	2.6	2.6	2.4	2.2	2.0	1.9
NAZARETH	4.2	3.9	3.7	3.6	3.4	3.3
NEW DEAL	4.3	4.1	3.8	3.5	3.3	3.1
ODONNELL	1.8	1.9	1.9	1.9	1.9	1.9
OLTON	2.9	3.0	3.0	3.1	3.1	3.1
PETERSBURG MUNICIPAL WATER SYSTEM	1.9	1.8	1.8	1.8	1.8	1.8
PLAINS	2.6	2.4	2.2	2.0	1.8	1.7
PLAINVIEW	1.9	2.2	2.4	2.5	2.4	2.4
POST	1.2	1.2	1.1	1.1	1.0	1.0
QUITAQUE	3.0	3.1	3.1	3.1	3.2	3.2
RALLS	1.3	1.2	1.2	1.1	1.1	1.0
RANSOM CANYON	1.7	1.6	1.5	1.5	1.4	1.3
RED RIVER AUTHORITY OF TEXAS*	1.2	1.3	1.4	1.3	1.3	1.3
SEAGRAVES	2.3	2.2	2.2	2.0	2.0	1.9
SEMINOLE	1.3	1.2	1.3	1.2	1.1	1.0
SHALLOWATER	1.6	1.4	1.3	1.2	1.1	1.0
SILVERTON	1.0	1.0	1.1	1.1	1.1	1.1
SLATON	2.8	3.1	3.2	3.2	3.2	3.2
SPUR	1.3	1.3	1.3	1.3	1.3	1.3
STEAM ELECTRIC POWER, HALE	1.0	1.0	1.0	1.0	1.0	1.0
STEAM ELECTRIC POWER, LAMB	1.2	1.2	1.2	1.2	1.2	1.2
STEAM ELECTRIC POWER, LUBBOCK	1.8	1.8	1.8	1.4	1.4	1.4
STEAM ELECTRIC POWER, YOAKUM	1.0	1.0	1.0	1.0	1.0	1.0
SUDAN	1.7	1.6	1.5	1.5	1.5	1.4
SUNDOWN	2.1	2.0	1.9	1.9	1.9	1.8
TAHOKA PUBLIC WATER SYSTEM	1.8	1.9	1.9	1.9	1.9	1.9

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

Region O Water User Group (WUG) Management Supply Factor

	WUG MANAGEMENT SUPPLY FACTOR					
WUG NAME	2020	2030	2040	2050	2060	2070
TULIA	2.1	2.0	2.1	2.1	2.0	2.0
WHITEFACE	2.7	2.6	2.6	2.6	2.6	2.5
WOLFFORTH	1.6	1.3	1.9	1.6	1.4	1.3

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

Region O Recommended Water Management Strategy (WMS) Supply Associated with a New or Amended Inter-Basin Transfer (IBT) Permit

IBT WMS supply is the portion of the total WMS benefitting WUGs that will require a new or amended IBT permit that is not considered exempt under the Texas Water Code § 11.085.

			IBT WMS SUPPLY (ACRE-FEET PER YEAR)					
WMS NAME	SOURCE BASIN	RECIPIENT WUG BASIN	2020	2030	2040	2050	2060	2070

Region O Water User Groups (WUGs)
Recommended Water Management Strategy (WMS) Supply Associated with a
New or Amended Inter-Basin Transfer (IBT) Permit and Total Recommended Conservation WMS Supply

IBT WMS supply is the portion of the total WMS benefitting the WUG basin split listed that will require a new or amended IBT permit that is not considered exempt under the Texas Water Code § 11.085. Total conservation supply represents all conservation WMS volumes recommended within the WUG's region-basin geographic split.

BENEFITTING WUG NAME | BASIN	WMS SOURCE ORIGIN BASIN | WMS NAME	WMS SUPPLY (ACRE-FEET PER YEAR)					
		2020	2030	2040	2050	2060	2070

Region O Sponsored Recommended Water Management Strategy (WMS) Supplies Unallocated* to Water User Groups (WUG)

WMS NAME	WMS SPONSOR	SOURCE NAME	UNALLOCATED STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
		TOTAL UNALLOCATED STRATEGY SUPPLIES						

* Strategy supplies created through the WMS that have not been assigned to a WUG will be allocated to the entity responsible for the water through an ‘unassigned water volumes’ entity. Only strategy supplies associated with an 'unassigned water volume' entity are shown in this report, and may not represent all strategy supplies associated with the listed WMS.

Region O Water User Group (WUG) Strategy Supplies by Water Management Strategy (WMS) Type

WMS TYPE *	STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
AQUIFER STORAGE & RECOVERY	0	1,487	2,287	2,287	13,207	13,207
GROUNDWATER WELLS & OTHER	22,231	33,362	39,294	45,172	48,217	48,270
IRRIGATION CONSERVATION	94,615	157,691	188,376	169,218	158,961	153,077
MUNICIPAL CONSERVATION	2,330	920	335	352	464	611
NEW MAJOR RESERVOIR	0	0	11,975	11,975	11,975	11,975
OTHER CONSERVATION	217	687	1,094	1,020	953	899
OTHER DIRECT REUSE	0	0	560	560	560	8,624
OTHER SURFACE WATER	0	5,100	5,100	5,100	5,100	5,100
DIRECT POTABLE REUSE	0	0	0	0	0	0
DROUGHT MANAGEMENT	0	0	0	0	0	0
SEAWATER DESALINATION	0	0	0	0	0	0
INDIRECT REUSE	0	0	0	0	0	0
GROUNDWATER DESALINATION	0	0	0	0	0	0
OTHER STRATEGIES	0	0	0	0	0	0
CONJUNCTIVE USE	0	0	0	0	0	0
TOTAL STRATEGY SUPPLIES	**119,393**	**199,247**	**249,021**	**235,684**	**239,437**	**241,763**

* WMS type descriptions can be found on the interactive state water plan website at http://texasstatewaterplan.org/ using the 'View data for' drop-down menus to navigate to a specific WMS Type page. The data used to create each WMS type value is available in Appendix 3 of the Guidelines for Regional Water Planning Data Deliverable (Exhibit D) document at http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/ExhibitD.pdf.

Region O Water User Group (WUG)
Recommended Water Management Strategy (WMS) Supplies by Source Type

SOURCE SUBTYPE*	STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
AQUIFER STORAGE & RECOVERY	0	1,487	2,287	2,287	13,207	13,207
GROUNDWATER	22,231	33,362	39,294	45,172	48,217	48,270
GROUNDWATER TOTAL STRATEGY SUPPLIES	**22,231**	**34,849**	**41,581**	**47,459**	**61,424**	**61,477**
DIRECT NON-POTABLE REUSE	0	0	560	560	560	8,624
DIRECT POTABLE REUSE	0	0	0	0	0	0
INDIRECT NON-POTABLE REUSE	0	0	0	0	0	0
INDIRECT POTABLE REUSE	0	0	0	0	0	0
REUSE TOTAL STRATEGY SUPPLIES	**0**	**0**	**560**	**560**	**560**	**8,624**
ATMOSPHERE	0	0	0	0	0	0
GULF OF MEXICO	0	0	0	0	0	0
LIVESTOCK LOCAL SUPPLY	0	0	0	0	0	0
OTHER LOCAL SUPPLY	0	0	0	0	0	0
RAINWATER HARVESTING	0	0	0	0	0	0
RESERVOIR	0	5,100	17,075	17,075	17,075	17,075
RESERVOIR SYSTEM	0	0	0	0	0	0
RUN-OF-RIVER	0	0	0	0	0	0
SURFACE WATER TOTAL STRATEGY SUPPLIES	**0**	**5,100**	**17,075**	**17,075**	**17,075**	**17,075**
REGION O TOTAL STRATEGY SUPPLIES	**22,231**	**39,949**	**59,216**	**65,094**	**79,059**	**87,176**

* A full list of source subtype definitions can be found in section 3 of the Guidelines for Regional Water Planning Data Deliverable (Exhibit D) document at http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/ExhibitD.pdf.

Region O Major Water Provider (MWP) Existing Sales and Transfers

Major Water Providers are entities of particular significance to a region's water supply as defined by the Regional Water Planning Group (RWPG), and may be a Water User Group (WUG) entity, Wholesale Water Provider (WWP) entity , or both (WUG/WWP).

Retail denotes WUG projected demands and existing water supplies used by the WUG. Wholesale denotes a WWP or WUG/WWP selling water to another entity.

CANADIAN RIVER MUNICIPAL WATER AUTHORITY - WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED WHOLESALE CONTRACT DEMANDS	101,071	109,865	115,523	120,717	121,460	121,598
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**101,071**	**109,865**	**115,523**	**120,717**	**121,460**	**121,598**
GROUNDWATER SALES TO WHOLESALE CUSTOMERS	63,003	63,289	60,674	55,476	49,833	49,833
SURFACE WATER SALES TO WHOLESALE CUSTOMERS	24,669	24,635	24,602	24,568	24,534	24,501
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**87,672**	**87,924**	**85,276**	**80,044**	**74,367**	**74,334**

LUBBOCK - WUG/WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED RETAIL WUG DEMANDS	46,775	51,386	56,443	60,464	64,576	68,389
PROJECTED WHOLESALE CONTRACT DEMANDS	3,088	3,088	3,088	3,088	3,088	3,088
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**49,863**	**54,474**	**59,531**	**63,552**	**67,664**	**71,477**
GROUNDWATER SALES TO RETAIL CUSTOMERS	26,706	26,515	25,731	23,913	20,951	18,919
SURFACE WATER SALES TO RETAIL CUSTOMERS	16,353	16,399	16,894	17,195	17,124	17,100
GROUNDWATER SALES TO WHOLESALE CUSTOMERS	1,280	1,280	1,280	1,280	1,280	1,280
SURFACE WATER SALES TO WHOLESALE CUSTOMERS	370	370	370	370	370	370
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**44,709**	**44,564**	**44,275**	**42,758**	**39,725**	**37,669**

MACKENZIE MUNICIPAL WATER AUTHORITY - WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED WHOLESALE CONTRACT DEMANDS	568	568	568	568	568	568
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**568**	**568**	**568**	**568**	**568**	**568**
SURFACE WATER SALES TO WHOLESALE CUSTOMERS	568	568	568	568	568	568
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**568**	**568**	**568**	**568**	**568**	**568**

RED RIVER AUTHORITY OF TEXAS - WUG/WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED RETAIL WUG DEMANDS	2,097	2,215	2,319	2,442	2,551	2,616
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**2,097**	**2,215**	**2,319**	**2,442**	**2,551**	**2,616**
GROUNDWATER SALES TO RETAIL CUSTOMERS	1,192	1,245	1,293	1,326	1,369	1,419
SURFACE WATER SALES TO RETAIL CUSTOMERS	1,307	1,358	1,396	1,382	1,366	1,255
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**2,499**	**2,603**	**2,689**	**2,708**	**2,735**	**2,674**

WHITE RIVER MWD - WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED WHOLESALE CONTRACT DEMANDS	1,019	1,019	1,019	1,019	1,019	1,019
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**1,019**	**1,019**	**1,019**	**1,019**	**1,019**	**1,019**
GROUNDWATER SALES TO WHOLESALE CUSTOMERS	1,070	1,070	1,070	1,070	1,070	1,070
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**1,070**	**1,070**	**1,070**	**1,070**	**1,070**	**1,070**

Region O Major Water Provider (MWP) Water Management Strategy (WMS) Summary

MWPs are entities of significance to a region's water supply as defined by the Regional Water Planning Group (RWPG) and may be a Water User Group (WUG) entity, Wholesale Water Provider (WWP) entity, or both (WUG/WWP).'MWP Retail Customers' denotes recommended WMS supply used by the WUG. 'Transfers Related to Wholesale Customers' denotes a WWP or WUG/WWP selling or transferring recommended WMS supply to another entity. Supply associated with the MWP's wholesale transfers will only display if it is listed as the main seller in the State Water Planning database, even if multiple sellers are involved with the sale o water to WUGs. Unallocated water volumes represent MWP recommended WMS supply not currently allocated to a customer of the MWP.'Total MWP Related WMS Supply' will display if the MWP's WMS is related to more than one WMS supply type (retail, wholesale, and/or unallocated). Associated WMS Projects are listed when the MWP is one of the project's sponsors. Report contains draft data and is subject to change.

CANADIAN RIVER MUNICIPAL WATER AUTHORITY | BRUSH CONTROL - CRMWA

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
RELATED UNALLOCATED WMS WATER VOLUMES	2,500	2,500	2,500	2,500	2,500	2,500

CANADIAN RIVER MUNICIPAL WATER AUTHORITY | EXPAND CAPACITY CRMWA II

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	0	15,746	19,884	26,048	25,838	22,573
RELATED UNALLOCATED WMS WATER VOLUMES	0	31,411	26,438	19,323	14,832	12,568
TOTAL MWP RELATED WMS SUPPLY	0	47,157	46,322	45,371	40,670	35,141

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
EXPANSION OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2024 - CRMWA2	MULTIPLE WELLS/WELL FIELD
CRMWA II SHARED PIPELINE	CONVEYANCE/TRANSMISSION PIPELINE
CRMWA II CRMWA PIPELINE	CONVEYANCE/TRANSMISSION PIPELINE

CANADIAN RIVER MUNICIPAL WATER AUTHORITY | PWPA ASR

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	0	500	1,800	1,800	1,800	1,800
RELATED UNALLOCATED WMS WATER VOLUMES	0	11,500	10,200	10,200	10,200	10,200
TOTAL MWP RELATED WMS SUPPLY	0	12,000	12,000	12,000	12,000	12,000

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
AQUIFER STORAGE AND RECOVERY - CRMWA	MULTIPLE WELLS/WELL FIELD; INJECTION WELL

CANADIAN RIVER MUNICIPAL WATER AUTHORITY | REPLACE WELL CAPACITY

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	0	0	1,889	5,197	11,450	14,558
RELATED UNALLOCATED WMS WATER VOLUMES	0	0	2,437	4,327	8,043	10,133
TOTAL MWP RELATED WMS SUPPLY	0	0	4,326	9,524	19,493	24,691

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2040 - CRMWA	MULTIPLE WELLS/WELL FIELD

LUBBOCK | EXPAND CAPACITY CRMWA II

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	7,201	10,679	13,812	13,792	12,642

LUBBOCK | LUBBOCK COUNTY - LUBBOCK BAILEY COUNTY WELL FIELD CAPACITY MAINTENANCE

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	2,431	2,431	2,431	2,431	2,431	2,431

Region O Major Water Provider (MWP) Water Management Strategy (WMS) Summary

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
LUBBOCK COUNTY - LUBBOCK BAILEY COUNTY WELL FIELD CAPACITY MAINTENANCE	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD

LUBBOCK | LUBBOCK COUNTY - LUBBOCK CRMWA AQUIFER STORAGE AND RECOVERY

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	0	0	0	10,920	10,920

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
LUBBOCK COUNTY - LUBBOCK CRMWA AQUIFER STORAGE AND RECOVERY	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK; NEW WATER RIGHT/PERMIT NO IBT

LUBBOCK | LUBBOCK COUNTY - LUBBOCK DIRECT POTABLE REUSE TO NORTH WATER TREATMENT PLANT

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	0	0	0	0	8,064

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
LUBBOCK COUNTY - LUBBOCK DIRECT POTABLE REUSE TO NORTH WATER TREATMENT PLANT	CONVEYANCE/TRANSMISSION PIPELINE; INJECTION WELL; PUMP STATION; WATER TREATMENT PLANT EXPANSION

LUBBOCK | LUBBOCK COUNTY - LUBBOCK JIM BERTRAM LAKE 7

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	0	11,975	11,975	11,975	11,975

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
LUBBOCK COUNTY - LUBBOCK JIM BERTRAM LAKE 7	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; RESERVOIR CONSTRUCTION; WATEF TREATMENT PLANT EXPANSION; NEW SURFACE WATER INTAKE

LUBBOCK | LUBBOCK COUNTY - LUBBOCK LAKE ALAN HENRY PHASE 2

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	5,100	5,100	5,100	5,100	5,100

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
LUBBOCK COUNTY - LUBBOCK LAKE ALAN HENRY PHASE 2	PUMP STATION; WATER TREATMENT PLANT EXPANSION

LUBBOCK | LUBBOCK COUNTY - LUBBOCK MUNICIPAL WATER CONSERVATION

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	1,289	393	0	0	0	0

LUBBOCK | REPLACE WELL CAPACITY

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	0	711	2,024	4,431	5,627

MACKENZIE MUNICIPAL WATER AUTHORITY | NO RECOMMENDED WMS SUPPLY RELATED TO MWP

RED RIVER AUTHORITY OF TEXAS | CONSERVATION - RED RIVER AUTHORITY OF TEXAS

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	1	3	4	6	8	9

Region O Major Water Provider (MWP) Water Management Strategy (WMS) Summary

RED RIVER AUTHORITY OF TEXAS | CONSERVATION, WATER LOSS CONTROL - RED RIVER AUTHORITY OF TEXAS

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	2	2	0	0	0	0

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
CONSERVATION, WATER LOSS CONTROL - RED RIVER AUTHORITY OF TEXAS	WATER LOSS CONTROL

RED RIVER AUTHORITY OF TEXAS | DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	0	0	9	94	182

RED RIVER AUTHORITY OF TEXAS | LAKE RINGGOLD

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	0	350	349	346	343

RED RIVER AUTHORITY OF TEXAS | MUNICIPAL CONSERVATION - RED RIVER AUTHORITY

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	101	105	109	113	117

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
AUTOMATED METER INFRASTRUCTURE (AMI) - RED RIVER AUTHORITY	DATA GATHERING/MONITORING TECHNOLOGY

RED RIVER AUTHORITY OF TEXAS | MUNICIPAL CONSERVATION - WICHITA FALLS

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	100	100	100	100	100

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
TREATED WATER LINE - RRA CLAY COUNTY	CONVEYANCE/TRANSMISSION PIPELINE

RED RIVER AUTHORITY OF TEXAS | MUNICIPAL WATER CONSERVATION - RED RIVER AUTHORITY OF TEXAS

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	3	5	7	9	10

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
MUNICIPAL WATER CONSERVATION - RED RIVER AUTHORITY OF TEXAS	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); DATA GATHERING/MONITORING TECHNOLOGY

WHITE RIVER MWD | NO RECOMMENDED WMS SUPPLY RELATED TO MWP

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Regional Surface Water Rights

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WR No	WR Typ	Seq	App No	WR Issue Date	Amend	Owners	Divert Amt	Use	Prio Dt	Prio Class	Consumptive Amt	Stor Amt	Basin	WM Area	County
3122	WRPERM	1.0	3417	05/21/1975		City of Lamesa	918.00	AGRICULTURE - IRRIGATION	03/24/1975			202.00	Colorado	NOT IN WM AREA	DAWSON
3150	WRPERM	1.0	3447	07/18/1975		City of Brownfield	2,000.00	AGRICULTURE - IRRIGATION	05/05/1975			39.00	Colorado	NOT IN WM AREA	TERRY
3664	ADJ	1.0	3664	02/20/1985		Mary Ellen McKillip MCKILLIP, TRUMAN	3.00	AGRICULTURE - IRRIGATION	09/27/1976			1.50	Brazos	NOT IN WM AREA	PARMER
3665	ADJ	1.0	3665	02/20/1985		MCKILLIP, TRUMAN	50.00	AGRICULTURE - IRRIGATION	07/31/1978			190.00	Brazos	NOT IN WM AREA	PARMER
3666	ADJ	1.0	3666	02/20/1985		Arvel Fleming Ethel Mae Fleming	14.00	AGRICULTURE - IRRIGATION	05/30/1966			14.00	Brazos	NOT IN WM AREA	PARMER
3667	ADJ	1.0	3667	02/20/1985		Allen Estlack Helen Arline Estlack	125.00	AGRICULTURE - IRRIGATION	04/17/1968			125.00	Brazos	NOT IN WM AREA	PARMER
3668	ADJ	1.0	3668	02/20/1985		Arlin LeRoy Hartzog Trudy Hartzog	75.00	AGRICULTURE - IRRIGATION	02/05/1968			75.00	Brazos	NOT IN WM AREA	PARMER
3669	ADJ	1.0	3669	02/20/1985		Kuntz Cattle Co.		OTHER	06/06/1977			30.00	Brazos	NOT IN WM AREA	PARMER
3670	ADJ	1.0	3670	02/20/1985		Randy K. Roberts	120.00	AGRICULTURE - IRRIGATION	11/17/1969			90.00	Brazos	NOT IN WM AREA	PARMER
3671	ADJ	1.0	3671	02/20/1985		J. W. Gammon	338.00	AGRICULTURE - IRRIGATION	03/10/1975				Brazos	NOT IN WM AREA	PARMER
3672	ADJ	1.0	3672	02/20/1985		A. Wayne Clark	988.00	AGRICULTURE - IRRIGATION	03/10/1975				Brazos	NOT IN WM AREA	PARMER
3673	ADJ	1.0	3673	02/20/1985		COX T 5, INC.	1,248.00	AGRICULTURE - IRRIGATION	03/10/1975			4,427.00	Brazos	NOT IN WM AREA	PARMER
3674	ADJ	1.0	3674	02/20/1985		DANIEL, JIM ROY	26.00	AGRICULTURE - IRRIGATION	03/10/1975				Brazos	NOT IN WM AREA	PARMER
3675	ADJ	1.0	3675	02/20/1985		MCGILL, TOM B	86.00	AGRICULTURE - IRRIGATION	06/30/1961			12.00	Brazos	NOT IN WM AREA	CASTRO
3676	ADJ	1.0	3676	02/20/1985		THE TWELVE COMPANY	10.00	AGRICULTURE - IRRIGATION	09/29/1969			10.00	Brazos	NOT IN WM AREA	CASTRO
3677	ADJ	1.0	3677	02/20/1985		Wilma Lemons	31.00	AGRICULTURE - IRRIGATION	02/09/1970				Brazos	NOT IN WM AREA	CASTRO
3677	ADJ	2.0	3677	02/20/1985		Brad Steven Lemons Keith David Lemons	31.00	AGRICULTURE - IRRIGATION	02/09/1970			62.00	Brazos	NOT IN WM AREA	CASTRO
3678	ADJ	1.0	3678	02/20/1985		Roy Taack	40.00	AGRICULTURE - IRRIGATION	10/09/1968			10.00	Brazos	NOT IN WM AREA	CASTRO
3679	ADJ	1.0	3679	02/20/1985		L. D. Amerson	2.50	AGRICULTURE - IRRIGATION	06/25/1973			2.00	Brazos	NOT IN WM AREA	CASTRO
3680	ADJ	1.0	3680	02/20/1985		CARSON, KW	1.20	AGRICULTURE - IRRIGATION	07/31/1978			3.50	Brazos	NOT IN WM AREA	HALE
3681	ADJ	1.0	3681	02/20/1985		HECK, MARJORIE W	1.00	AGRICULTURE - IRRIGATION	12/19/1977			1.20	Brazos	NOT IN WM AREA	HALE
3682	ADJ	1.0	3682	02/20/1985		Kerri Falkenberg Randy Falkenberg	28.00	AGRICULTURE - IRRIGATION	04/01/1970			28.00	Brazos	NOT IN WM AREA	HALE
3683	ADJ	1.0	3683	02/20/1985		High Plains Pavers, Inc.	110.00	AGRICULTURE - IRRIGATION	03/29/1976			110.00	Brazos	NOT IN WM AREA	HALE
3684	ADJ	1.0	3684	02/20/1985		JAMES, RICKY JOE	80.00	AGRICULTURE - IRRIGATION	03/15/1976			3.00	Brazos	NOT IN WM AREA	HALE
3685	ADJ	1.0	3685	02/20/1985		Fred Keesee Jr.	170.00	AGRICULTURE - IRRIGATION	05/21/1979			224.00	Brazos	NOT IN WM AREA	HALE
3685	ADJ	2.0	3685	02/20/1985		Fred Keesee Jr.	150.00	AGRICULTURE - IRRIGATION RECREATION	07/14/1975			200.00	Brazos	NOT IN WM AREA	HALE
3686	ADJ	1.0	3686	02/20/1985		Kay Todd	120.00	AGRICULTURE - IRRIGATION	11/15/1976				Brazos	NOT IN WM AREA	HALE
3687	ADJ	1.0	3687	02/20/1985		Legacy Dairy Farms, Ltd.	75.00	AGRICULTURE - IRRIGATION	11/15/1976				Brazos	NOT IN WM AREA	HALE
3688	ADJ	1.0	3688	02/20/1985		Joel B. Mitchell	87.00	AGRICULTURE - IRRIGATION	01/31/1963				Brazos	NOT IN WM AREA	HALE

3689	ADJ	1.0	3689	02/20/1985		Glenith B. Amonett	48.00	AGRICULTURE - IRRIGATION	03/10/1969			53.20	Brazos	NOT IN WM AREA	HALE
3690	ADJ	1.0	3690	02/20/1985		Charles Donald Schuler	2.00	AGRICULTURE - IRRIGATION	12/31/1960				Brazos	NOT IN WM AREA	FLOYD
3691	ADJ	1.0	3691	02/20/1985		Harrison N. Watson Jr Shirley Dean Watson	11.00	AGRICULTURE - IRRIGATION	11/12/1963			150.00	Brazos	NOT IN WM AREA	CROSBY
3692	ADJ	1.0	3692	02/20/1985		Otis English Jr.	29.00	AGRICULTURE - IRRIGATION	05/12/1953			14.50	Brazos	NOT IN WM AREA	CROSBY
3693	ADJ	1.0	3693	02/20/1985		White River Municipal Water District		MUNICIPAL/DOMESTIC	11/21/1960			5,072.00	Brazos	NOT IN WM AREA	CROSBY
3693	ADJ	2.0	3693	02/20/1985		White River Municipal Water District		MUNICIPAL/DOMESTIC	08/16/1971			6,665.00	Brazos	NOT IN WM AREA	CROSBY
3693	ADJ	3.0	3693	02/20/1985		White River Municipal Water District	4,000.00	MUNICIPAL/DOMESTIC	09/22/1958			33,160.00	Brazos	NOT IN WM AREA	CROSBY
3693	ADJ	4.0	3693	02/20/1985		White River Municipal Water District	2,000.00	MINING	09/22/1958				Brazos	NOT IN WM AREA	CROSBY
3694	ADJ	1.0	3694	02/20/1985		Joanie Hudgeons Phillip Hudgeons	47.00	AGRICULTURE - IRRIGATION	12/02/1966				Brazos	NOT IN WM AREA	CROSBY
3695	ADJ	1.0	3695	02/20/1985		Marvin Shurbet	80.00	AGRICULTURE - IRRIGATION	09/29/1969			1.00	Brazos	NOT IN WM AREA	CROSBY
3696	ADJ	1.0	3696	02/20/1985		Eleanora S. Barron O. J. Barron Jr.	260.00	AGRICULTURE - IRRIGATION	09/14/1965			634.00	Brazos	NOT IN WM AREA	DICKENS
3697	ADJ	1.0	3697	02/20/1985		Eleanora S. Barron O. J. Barron Jr.		RECREATION	08/28/1972			338.00	Brazos	NOT IN WM AREA	DICKENS
3698	ADJ	1.0	3698	02/20/1985		Eleanora S. Barron O. J. Barron Jr.	768.00	AGRICULTURE - IRRIGATION	08/01/1966			2,249.00	Brazos	NOT IN WM AREA	DICKENS
3699	ADJ	1.0	3699	02/20/1985		Trent G. and Susanne Long Living Trust	160.00	AGRICULTURE - IRRIGATION RECREATION	06/02/1969			437.00	Brazos	NOT IN WM AREA	DICKENS
3700	ADJ	1.0	3700	02/20/1985		Jesse H. Daughtery Ruby H. Daughtery	160.00	AGRICULTURE - IRRIGATION	11/17/1969				Brazos	NOT IN WM AREA	DICKENS
3703	ADJ	1.0	3703	02/20/1985		W.T. Millen	4.08	AGRICULTURE - IRRIGATION	11/25/1968				Brazos	NOT IN WM AREA	BAILEY
3703	ADJ	2.0	3703	02/20/1985		RINGLAND J.C. GATEWOOD Zona Ann Gatewood	102.77	AGRICULTURE - IRRIGATION	11/25/1968				Brazos	NOT IN WM AREA	BAILEY
3703	ADJ	3.0	3703	02/20/1985		HETTINGA REVOCABLE TRUST	148.16	AGRICULTURE - IRRIGATION	11/25/1968				Brazos	NOT IN WM AREA	BAILEY
3704	ADJ	1.0	3704	02/20/1985		Anna Mae Johnston Trust Anita Marie Kleinert	50.00	AGRICULTURE - IRRIGATION	06/30/1962			105.00	Brazos	NOT IN WM AREA	HALE
3705	ADJ	1.0	3705	02/20/1985		City of Lubbock		RECREATION	04/06/1972			577.00	Brazos	NOT IN WM AREA	LUBBOCK
3705	ADJ	3.0	3705	02/20/1985		City of Lubbock	4,816.00	AGRICULTURE - IRRIGATION INDUSTRIAL MUNICIPAL/DOMESTIC	06/10/1996				Brazos	NOT IN WM AREA	LUBBOCK
3706	ADJ	1.0	3706	02/20/1985		Lubbock County Water Control Improvement District 1		RECREATION	04/08/1957			4,730.00	Brazos	NOT IN WM AREA	LUBBOCK
3707	ADJ	1.0	3707	02/20/1985		Town of Ransom Canyon		RECREATION	04/16/1962			278.00	Brazos	NOT IN WM AREA	LUBBOCK
3707	ADJ	2.0	3707	02/20/1985		Town of Ransom Canyon	150.00	MUNICIPAL/DOMESTIC RECREATION	04/06/1972			282.00	Brazos	NOT IN WM AREA	LUBBOCK
3707	ADJ	3.0	3707	02/20/1985		Town of Ransom Canyon	4.00	AGRICULTURE - IRRIGATION RECREATION	08/25/1980			8.00	Brazos	NOT IN WM AREA	LUBBOCK
3708	ADJ	1.0	3708	02/20/1985		CADDELL, DELTON	120.00	AGRICULTURE - IRRIGATION	08/01/1966			180.00	Brazos	NOT IN WM AREA	CROSBY
3709	ADJ	1.0	3709	02/20/1985		Jan Wood Nathaniel Clark Wood Jr.	15.00	AGRICULTURE - IRRIGATION	12/31/1967			5.00	Brazos	NOT IN WM AREA	CROSBY
3709	ADJ	2.0	3709	02/20/1985		Jan Wood Nathaniel Clark Wood Jr.	795.00	AGRICULTURE - IRRIGATION	04/17/1968			196.00	Brazos	NOT IN WM AREA	CROSBY
3710	ADJ	1.0	3710	02/20/1985		R. E. Janes Gravel Co.	450.00	MINING	04/17/1968			196.00	Brazos	NOT IN WM AREA	CROSBY

3711	ADJ	1.0	3711	02/20/1985		White River Municipal Water District	5,600.00	MUNICIPAL/DOMESTIC	01/20/1970			57,420.00	Brazos	NOT IN WM AREA	GARZA
3711	ADJ	2.0	3711	02/20/1985		White River Municipal Water District	1,000.00	INDUSTRIAL	01/20/1970				Brazos	NOT IN WM AREA	GARZA
3711	ADJ	3.0	3711	02/20/1985		White River Municipal Water District	4,000.00	MINING	01/20/1970				Brazos	NOT IN WM AREA	GARZA
3713	ADJ	1.0	3713	02/20/1985		CASSANDRA KEITH MARION H. KEITH	140.00	AGRICULTURE - IRRIGATION	06/30/1967			430.00	Brazos	NOT IN WM AREA	LYNN
3715	ADJ	1.0	3715	02/20/1985		Barbara C. Boren James Boren Joan C. Hood Odie A. Hood	166.00	MUNICIPAL/DOMESTIC	11/16/1927			526.00	Brazos	NOT IN WM AREA	GARZA
3813	WRPERM	1.0	4111	06/23/1981		Kevin Igo Roxie Igo	8.00	AGRICULTURE - IRRIGATION	03/24/1981				Brazos	NOT IN WM AREA	HALE
3915	WRPERM	1.0	4215	11/03/1982		Texas Department of Criminal Justice	60.00	AGRICULTURE - IRRIGATION	05/10/1982				Brazos	NOT IN WM AREA	HALE
3985	WRPERM	1.0	4340	06/07/1983	B	City of Lubbock	32,991.00	AGRICULTURE - IRRIGATION INDUSTRIAL MUNICIPAL/DOMESTIC RECREATION	03/07/1983				Brazos	NOT IN WM AREA	LUBBOCK
3985	WRPERM	5.0	4340	06/07/1983	C	City of Lubbock	13,825.00	AGRICULTURE - IRRIGATION INDUSTRIAL MUNICIPAL/DOMESTIC RECREATION					Brazos	NOT IN WM AREA	LUBBOCK
4035	WRPERM	1.0	4369	10/07/1983		Legacy Dairy Farms, Ltd.	200.00	AGRICULTURE - IRRIGATION	05/31/1983				Brazos	NOT IN WM AREA	HALE
4064	WRPERM	1.0	4383	01/10/1984		Jess and Gail Visser Family Trust	60.00	AGRICULTURE - IRRIGATION	07/11/1983			200.00	Brazos	NOT IN WM AREA	CASTRO
4127	WRPERM	1.0	4391	07/30/1984		Roaring Springs Ranch Club, Inc.	36.00	RECREATION	08/22/1983			51.30	Red	NOT IN WM AREA	MOTLEY
5099	ADJ	1.0	5099	08/07/1987		Gary Raymond Powell Lorna Powell	116.80	AGRICULTURE - IRRIGATION	06/25/1962			718.00	Red	NOT IN WM AREA	BRISCOE
5100	ADJ	1.0	5100	08/07/1987		RICHARDSON, FLOYD J	19.00	AGRICULTURE - IRRIGATION	09/16/1964				Red	NOT IN WM AREA	BRISCOE
5100	ADJ	2.0	5100	08/07/1987		RICHARDSON, FLOYD J		RECREATION	09/16/1964			179.00	Red	NOT IN WM AREA	BRISCOE
5101	ADJ	1.0	5101	08/07/1987		CHAMALES, LINDA LORRAINE CHAMALES, MICHAEL HOOD	20.77	AGRICULTURE - IRRIGATION RECREATION	05/25/1964				Red	NOT IN WM AREA	FLOYD
5101	ADJ	2.0	5101	08/07/1987		MCWILLIAMS, BOB	16.23	AGRICULTURE - IRRIGATION RECREATION	05/25/1964				Red	NOT IN WM AREA	FLOYD
5102	ADJ	1.0	5102	08/07/1987		Dm Cogdell Jr Land Co Ltd	50.00	DOMESTIC AND LIVESTOCK RECREATION	03/11/1957			1,092.00	Red	NOT IN WM AREA	MOTLEY
5102	ADJ	2.0	5102	08/07/1987		Dm Cogdell Jr Land Co Ltd	33.00	AGRICULTURE - IRRIGATION	03/11/1957				Red	NOT IN WM AREA	MOTLEY
5103	ADJ	1.0	5103	08/07/1987		MAYFIELD, J A	28.00	AGRICULTURE - IRRIGATION	05/12/1964			235.00	Red	NOT IN WM AREA	BRISCOE
5104	ADJ	1.0	5104	08/07/1987		PIGG, BILLY M PIGG, KAROL LYNN	17.00	AGRICULTURE - IRRIGATION	06/29/1964				Red	NOT IN WM AREA	BRISCOE
5105	ADJ	1.0	5105	08/07/1987		MERRELL, DEXTER L MERRELL, JOSEPHINE M	30.00	AGRICULTURE - IRRIGATION RECREATION	06/22/1964				Red	NOT IN WM AREA	BRISCOE
5106	ADJ	1.0	5106	08/07/1987		Rodney D. Carpenter Ronald H. Carpenter R & R Cattle Company	80.00	AGRICULTURE - IRRIGATION	05/04/1964				Red	NOT IN WM AREA	BRISCOE
5110	ADJ	1.0	5110	08/07/1987		LAURA K. BAKER	40.00	AGRICULTURE - IRRIGATION	01/01/1958				Red	NOT IN WM AREA	DICKENS
5110	ADJ	2.0	5110	08/07/1987		LAURA K. BAKER		RECREATION	01/01/1955			104.00	Red	NOT IN WM AREA	DICKENS

5179	ADJ	1.0	5179	09/25/1987		GRIGSBY, RALPH R JR GRIGSBY, SAMUEL F SR	796.00	AGRICULTURE - IRRIGATION	07/31/1966				Red	NOT IN WM AREA	DEAF SMITH
5182	ADJ	1.0	5182	09/25/1987		2BR Land, LP	37.00	AGRICULTURE - IRRIGATION	07/31/1964			15.00	Red	NOT IN WM AREA	DEAF SMITH
5184	ADJ	1.0	5184	09/25/1987		MARTIN, CLARENCE W Lawrence J Martin MARTIN, MARTHA WYNONA Patsy Arleen Martin	54.00	AGRICULTURE - IRRIGATION	07/31/1964			40.00	Red	NOT IN WM AREA	DEAF SMITH
5185	ADJ	1.0	5185	09/25/1987		SIMPSON, JAMES E SIMPSON, MAYMIE SIMPSON, R L SIMPSON, VEATRICE	125.00	AGRICULTURE - IRRIGATION	06/30/1965			7.00	Red	NOT IN WM AREA	DEAF SMITH
5186	ADJ	1.0	5186	09/25/1987		FRYE, GEORGE ARRON FRYE, H HOUSTON FRYE, HARLAND H FRYE, HERTHA FRYE, KENNETH FRYE, LINDA FRYE, VERNA	200.00	AGRICULTURE - IRRIGATION	01/08/1962			492.00	Red	NOT IN WM AREA	PARMER
5187	ADJ	1.0	5187	09/25/1987		Floyd Cole Estate	40.00	AGRICULTURE - IRRIGATION	07/31/1967			8.00	Red	NOT IN WM AREA	CASTRO
5196	ADJ	1.0	5196	09/25/1987		HEARD, DAN J	124.00	AGRICULTURE - IRRIGATION	05/31/1961			19.00	Red	NOT IN WM AREA	CASTRO
5197	ADJ	1.0	5197	09/25/1987		ESTATE OF WILLIAM MASON BIVENS	42.72	AGRICULTURE - IRRIGATION	02/18/1963			120.00	Red	NOT IN WM AREA	SWISHER
5197	ADJ	2.0	5197	09/25/1987		ROYAL PLASTICS, INC.	7.09	AGRICULTURE - IRRIGATION	02/18/1963			5.00	Red	NOT IN WM AREA	SWISHER
5197	ADJ	3.0	5197	09/25/1987		Chamisa CAES at Tulia LLC	99.19	AGRICULTURE - IRRIGATION	02/18/1963			5.00	Red	NOT IN WM AREA	SWISHER
5198	ADJ	1.0	5198	09/25/1987		BYRD, WYLIE A	1.05	AGRICULTURE - IRRIGATION	12/01/1969				Red	NOT IN WM AREA	SWISHER
5198	ADJ	2.0	5198	09/25/1987		BB-ARMS L.P.	55.95	AGRICULTURE - IRRIGATION	12/01/1969				Red	NOT IN WM AREA	SWISHER
5199	ADJ	1.0	5199	09/25/1987		JOHNSON, CONE JOHNSON, EDITH JOHNSON, RANDY JOHNSON, ROXIE WYNN	66.30	AGRICULTURE - IRRIGATION	03/01/1971			173.00	Red	NOT IN WM AREA	CASTRO
5199	ADJ	3.0	5199	09/25/1987		JOHNSON, CONE	89.03	AGRICULTURE - IRRIGATION	03/01/1971				Red	NOT IN WM AREA	CASTRO
5199	ADJ	5.0	5199	09/25/1987		JOHNSON, ROXIE WYNN	107.67	AGRICULTURE - IRRIGATION	03/01/1971			90.00	Red	NOT IN WM AREA	CASTRO
5200	ADJ	1.0	5200	09/25/1987		BRIGGS, JIMMIE BRIGGS, PHILLIP BRIGGS, R L	12.00	AGRICULTURE - IRRIGATION	12/01/1969				Red	NOT IN WM AREA	SWISHER
5202	ADJ	1.0	5202	09/25/1987		ROUSSEAU, PAUL	61.00	AGRICULTURE - IRRIGATION	12/01/1969				Red	NOT IN WM AREA	SWISHER
5203	ADJ	1.0	5203	09/25/1987		Debra Ann Barnes Mikeal Barnes	26.00	AGRICULTURE - IRRIGATION	12/01/1969			26.00	Red	NOT IN WM AREA	SWISHER
5204	ADJ	1.0	5204	09/25/1987		Dera Beth Rousseau Leland Paul Rousseau	34.00	AGRICULTURE - IRRIGATION	07/20/1970				Red	NOT IN WM AREA	SWISHER
5205	ADJ	1.0	5205	09/25/1987		City Of Tulia		RECREATION	08/22/1938			500.00	Red	NOT IN WM AREA	SWISHER
5206	ADJ	1.0	5206	09/25/1987		CROUSE, GLADYS DAWSON DAWSON, EDWIN L DAWSON, R B JR	24.00	AGRICULTURE - IRRIGATION	12/01/1969				Red	NOT IN WM AREA	SWISHER
5207	ADJ	1.0	5207	09/25/1987		SIMPSON, J E JR	8.00	AGRICULTURE - IRRIGATION	12/01/1969				Red	NOT IN WM AREA	SWISHER
5208	ADJ	1.0	5208	09/25/1987		Larry Nelson Farms, Inc.	55.00	AGRICULTURE - IRRIGATION	06/16/1970				Red	NOT IN WM AREA	SWISHER
5209	ADJ	1.0	5209	09/25/1987		DIAMOND B FEEDYARD, LLC	284.00	AGRICULTURE - IRRIGATION	03/04/1968			294.50	Red	NOT IN WM AREA	SWISHER
5210	ADJ	1.0	5210	09/25/1987		SIMPSON, J E JR	60.00	AGRICULTURE - IRRIGATION	12/01/1969				Red	NOT IN WM AREA	SWISHER

5211	ADJ	1.0	5211	09/25/1987		Mackenzie Municipal Water Authority	4,000.00	MUNICIPAL/DOMESTIC RECREATION	06/26/1967			46,450.00	Red	NOT IN WM AREA	BRISCOE
5211	ADJ	2.0	5211	09/25/1987		Mackenzie Municipal Water Authority	1,200.00	INDUSTRIAL	06/26/1967				Red	NOT IN WM AREA	BRISCOE
5212	ADJ	1.0	5212	09/25/1987		Roy Mayfield Estate	107.00	AGRICULTURE - IRRIGATION	05/15/1967				Red	NOT IN WM AREA	BRISCOE
5219	ADJ	1.0	5219	09/25/1987		HAWKINS, DORA HAWKINS, WILLIAM ELBERT		RECREATION	03/16/1964				Red	NOT IN WM AREA	BRISCOE
5220	ADJ	1.0	5220	09/25/1987		Texas Parks And Wildlife Department	20.00	MUNICIPAL/DOMESTIC RECREATION	03/09/1964			1,184.00	Red	NOT IN WM AREA	BRISCOE
5266	ADJ	1.0	5266	08/07/1987		FLETCHER, DARLEEN FLETCHER, J N JR		RECREATION	04/19/1971				Red	NOT IN WM AREA	MOTLEY
5267	ADJ	1.0	5267	08/07/1987		Cottonwood Lake LLC	100.00	AGRICULTURE - IRRIGATION	11/25/1963				Red	NOT IN WM AREA	BRISCOE
5267	ADJ	2.0	5267	08/07/1987		Cottonwood Lake LLC		RECREATION	11/25/1963			132.00	Red	NOT IN WM AREA	BRISCOE
5359	WRPERM	1.0	5359	08/28/1991		Citation 2002 Investment Limited Partnership	200.00	MINING	05/19/1991				Brazos	NOT IN WM AREA	GARZA
5405	WRPERM	1.0	5405	06/16/1992		Scott D. Horne	4.00	AGRICULTURE - IRRIGATION	03/05/1992				Brazos	NOT IN WM AREA	HALE
12243	WRPERM	1.0	12243	05/17/2010		City of Lamesa		AGRICULTURE - IRRIGATION INDUSTRIAL MUNICIPAL/DOMESTIC					Colorado	NOT IN WM AREA	DAWSON
12729	WRPERM	1.0	12729	06/19/2012		BRISCOE, DOLPH III		AGRICULTURE - WILDLIFE MANAGEMENT DOMESTIC AND LIVESTOCK	10/21/2011			1,600.00	Red	NOT IN WM AREA	MOTLEY

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Technical Memoranda:

2021 Regional Water Plan Population and Water Demand Revision Requests

2021 Llano Estacado Region O Regional Water Plan

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Memo

Date:	December 21, 2017; Amended January 9, 2018; Amended January 12, 2018
Project:	Llano Estacado (Region O) Regional Water Plan
To:	Yun Cho, Texas Water Development Board
From:	Paula Jo Lemonds, PE, PG and Grady Reed, HDR, on behalf of the LERWPG
Subject:	**2021 Regional Water Plan Population and Water Demand Revision Requests**

Introduction

The Texas Water Development Board (TWDB) 2021 Regional Water Plan Draft Population and Water Demand Projections were presented to the Llano Estacado Regional Water Planning Group (LERWPG) at a regular meeting of the LERWPG on August 22, 2017. In addition, the South Plains Association of Government (SPAG) mailed the TWDB 2021 Draft Population and Water Demand Projections to 50 Municipal Water User Groups (WUGs), 5 Wholesale Water Providers (WWPs), 21 County Judges, 3 Councils of Government and 8 Groundwater Conservation Districts (GCDs) on September 8, 2017. Those entities that requested population and/or water demand revisions are listed below. Additional detailed information regarding these requests is provided in the following sections of this memorandum.

WUG Name	Service Area – Primary County
Floydada	Floyd
Hale Center	Hale
Hale County Steam-Electric	Hale
Lamb County Manufacturing	Lamb
Littlefield	Lamb
Livestock	All Region O Counties
Lubbock	Lubbock
Brownfield	Terry
Yoakum County Steam-Electric	Yoakum
Dawson County Mining	Dawson

Municipal Water User Groups

This section summarizes the recommended changes to the population and water demand projections for municipal water user groups.

Floyd County

The following tables show the recommended population and water demand revisions for municipal WUGs located in Floyd County.

2021 RWP Draft Projections

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
FLOYD	COUNTY-OTHER, FLOYD	1,598	1,691	1,750	1,815	1,865	1,906	192	193	198	205	210	215	107	102	101	101	101	101
FLOYD	FLOYDADA	3,242	3,447	3,577	3,718	3,828	3,920	572	589	603	625	642	657	158	153	150	150	150	150
FLOYD	LOCKNEY	2,029	2,156	2,236	2,321	2,388	2,444	277	283	285	295	303	310	122	117	114	113	113	113

2021 RWP Draft Projections (Recommended Revision)

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
FLOYD	***COUNTY-OTHER, FLOYD***	***1,598***	***1,896***	***2,085***	***2,291***	***2,451***	***2,584***	***192***	***216***	***236***	***259***	***276***	***291***	107	102	101	101	101	101
FLOYD	***FLOYDADA***	***3,242***	***3,242***	***3,242***	***3,242***	***3,242***	***3,242***	***572***	***554***	***547***	***545***	***544***	***543***	158	153	150	150	150	150
FLOYD	LOCKNEY	2,029	2,156	2,236	2,321	2,388	2,444	277	283	285	295	303	310	122	117	114	113	113	113

Change from 2021 RWP Draft Projections

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
FLOYD	COUNTY-OTHER, FLOYD	-	205	335	476	586	678	-	23	38	54	66	76	-	-	-	-	-	-
FLOYD	FLOYDADA	-	(205)	(335)	(476)	(586)	(678)	-	(35)	(56)	(80)	(98)	(114)	-	-	-	-	-	-
FLOYD	LOCKNEY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

City of Floydada

SUMMARY OF COMMENTS RECEIVED

- The population projections are too high.
- Floyd County population has been decreasing.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- Comment received from the Floyd County Judge, Marty Lucke. See Attachment A.
- Comment received from Floydada City Manager, Jeff Johnston. See Attachment A.

RWPG RECOMMENDATION

- Methodology – No change to the 2020 population. Set all remaining decadal values to the 2020 population (see table above).

City of Lockney

SUMMARY OF COMMENTS RECEIVED

- The population and water demand projections are adequate.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- Comment received from Lockney City Manager, Buster Poling. See Attachment A.

RWPG RECOMMENDATION

- Keep projections as presented by TWDB.

Floyd County-Other

SUMMARY OF COMMENTS RECEIVED

- No request received.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- None.

RWPG RECOMMENDATION

- Methodology – Move population from City of Floydada to Floyd County-Other (see table above).

Hale County

The following tables show the recommended population and water demand revisions for municipal WUGs located in Hale County.

2021 RWP Draft Projections

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
HALE	ABERNATHY	2,263	2,360	2,401	2,381	2,444	2,469	536	547	549	540	553	559	211	207	204	202	202	202
HALE	COUNTY-OTHER, HALE	7,795	8,132	8,270	8,201	8,417	8,508	1,015	1,020	1,007	983	1,006	1,016	116	112	109	107	107	107
HALE	HALE CENTER	2,380	2,482	2,524	2,503	2,569	2,597	297	299	295	288	295	298	111	108	104	103	103	102
HALE	PETERSBURG MUNICIPAL WATER SYSTEM	1,252	1,306	1,329	1,317	1,352	1,366	321	329	329	325	333	336	229	225	221	220	220	220
HALE	PLAINVIEW	24,624	25,685	26,123	25,905	26,587	26,874	4,587	4,664	4,650	4,562	4,672	4,722	166	162	159	157	157	157

2021 RWP Draft Projections (Recommended Revision)

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
HALE	ABERNATHY	2,263	2,360	2,401	2,381	2,444	2,469	536	547	549	540	553	559	211	207	204	202	202	202
HALE	***COUNTY-OTHER, HALE***	***7,923***	***8,362***	***8,542***	***8,452***	***8,734***	***8,853***	***1,032***	***1,049***	***1,040***	***1,013***	***1,044***	***1,057***	116	112	109	107	107	107
HALE	***HALE CENTER***	***2,252***	***2,252***	***2,252***	***2,252***	***2,252***	***2,252***	***281***	***271***	***263***	***259***	***259***	***258***	111	108	104	103	103	102
HALE	PETERSBURG MUNICIPAL WATER SYSTEM	1,252	1,306	1,329	1,317	1,352	1,366	321	329	329	325	333	336	229	225	221	220	220	220
HALE	PLAINVIEW	24,624	25,685	26,123	25,905	26,587	26,874	4,587	4,664	4,650	4,562	4,672	4,722	166	162	159	157	157	157

Change from 2021 RWP Draft Projections

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
HALE	ABERNATHY	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
HALE	COUNTY-OTHER, HALE	128	230	272	251	317	345	17	29	33	30	38	41	0	0	0	0	0	0
HALE	HALE CENTER	(128)	(230)	(272)	(251)	(317)	(345)	(16)	(28)	(32)	(29)	(36)	(40)	0	0	0	0	0	0
HALE	PETERSBURG MUNICIPAL WATER SYSTEM	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
HALE	PLAINVIEW	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0

City of Hale Center

SUMMARY OF COMMENTS RECEIVED

- The City does not expect any increases in the City's water usage.
- The City predicts that the City population will remain about the same (plus or minus 100 people) of their current population of 2,252.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- Revision request received via email from the Hale Center City Manager Dennis Burton dated October 26, 2017. See Attachment B.

RWPG RECOMMENDATION

- Methodology – Set the population of Hale Center to the current population of 2,252 in all decades (see table above).

Hale County-Other

SUMMARY OF COMMENTS RECEIVED

- No request received.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- None.

RWPG RECOMMENDATION

- Methodology – Move population from City of Hale Center to Hale County-Other (see table above).

Lamb County

The following tables show the recommended population and water demand revisions for municipal WUGs located in Lamb County.

HDR

2021 RWP Draft Projections

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
LAMB	AMHERST	799	877	930	963	1,018	1,059	102	107	110	113	119	124	114	109	106	105	104	105
LAMB	COUNTY-OTHER, LAMB	3,083	3,468	3,742	3,933	4,212	4,430	445	481	514	538	575	605	129	124	123	122	122	122
LAMB	EARTH	1,099	1,125	1,131	1,118	1,134	1,137	191	190	186	183	186	186	155	151	147	146	146	146
LAMB	LITTLEFIELD	6,342	6,303	6,187	5,974	5,925	5,816	943	907	864	824	815	800	133	128	125	123	123	123
LAMB	OLTON	2,250	2,275	2,266	2,218	2,229	2,217	466	461	451	437	438	436	185	181	178	176	175	176
LAMB	SUDAN	1,042	1,127	1,182	1,213	1,273	1,316	250	264	273	278	292	301	214	209	206	205	205	204

2021 RWP Draft Projections (Recommended Revision)

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
LAMB	AMHERST	799	877	930	963	1,018	1,059	102	107	110	113	119	124	114	109	106	105	104	105
LAMB	***COUNTY-OTHER, LAMB***	***2,783***	***3,129***	***3,287***	***3,265***	***3,495***	***3,604***	***402***	***434***	***452***	***447***	***477***	***492***	129	124	123	122	122	122
LAMB	EARTH	1,099	1,125	1,131	1,118	1,134	1,137	191	190	186	183	186	186	155	151	147	146	146	146
LAMB	***LITTLEFIELD***	***6,642***	***6,642***	***6,642***	***6,642***	***6,642***	***6,642***	***988***	***956***	***928***	***916***	***914***	***914***	133	128	125	123	123	123
LAMB	OLTON	2,250	2,275	2,266	2,218	2,229	2,217	466	461	451	437	438	436	185	181	178	176	175	176
LAMB	SUDAN	1,042	1,127	1,182	1,213	1,273	1,316	250	264	273	278	292	301	214	209	206	205	205	204

Change from 2021 RWP Draft Projections

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
LAMB	AMHERST	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
LAMB	COUNTY-OTHER, LAMB	(300)	(339)	(455)	(668)	(717)	(826)	(43)	(47)	(62)	(91)	(98)	(113)	0	0	0	0	0	0
LAMB	EARTH	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
LAMB	LITTLEFIELD	300	339	455	668	717	826	45	49	64	92	99	114	0	0	0	0	0	0
LAMB	OLTON	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
LAMB	SUDAN	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0

City of Littlefield

SUMMARY OF COMMENTS RECEIVED

- The City expects water demand to increase by 350,000 gallons/day in 2019 when the new milk processing facility opens (see manufacturing water demand revision request for Lamb County).
- The City expects the population to grow by 280 to 300 people through increased employment at the Texas Civil Commitment (the total number of guards at the center is expected to be 140).
- The City's current demand is about 600,000 gallons/day and that is expected to increase to 950,000 to 1,000,000 gallons/per with the dairy plant.
- There are currently about 2,344 water accounts within the City.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- Revision request received via email from the Littlefield City Manager Mitch Grant dated October 17, 2017. See Attachment C.

RWPG RECOMMENDATION

- Methodology – Added 300 residents to the 2020 population. Kept this population constant through the planning period. No change was made to the gpcd. The additional water demand for the new milk processing facility will be shown as a revision to the Lamb County manufacturing water demands (see table above).

Lamb County-Other

SUMMARY OF COMMENTS RECEIVED

- No request received.

SUMMARY OF SUPPORTING MATERIALS RECEIVED (SEE ATTACHMENTS)

- None.

RWPG RECOMMENDATION

- Methodology – Move population from Lamb County-Other to the City of Littlefield (see table above).

Lubbock County

The following tables show the recommended population and water demand revisions for municipal WUGs located in Lubbock County.

2021 RWP Draft Projections

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
LUBBOCK	ABERNATHY	786	874	961	1,054	1,142	1,229	186	203	220	239	258	278	211	207	204	202	202	202
LUBBOCK	COUNTY-OTHER, LUBBOCK	35,685	39,738	43,806	48,141	52,269	56,365	4,634	4,997	5,388	5,854	6,339	6,831	116	112	110	109	108	108
LUBBOCK	IDALOU	2,425	2,534	2,647	2,772	2,883	2,993	434	441	451	467	485	503	160	155	152	150	150	150
LUBBOCK	LUBBOCK	255,257	283,597	312,043	342,371	371,227	399,846	45,622	49,423	53,437	58,112	62,886	67,702	160	156	153	152	151	151
LUBBOCK	NEW DEAL	869	951	1,036	1,125	1,210	1,294	113	120	128	137	147	158	116	113	110	109	108	109
LUBBOCK	RANSOM CANYON	1,171	1,257	1,344	1,438	1,525	1,612	336	355	376	400	424	448	256	252	250	248	248	248
LUBBOCK	SHALLOWATER	2,820	3,192	3,562	3,956	4,334	4,709	422	464	507	558	610	662	134	130	127	126	126	126
LUBBOCK	SLATON	6,179	6,257	6,352	6,467	6,547	6,621	745	725	712	711	717	725	108	103	100	98	98	98
LUBBOCK	WOLFFORTH	4,577	5,577	6,569	7,614	8,633	9,647	765	912	1,061	1,223	1,384	1,546	149	146	144	143	143	143

2021 RWP Draft Projections (Recommended Revision)

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
LUBBOCK	ABERNATHY	786	874	961	1,054	1,142	1,229	186	203	220	239	258	278	211	207	204	202	202	202
LUBBOCK	***COUNTY-OTHER, LUBBOCK***	***29,236***	***28,473***	***26,252***	***34,285***	***42,291***	***52,310***	***3,797***	***3,580***	***3,229***	***4,169***	***5,129***	***6,340***	116	112	110	109	108	108
LUBBOCK	IDALOU	2,425	2,534	2,647	2,772	2,883	2,993	434	441	451	467	485	503	160	155	152	150	150	150
LUBBOCK	***LUBBOCK***	***261,706***	***294,862***	***329,597***	***356,227***	***381,205***	***403,901***	***46,775***	***51,386***	***56,443***	***60,464***	***64,576***	***68,389***	160	156	153	152	151	151
LUBBOCK	NEW DEAL	869	951	1,036	1,125	1,210	1,294	113	120	128	137	147	158	116	113	110	109	108	109
LUBBOCK	RANSOM CANYON	1,171	1,257	1,344	1,438	1,525	1,612	336	355	376	400	424	448	256	252	250	248	248	248
LUBBOCK	SHALLOWATER	2,820	3,192	3,562	3,956	4,334	4,709	422	464	507	558	610	662	134	130	127	126	126	126
LUBBOCK	SLATON	6,179	6,257	6,352	6,467	6,547	6,621	745	725	712	711	717	725	108	103	100	98	98	98
LUBBOCK	WOLFFORTH	4,577	5,577	6,569	7,614	8,633	9,647	765	912	1,061	1,223	1,384	1,546	149	146	144	143	143	143

Change from 2021 RWP Draft Projections

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
LUBBOCK	ABERNATHY	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
LUBBOCK	COUNTY-OTHER, LUBBOCK	(6,449)	(11,265)	(17,554)	(13,856)	(9,978)	(4,055)	(837)	(1,417)	(2,159)	(1,685)	(1,210)	(491)	0	0	0	0	0	0
LUBBOCK	IDALOU	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
LUBBOCK	LUBBOCK	6,449	11,265	17,554	13,856	9,978	4,055	1,153	1,963	3,006	2,352	1,690	687	0	0	0	0	0	0
LUBBOCK	NEW DEAL	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
LUBBOCK	RANSOM CANYON	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
LUBBOCK	SHALLOWATER	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
LUBBOCK	SLATON	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
LUBBOCK	WOLFFORTH	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0

City of Lubbock

SUMMARY OF COMMENTS RECEIVED

- The population projections are inconsistent with the City's Strategic Water Supply Plan.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- Revision request materials were developed by HDR Engineering, Inc. on behalf of City of Lubbock. See Attachment D.

RWPG RECOMMENDATION

- Methodology – Revise consistent with the recommended changes. Additional population for the City would come from County-Other (see table above).

Lubbock County-Other

SUMMARY OF COMMENTS RECEIVED

- No request received.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- None.

RWPG RECOMMENDATION

- Methodology – Move population from Lubbock County-Other to the City of Lubbock (see table above).

Terry County

The following tables show the recommended population and water demand revisions for municipal WUGs located in Terry County.

2021 RWP Draft Projections

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
TERRY	BROWNFIELD	10,381	11,036	11,696	12,296	12,860	13,386	1,793	1,854	1,923	1,999	2,086	2,171	154	150	147	145	145	145
TERRY	COUNTY-OTHER, TERRY	3,218	3,421	3,625	3,812	3,987	4,149	398	404	419	440	459	477	110	105	103	103	103	103

2021 RWP Draft Projections (Recommended Revision)

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
TERRY	***BROWNFIELD***	***10,000***	***10,700***	***11,300***	***12,250***	***12,800***	***13,300***	***1,600***	***1,680***	***1,751***	***1,865***	***1,921***	***1,979***	***143***	***140***	***138***	***136***	***134***	***133***
TERRY	***COUNTY-OTHER, TERRY***	***3,599***	***3,757***	***4,021***	***3,858***	***4,047***	***4,235***	***445***	***444***	***465***	***445***	***466***	***487***	110	105	103	103	103	103

Change from 2021 RWP Draft Projections

County	WUG Name	Population 2020	Population 2030	Population 2040	Population 2050	Population 2060	Population 2070	Municipal Demands 2020	Municipal Demands 2030	Municipal Demands 2040	Municipal Demands 2050	Municipal Demands 2060	Municipal Demands 2070	GPCD 2020	GPCD 2030	GPCD 2040	GPCD 2050	GPCD 2060	GPCD 2070
TERRY	BROWNFIELD	(381)	(336)	(396)	(46)	(60)	(86)	(193)	(174)	(172)	(134)	(165)	(192)	-11	-10	-8	-9	-11	-12
TERRY	COUNTY-OTHER, TERRY	381	336	396	46	60	86	47	40	46	5	7	10	0	0	0	0	0	0

City of Brownfield

SUMMARY OF COMMENTS RECEIVED

- 2020 – 10,000 population; 1,600 acft/yr demand; gpcd of 143
- 2030 – 10,700 population; 1,680 acft/yr demand; gpcd of 140
- 2040 – 11,300 population; 1,751 acft/yr demand; gpcd of 138
- 2050 – 12,250 population; 1,865 acft/yr demand; gpcd of 136
- 2060 – 12,800 population; 1,921 acft/yr demand; gpcd of 134
- 2070 – 13,300 population; 1,979 acft/yr demand; gpcd of 133

SUMMARY OF SUPPORTING MATERIALS RECEIVED (SEE ATTACHMENTS)

- Revision request received via email dated October 20, 2017, from Brownfield Public Works Director Willie Herrera, Jr. See Attachment E.

RWPG RECOMMENDATION

- Methodology – Revise consistent with the recommended changes. Additional population for the City would come from County-Other (see table above).

Terry County-Other

SUMMARY OF COMMENTS RECEIVED

- No request received.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- None.

RWPG RECOMMENDATION

Methodology – Move population from Terry County-Other to the City of Brownfield (see table above).

Manufacturing Water User Groups

This section summarizes the recommended changes to the water demand projections for manufacturing water user groups.

Lamb County Manufacturing

The following tables show the recommended water demand revisions for manufacturing use in Lamb County.

2021 RWP Draft Projections							
County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
LAMB	MANUFACTURING	415	548	548	548	548	548

2021 RWP Draft Projections (Recommended Revision)							
County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
LAMB	MANUFACTURING	807	940	940	940	940	940

Change from 2021 RWP Draft Projections							
County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
LAMB	MANUFACTURING	392	392	392	392	392	392

SUMMARY OF COMMENTS RECEIVED

- The City of Littlefield expects water demand to increase by 350,000 gallons/day in 2019 when the new milk processing facility begins operations.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- Revision request received via email from the Littlefield City Manager Mitch Grant dated October 17, 2017. See Attachment C.

RWPG RECOMMENDATION

- Methodology – Add 392 acft/yr (or 350,000 gallons/day) to the Lamb County manufacturing demands in every decade.

Steam-Electric Water User Groups

This section summarizes the recommended changes to the water demand projections for Steam-Electric water user groups.

Hale County Steam-Electric

The following tables show the recommended water demand revisions for steam-electric use in Hale County.

2021 RWP Draft Projections							
County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
HALE	STEAM-ELECTRIC	1,799	1,799	1,799	1,799	1,799	1,799

2021 RWP Draft Projections (Recommended Revision)							
County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
HALE	STEAM-ELECTRIC	31	31	31	31	31	31

Change from 2021 RWP Draft Projections							
County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
HALE	STEAM-ELECTRIC	(1,768)	(1,768)	(1,768)	(1,768)	(1,768)	(1,768)

SUMMARY OF COMMENTS RECEIVED

- There is only one power plant located in Hale County.
- That power plant is expected to use about 10,000,000 gallons per year.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- Emails documenting projected water usage from Shane McMinn, Manager of Engineering Services, Golden Spread Electric Cooperative, Inc. and Bill Billingsley, TWDB, were received. See Attachment F.

RWPG RECOMMENDATION

- Methodology – Revise consistent with the recommended changes. The projected demand would be 31 acft/yr throughout the planning period.

Yoakum County Steam-Electric

The following tables show the recommended water demand revisions for steam-electric use in Yoakum County.

2021 RWP Draft Projections

County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
YOAKUM	STEAM-ELECTRIC	-	-	-	-	-	-

2021 RWP Draft Projections (Recommended Revision)

County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
YOAKUM	STEAM-ELECTRIC	1,910	1,910	1,910	1,910	1,910	1,910

Change from 2021 RWP Draft Projections

County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
YOAKUM	STEAM-ELECTRIC	1,910	1,910	1,910	1,910	1,910	1,910

SUMMARY OF COMMENTS RECEIVED

- The steam-electric plant in Yoakum County has not been submitting annual water use reports.
- In an email from the TWDB dated December 12, 2017, Golden Spread Electric Cooperative, Inc. - Mustang Station (Plant 55065) reported the use county as Potter (1,302 AF on their 2016 survey) and was added to the historical estimates. The plant is actually located in Yoakum County, and has been corrected. 1,302AF was removed from the draft projections for Potter County and added to Yoakum to account for this.
- Water use for the last five years was provided was provided by Golden Spread Electric Cooperative, Inc.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- Emails from Shane McMinn, Manager of Engineering Services, Golden Spread Electric Cooperative, Inc. documenting historical and projected water usage. See Attachment G.
- Email from the TWDB dated December 12, 2017. See Attachment G.

RWPG RECOMMENDATION

Methodology – Used the average of the water usage values reported by Golden Spread Electric Cooperative, Inc., except for the 2015 volume when the unit was out of service. This value (1,910 acft/yr) is used for 2020 and is held constant for all other decadal points.

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.

2021 RWP Draft Projections							
County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
BAILEY	LIVESTOCK	3,093	3,991	4,049	4,111	4,176	4,244
BRISCOE	LIVESTOCK	285	293	301	310	319	329
CASTRO	LIVESTOCK	10,533	12,824	13,130	13,451	13,788	14,141
COCHRAN	LIVESTOCK	438	460	483	507	532	559
CROSBY	LIVESTOCK	191	196	200	205	209	215
DAWSON	LIVESTOCK	147	151	155	160	164	168
DEAF SMITH	LIVESTOCK	11,773	13,414	13,885	14,380	14,900	15,446
DICKENS	LIVESTOCK	305	311	318	327	335	343
FLOYD	LIVESTOCK	1,274	1,338	1,405	1,474	1,548	1,626
GAINES	LIVESTOCK	190	199	209	220	230	242
GARZA	LIVESTOCK	220	224	229	235	241	254
HALE	LIVESTOCK	3,556	4,626	4,690	4,758	4,831	4,906
HOCKLEY	LIVESTOCK	395	415	435	458	480	505
LAMB	LIVESTOCK	4,460	4,711	4,813	4,920	5,031	5,148
LUBBOCK	LIVESTOCK	706	803	831	861	892	925
LYNN	LIVESTOCK	81	84	87	89	92	95
MOTLEY	LIVESTOCK	370	377	384	392	399	407
PARMER	LIVESTOCK	9,817	12,037	12,314	12,605	12,910	13,230
SWISHER	LIVESTOCK	3,252	3,416	3,587	3,766	3,955	4,152
TERRY	LIVESTOCK	303	323	346	372	399	443
YOAKUM	LIVESTOCK	137	139	141	144	147	157
	Total	51,526	60,332	61,992	63,745	65,578	67,535

2021 RWP Draft Projections (Recommended Revision)

County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
BAILEY	LIVESTOCK	2,428	2,821	3,070	3,341	3,639	3,958
BRISCOE	LIVESTOCK	286	300	315	331	347	352
CASTRO	LIVESTOCK	6,721	7,589	8,179	8,820	9,517	10,261
COCHRAN	LIVESTOCK	102	106	109	113	117	118
CROSBY	LIVESTOCK	171	179	188	197	207	209
DAWSON	LIVESTOCK	53	55	58	61	64	65
DEAF SMITH	LIVESTOCK	11,170	12,157	12,933	13,766	14,661	15,604
DICKENS	LIVESTOCK	387	406	426	447	470	475
FLOYD	LIVESTOCK	1,168	1,189	1,212	1,237	1,262	1,268
GAINES	LIVESTOCK	123	126	129	133	136	137
GARZA	LIVESTOCK	148	155	162	170	179	181
HALE	LIVESTOCK	2,752	3,111	3,325	3,561	3,820	4,098
HOCKLEY	LIVESTOCK	133	138	144	150	156	157
LAMB	LIVESTOCK	3,940	4,529	4,910	5,325	5,780	6,271
LUBBOCK	LIVESTOCK	1,088	1,138	1,173	1,212	1,253	1,287
LYNN	LIVESTOCK	65	68	71	74	78	79
MOTLEY	LIVESTOCK	276	290	305	320	336	340
PARMER	LIVESTOCK	7,339	8,318	8,967	9,674	10,444	11,276
SWISHER	LIVESTOCK	2,728	2,864	3,007	3,157	3,314	3,469
TERRY	LIVESTOCK	420	461	492	526	562	586
YOAKUM	LIVESTOCK	91	96	101	106	111	113
	Total	41,589	46,096	49,276	52,721	56,453	60,304

Change from 2021 RWP Draft Projections

County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
BAILEY	LIVESTOCK	(665)	(1,170)	(979)	(770)	(537)	(286)
BRISCOE	LIVESTOCK	1	7	14	21	28	23
CASTRO	LIVESTOCK	(3,812)	(5,235)	(4,951)	(4,631)	(4,271)	(3,880)
COCHRAN	LIVESTOCK	(336)	(354)	(374)	(394)	(415)	(441)
CROSBY	LIVESTOCK	(20)	(17)	(12)	(8)	(2)	(6)
DAWSON	LIVESTOCK	(94)	(96)	(97)	(99)	(100)	(103)
DEAF SMITH	LIVESTOCK	(603)	(1,257)	(952)	(614)	(239)	158
DICKENS	LIVESTOCK	82	95	108	120	135	132
FLOYD	LIVESTOCK	(106)	(149)	(193)	(237)	(286)	(358)
GAINES	LIVESTOCK	(67)	(73)	(80)	(87)	(94)	(105)
GARZA	LIVESTOCK	(72)	(69)	(67)	(65)	(62)	(73)
HALE	LIVESTOCK	(804)	(1,515)	(1,365)	(1,197)	(1,011)	(808)
HOCKLEY	LIVESTOCK	(262)	(277)	(291)	(308)	(324)	(348)
LAMB	LIVESTOCK	(520)	(182)	97	405	749	1,123
LUBBOCK	LIVESTOCK	382	335	342	351	361	362
LYNN	LIVESTOCK	(16)	(16)	(16)	(15)	(14)	(16)
MOTLEY	LIVESTOCK	(94)	(87)	(79)	(72)	(63)	(67)
PARMER	LIVESTOCK	(2,478)	(3,719)	(3,347)	(2,931)	(2,466)	(1,954)
SWISHER	LIVESTOCK	(524)	(552)	(580)	(609)	(641)	(683)
TERRY	LIVESTOCK	117	138	146	154	163	143
YOAKUM	LIVESTOCK	(46)	(43)	(40)	(38)	(36)	(44)
	Total	(9,937)	(14,236)	(12,716)	(11,024)	(9,125)	(7,231)

SUMMARY OF COMMENTS RECEIVED

- Region O livestock water use is projected to increase slightly from the 2017 State Water Plan projections due to changes in inventory and projected future growth; however, livestock demands are likely to be lower than the 2021 RWP Draft Projections.
- County level livestock water use projections vary considerably from the 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 available in publicly available data systems to delineate confined livestock operations.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- Documentation of analysis provided by Ben Weinheimer, Texas Cattle Feeders Association. See Attachment H.

RWPG RECOMMENDATION

- Methodology – Revise consistent with the recommended changes for the 21 counties in Region O.

Mining Water User Groups

This section summarizes the recommended changes to the water demand projections for mining water uses.

The following tables show the recommended water demand revisions for mining use in Dawson County.

2021 RWP Draft Projections							
County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
DAWSON	MINING	954	1,164	1,023	703	423	255

2021 RWP Draft Projections (Recommended Revision)							
County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
DAWSON	MINING	1,812	1,812	1,812	1,812	1,812	1,812

Change from 2021 RWP Draft Projections							
County	WUG Name	Demands 2020	Demands 2030	Demands 2040	Demands 2050	Demands 2060	Demands 2070
DAWSON	MINING	858	648	789	1,109	1,389	1,557

Dawson County

SUMMARY OF COMMENTS RECEIVED

- At the November 15, 2017, Llano Estacado (Region O) Regional Water Planning Group meeting, the construction of a new sand mine to supply sand for hydraulic fracturing to support the oil and gas industry was mentioned by a Planning Group member.
- Follow up information showed that the sand mine would use more water than draft mining water demand projections, approximately 1,176 acft/yr.

SUMMARY OF SUPPORTING MATERIALS RECEIVED

- Comment received from Jacob Hernandez, Mesa County Underground Water Conservation District General Manager, who had contacted US Silica to determine their expected water use. See Attachment I.

RWPG RECOMMENDATION

- Methodology – Revise mining demands consistent with expected use of 1,776 acft/yr plus the average of the last five years of reported water use in Dawson County.

Attachments

Attachment A

Floyd County

Water User Group	Population					
	2020	2030	2040	2050	2060	2070
COUNTY-OTHER, FLOYD	1,598	1,691	1,750	1,815	1,865	1,906
FLOYDADA	3,242	3,447	3,577	3,718	3,828	3,920
LOCKNEY	2,029	2,156	2,236	2,321	2,388	2,444
Total Population	**6,869**	**7,294**	**7,563**	**7,854**	**8,081**	**8,270**

Water User Group	Gallons per Capita per Day (GPCD)					
	2020	2030	2040	2050	2060	2070
COUNTY-OTHER, FLOYD	107	102	101	101	101	101
FLOYDADA	158	153	150	150	150	150
LOCKNEY	122	117	114	113	113	113

Water User Group	Water Demand (acft/yr)					
	2020	2030	2040	2050	2060	2070
COUNTY-OTHER, FLOYD	192	193	198	205	210	215
FLOYDADA	572	589	603	625	642	657
LOCKNEY	277	283	285	295	303	310
Total Water Demand	**1,041**	**1,065**	**1,086**	**1,125**	**1,155**	**1,182**

Kelly,

From 1960 {12,369} to 2010 {6446} the population of Floyd County decreased 5923 individuals or 47.9%. The chart provided shows a projected increase from 2020 {6869} to 2070 {8270} which is an increase of 1401 individuals or 20.4%. To compare apples to apples, I ran the numbers from 2010 {6446} to your projected 2060 {8081} that would give a good 100-year picture. That projected increase would be 1635 individuals or 25.4% over the projected 50-year period. With the decreased need for manual labor in the agricultural industry and the lack of manufacturing in Floyd County, I do not see that large of an increase, if any increase, in population.

Marty Locke

Lemonds, Paula Jo

From: jjohnston-cm@suddenlinkmail.com
Sent: Thursday, December 14, 2017 1:35 PM
To: Lemonds, Paula Jo
Subject: RE: Floydada Water Demand Projections

Paula,
I looked over the chart you sent me showing the changes (or there lack of) of the population growth in Floydada. I would agree that looking back historically, Floydada is on track to remain constant at its current population. With that said I believe the chart you submitted to me is accurate. I appreciate your work on this and please give me a holler when you have a chance to come over for Punkin Days! Please feel free to contact my office with any other questions you may have.

Jeff Johnston
City Manager
Floydada, Tx

From: Lemonds, Paula Jo [mailto:Paula.Lemonds@hdrinc.com]
Sent: Thursday, December 14, 2017 12:02 PM
To: jjohnston-cm@suddenlinkmail.com
Subject: Floydada Water Demand Projections

Jeff,

Thank you for the conversation this morning. As we discussed, County Judge Marty Lucke recommended that Floyd County's population and related water demands are not increasing as rapidly as the Texas Water Development Board (TWDB) water demand projections show. Please find below the water demand projections for Floydada and the revisions that we will recommend to the TWDB for Floydada. The table shows Floydada's population staying constant at 3,242 rather than climbing to 3,920, which translates into a lower water demand ranging from 35 to 114 acft/yr less than the TWDB water demand projections. How does this look to you?

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
FLOYDADA population – TWDB projection	3,242	3,447	3,577	3,718	3,828	3,920
FLOYDADA population – 2010 census (revised from TWDB's projection)	*3,242*	*3,242*	*3,242*	*3,242*	*3,242*	*3,242*
Change in Water Demand with steady population (acft/yr)	-	(35)	(56)	(80)	(98)	(114)

Thank you again for the visit. I'll look you up when we make it to the Punkin Days.

Paula Jo Lemonds, PG, PE
Water Resources Engineer | Associate

ONEHDRED
1917-2017

HDR

4401 West Gate Blvd., Suite 400
Austin, TX 78745
D 512.912.5127 | **F** 512.912.5158
paula.lemonds@hdrinc.com

hdrinc.com/follow-us

Attachment A

Lemonds, Paula Jo

From: Buster Poling <buster@cityoflockney.com>
Sent: Monday, October 30, 2017 12:03 PM
To: Lemonds, Paula Jo
Subject: FW: Region O Regional Water Planning - Projected Population & Water Demands (Follow Up Request)

Buster,
Thank you very much for the visit this morning. If you could forward me the email that you sent to Kelly Davila regarding the Texas Water Development Board's Water Demand Projections, I would certainly appreciate your help in this matter.

Paula Jo Lemonds, PG, PE
Water Resources Engineer | Associate

ONEHUNDRED
1917-2017

HDR
4401 West Gate Blvd., Suite 400
Austin, TX 78745
D 512.912.5127 | **F** 512.912.5158

hdrinc.com/follow-us

From: Buster Poling
Sent: Wednesday, October 4, 2017 10:09 AM
To: 'Kelly Davila' <Kdavila@spag.org>
Subject: RE: Region O Regional Water Planning - Projected Population & Water Demands (Follow Up Request)

Hi Kelly,

I have reviewed the information contained in the packet related to the 5th planning cycle for regional water plan. As you know, I am somewhat new to the area and still learning much. However, I really see no reason at this time to make any changes to the number and information as it relates to Lockney. I would leave the numbers as they currently are projected.

Thank you and have a great week.

G. A. 'Buster' Poling, Jr.
City Manager
City of Lockney
218 E. Locust/P.O. Box 387
Lockney, TX 79241
buster@cityoflockney
806-652-2355

From: Kelly Davila [mailto:Kdavila@spag.org]
Sent: Monday, October 2, 2017 12:31 PM
To: Kelly Davila <Kdavila@spag.org>; Belinda Solis <Bsolis@spag.org>
Subject: Region O Regional Water Planning - Projected Population & Water Demands (Follow Up Request)

Mayors & City Officials:
As you may recall, the Llano Estacado Regional Water Planning Group (LERWPG) is now being administratively managed by the South Plains Association of Governments (SPAG). Recently, the Planning Group began the '5th planning cycle' which will cover 2017-2021 and end with the completed 2021 regional water plan. The work conducted so far includes the hiring of an engineering technical consultant (HDR Engineering, Inc.) who will handle a significant portion of the water studies, modeling and surveys necessary to complete the next plan.

In September, a packet was mailed to you with the following items:

- A Cover Letter & Memo explaining one of the first steps in the planning process, which is to review draft population and water demand projections for your City, and provide feedback on these projections.
    - **We asked that you review this information and provide feedback on or before October 20, 2017. If you see reason for adjustments to the demands projected for your City, please let us know before the 20th.**
    - **If you would like me to email the projections for your City (and the information packet), please let me know and I will gladly do so.**
- Projections tables,
- TWDB's Criteria and Process for Revisions document, and
- Population and municipal projection method summary document from the TWDB

Region O, as designated by the Texas Water Development Board, consists of 21 counties in the Southern High Plains of Texas and covers the entire SPAG region and 6 additional counties outside of the SPAG boundaries (several of which are in the PRPC region). While SPAG serves as the administrative agent, we are working closely with HDR Engineering, Inc. and the Planning Group Members to facilitate the actual planning process. The enclosures you received in September provide general information about Region O and the first steps in this planning process, including the information we need from your entity.

Should you or your staff require additional information or want to discuss these items further, please feel free to contact me directly at 806.762.8721 or kdavila@spag.org .

Thanks!

Kelly Davila
Director of Regional Services
South Plains Association of Governments
1323 58th Street
Lubbock, Texas 79412

806.762.8721

Attachment B

Lemonds, Paula Jo

To: Kelly Davila
Subject: RE: Projected Water Usage

AMServiceURLStr: https://slingshot.hdrinc.com:443/CFSS/control?view=services/FTService

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From: Kelly Davila [mailto:Kdavila@spag.org]
Sent: Thursday, October 26, 2017 9:47 AM
To: Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
Cc: Aubrey Spear PE (ASpear@mail.ci.lubbock.tx.us) <ASpear@mail.ci.lubbock.tx.us>
Subject: FW: Projected Water Usage

Here is a late submittal.

From: Dennis Burton [mailto:citymanager@cityofhalecenter.com]
Sent: Thursday, October 26, 2017 9:05 AM
To: Kelly Davila <Kdavila@spag.org>
Subject: Projected Water Usage

Kelly,

My apologies for the delay in responding to your request for water demand projections for Hale Center.
I do not see any additional increases in the city's water usage. I hope and predict our population will remain about the same
(plus/minus 100) of our current population of 2,252.

One of my biggest concerns for Hale Center is that we do not have a secondary water source. Other than the Ogallala, we do not have
a planned strategy for other sources of water.

Our only options that I see is:

a. An agreement with a CRMWA member city (Plainview) to purchase water
b. Consider the Santa Rosa Dockum (depending on the salinity)
c. The recycling of the city's waste water

Your help and guidance in this matter would certainly be welcome.

Sincerely,

Dennis Burton

Dennis Burton
City Manager
City of Hale Center
P O Box 532 / 702 Main Street
Hale Center, TX 79041
806-839-2411, office
806-839-9970, fax

Lemonds, Paula Jo

From:	Kelly Davila <Kdavila@spag.org>
Sent:	Tuesday, October 17, 2017 3:37 PM
To:	Lemonds, Paula Jo
Cc:	ASpear@mail.ci.lubbock.tx.us
Subject:	Fwd: Region O Regional Water Planning - Projected Population & Water Demands (Follow Up Request)

Paula Jo/Aubrey,
Here is the information I received from Littlefield regarding population and demand projections.

Thanks!
Kelly

Sent from my iPhone

Begin forwarded message:

> **From:** Mitch Grant <mgrant@lfdtx.city>
> **Date:** October 17, 2017 at 3:34:50 PM CDT
> **To:** Kelly Davila <Kdavila@spag.org>
> **Cc:** Kevin Skinner <kskinner@lfdtx.city>
> **Subject: RE: Region O Regional Water Planning - Projected Population & Water Demands (Follow Up Request)**
>
> Kelly:
> Here are our thoughts on the regional plan update:
>
> We will need an additional 350,000 gallons per day beginning January 2019 for the new Dairy Plant.
> We anticipate 280 to 300 additional full time residents through the Texas Civil Commitment
> The guards for the commitment center total 140 (46 per shift)
> We are at about 600,000 gallons per day now and we anticipate 950,000 to 1,000,000 per day when the Dairy Plant opens
> We have 2,344 total water accounts
>
> Let me know if you need anything else
> Thanks,
>
> ***Mitch Grant***
> City Manager
> City of Littlefield
> 806.385.9202 – City Hall
> 806.385.0014 – Fax
> mgrant@lfdtx.city
> www.littlefieldtexas.org

ATTENTION ELECTED OFFICIALS:

A "Reply to All" of this e-mail could lead to violations of the Texas Open Meetings Act. Please reply only to the sender.

This message is intended only for the named recipient. If you are not the intended recipient, you are notified that disclosing, copying, distributing, or taking any action in reliance on the contents of this information is strictly prohibited

---

From: Kelly Davila [mailto:Kdavila@spag.org]
Sent: Monday, October 02, 2017 2:43 PM
To: Mitch Grant <mgrant@lfdtx.city>
Cc: Kevin Skinner <kskinner@lfdtx.city>
Subject: RE: Region O Regional Water Planning - Projected Population & Water Demands (Follow Up Request)

Thanks Mitch!

From: Mitch Grant [mailto:mgrant@lfdtx.city]
Sent: Monday, October 02, 2017 2:28 PM
To: Kelly Davila <Kdavila@spag.org>
Cc: Kevin Skinner <kskinner@lfdtx.city>
Subject: RE: Region O Regional Water Planning - Projected Population & Water Demands (Follow Up Request)

Thanks Kelly. We are looking at it now.

Mitch Grant
City Manager
City of Littlefield
806.385.9202 – City Hall
806.385.0014 – Fax
mgrant@lfdtx.city
www.littlefieldtexas.org

From: Kelly Davila [mailto:Kdavila@spag.org]
Sent: Monday, October 02, 2017 12:31 PM
To: Kelly Davila <Kdavila@spag.org>; Belinda Solis <Bsolis@spag.org>
Subject: Region O Regional Water Planning - Projected Population & Water Demands (Follow Up Request)

Mayors & City Officials:

As you may recall, the Llano Estacado Regional Water Planning Group (LERWPG) is now being administratively managed by the South Plains Association of Governments (SPAG). Recently, the Planning Group began the '5th planning cycle' which will cover 2017-2021 and end with the completed 2021 regional water plan. The work conducted so far includes the hiring of an engineering technical consultant (HDR Engineering, Inc.) who will handle a significant portion of the water studies, modeling and surveys necessary to complete the next plan.

In September, a packet was mailed to you with the following items:

- A Cover Letter & Memo explaining one of the first steps in the planning process, which is to review draft population and water demand projections for your City, and provide feedback on these projections.
    - **We asked that you review this information and provide feedback on or before October 20, 2017. If you see reason for adjustments to the demands projected for your City, please let us know before the 20th.**
    - **If you would like me to email the projections for your City (and the information packet), please let me know and I will gladly do so.**
- Projections tables,
- TWDB's Criteria and Process for Revisions document, and
- Population and municipal projection method summary document from the TWDB

Region O, as designated by the Texas Water Development Board, consists of 21 counties in the Southern High Plains of Texas and covers the entire SPAG region and 6 additional counties outside of the SPAG boundaries (several of which are in the PRPC region). While SPAG serves as the administrative agent, we are working closely with HDR Engineering, Inc. and the Planning Group Members to facilitate the actual planning process. The enclosures you received in September provide general information about Region O and the first steps in this planning process, including the information we need from your entity.

Should you or your staff require additional information or want to discuss these items further, please feel free to contact me directly at 806.762.8721 or kdavila@spag.org .

Thanks!

Kelly Davila
Director of Regional Services
South Plains Association of Governments
1323 58th Street
Lubbock, Texas 79412

806.762.8721

Attachment D

Lemonds, Paula Jo

From:	Dunn, David
Sent:	Tuesday, October 31, 2017 4:53 PM
To:	Lemonds, Paula Jo
Cc:	Aubrey Spear
Subject:	FW: Options for Region O Population Projections
Attachments:	Region_O_2018_SWSP_Comparison.xlsx

Paula,

Aubrey and I discussed the City of Lubbock projections for the 2021 Region O Plan. He would like us to request Alt. A for population in the attached file, but not request any change in GPCD – use the TWDB GPCD projections. I've marked the appropriate projections to include in the revisions request.

The justification for changing the population is for consistency with the City of Lubbock Strategic Water Supply Plan (2013 and upcoming 2018 Plans).

Thanks.

David

David D. Dunn, PE
D 512.912.5136 M 512.791.3671

ONEHDRED
1917-2017

Texas TBPE Firm No. F-754

hdrinc.com/follow-us

From: Dunn, David
Sent: Friday, October 27, 2017 5:39 PM
To: Aubrey Spear <ASpear@mail.ci.lubbock.tx.us>
Cc: Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
Subject: Options for Region O Population Projections

Aubrey,

Attached is a spreadsheet comparing the draft 2021 Region O population and water demands for Lubbock, and the population and water demands from the 2018 SWSP (in progress).

Here are a few notes.

1. I attempted to make the two population projections match exactly by drawing the difference from Lubbock County-Other. There is sufficient population in C-O to reasonably do so, except that it makes for a strange population pattern for C-O in 2030 and 2040. This is Alt. B.
2. I then reduced the population drawn from C-O in 2030 and 2040 so that it stays constant between 2020 and 2030, and increases slightly in 2040. This is Alt. A, with A noting my preference.
3. I then compared demands between the three alternatives, which is in the Demands Comparison tab. I focused on the Drought GPCD from the 2018 SWSP, which is comparable, but not exact, to the Draft Region O GPCD.

4. Based on review of the resulting population and water demand projections, I suggest that Region O request the Alt. A revision to Lubbock's population, but that we stick with the TWDB's GPCD projections. This will result in slightly smaller demand projections in 2020 and 2030 than the 2018 SWSP Drought demands, but very comparable for the rest of the decades, and it increases the demands over the draft 2021 Region O demands.

What I am not aware of is any issue in the area with moving population from County-Other to Lubbock. There really is no magic to the County-Other population projections. After projecting the county total population, the TWDB staff divides the population into the known water utilities, with the remainder being placed in County-Other.

We can discuss next week when you return.

David

David D. Dunn, PE
Vice President

ONEHDRED
1917-2017

HDR
4401 West Gate Blvd., Suite 400
Austin, Texas 78745
D 512.912.5136 **M** 512.791.3671
david.dunn@hdrinc.com

Texas TBPE Firm No. F-754

hdrinc.com/follow-us

Lemonds, Paula Jo

From: Aubrey Spear <ASpear@mail.ci.lubbock.tx.us>
Sent: Tuesday, January 9, 2018 5:53 PM
To: Dunn, David; Lemonds, Paula Jo
Cc: Newell, Peter
Subject: RE: 2017 Population Projections

City Planning Dept.
Aubrey

From: Dunn, David [mailto:David.Dunn@hdrinc.com]
Sent: Tuesday, January 9, 2018 5:48 PM
To: Aubrey Spear <ASpear@mail.ci.lubbock.tx.us>; Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
Cc: Newell, Peter <Peter.Newell@hdrinc.com>
Subject: RE: 2017 Population Projections

Thanks Aubrey. Is that from the State Data Center, or from the City's planning department?

David D. Dunn, PE
D 512.912.5136 **M** 512.791.3671

ONEHDRED
1917-2017

Texas TBPE Firm No. F-754

hdrinc.com/follow-us

From: Aubrey Spear [mailto:ASpear@mail.ci.lubbock.tx.us]
Sent: Tuesday, January 9, 2018 4:41 PM
To: Dunn, David <David.Dunn@hdrinc.com>; Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
Subject: 2017 Population Projections

David/Paula,

Hot off the press…

2017 population projection for the City of Lubbock is 252,506. See how that matches our planning documents.

Aubrey

Aubrey A. Spear, P.E.
Director of Water Utilities
City of Lubbock
806.775.2585
aspear@mylubbock.us

Lemonds, Paula Jo

From:	Aubrey Spear <ASpear@mail.ci.lubbock.tx.us>
Sent:	Friday, January 12, 2018 11:08 AM
To:	Newell, Peter; Lemonds, Paula Jo
Cc:	Dunn, David; 10055566_Lubbock 2018 Strategic WSP
Subject:	RE: Water Demand Tables

Peter,

Please update the Water Demand Tables to reflect the new 2017 population of 252,506.
We are going use this for Region O too. I think the deadline for Region O is today. Paula can work with you on this.

Aubrey

Aubrey A. Spear, P.E.
Director of Water Utilities
P.O. Box 2000 | Lubbock, TX 79457
(806) 775-2585 | aspear@mylubbock.us

From: Newell, Peter [mailto:Peter.Newell@hdrinc.com]
Sent: Wednesday, January 3, 2018 5:30 PM
To: Aubrey Spear <ASpear@mail.ci.lubbock.tx.us>
Cc: Dunn, David <David.Dunn@hdrinc.com>; 10055566_Lubbock 2018 Strategic WSP <10055566_Lubbock2018StrategicWSP@hdrinc.com>
Subject: Water Demand Tables

Aubrey

Per your request, I've attached the most recent spreadsheet with the annual supplies and various demand scenarios. See the "Data All" tab. Please let me know if you were expecting something else.

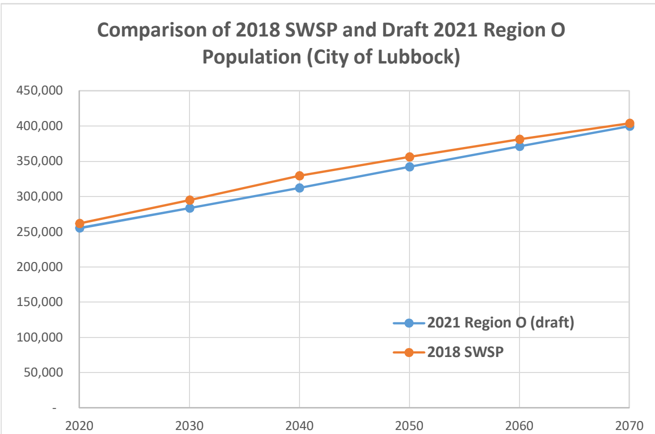
Peter Newell, PE
D 512.498.4703 M 602.621.0657

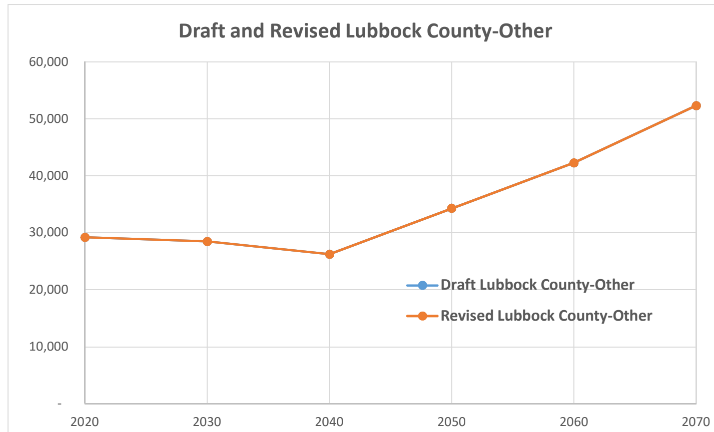
hdrinc.com/follow-us

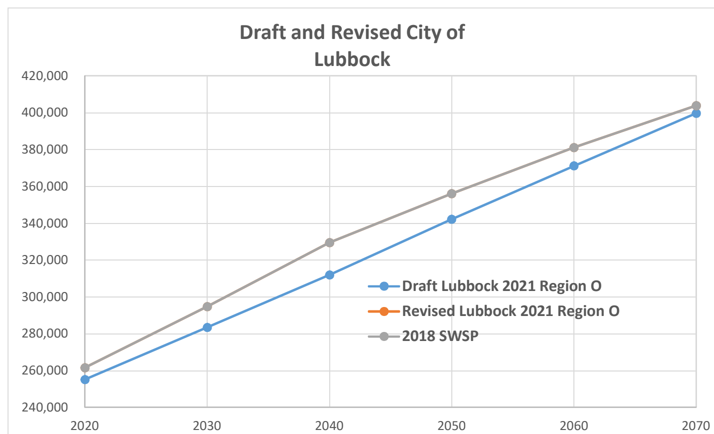
Notes:
1. Draw from County-Other the full amount of the difference between 2018 SWSP and Draft 2021 Region O in 2020, 2050, 2060 and 207
2. Draw just a portion of the difference from C-O in 2030 & 2040 such that C-O doesn't decrease after 2020, and has smooth growth pattern

	2020	2030	2040	2050	2060	2070
2016 Region O	255,257	283,597	312,043	342,371	371,227	399,846
2021 Region O (draft)	255,257	283,597	312,043	342,371	371,227	399,846
2018 SWSP	261,706	294,862	329,597	356,227	381,205	403,901
Difference	6,449	11,265	17,554	13,856	9,978	4,055
Difference (%)	2.46%	3.82%	5.33%	3.89%	2.62%	1.00%

	2020	2030	2040	2050	2060	2070	
Draft Lubbock 2021 Region O	255,257	283,597	312,043	342,371	371,227	399,846	
Adjustment (from C-O)	*6,449*	*11,265*	*17,554*	*13,856*	*9,978*	*4,055*	
Revised Lubbock 2021 Region O	261,706	294,862	329,597	356,227	381,205	403,901	Based on 2017 Planning Dept numbers
Draft Lubbock County-Other	29,236	28,473	26,252	34,285	42,291	52,310	
Adjustment (to Lubbock)	*(6,449)*	*(11,265)*	*(17,554)*	*(13,856)*	*(9,978)*	*(4,055)*	
Revised Lubbock County-Other	29,236	28,473	26,252	34,285	42,291	52,310	







Attachment E

Lemonds, Paula Jo

From: Kelly Davila <Kdavila@spag.org>
Sent: Friday, October 20, 2017 7:57 AM
To: Lemonds, Paula Jo
Cc: Aubrey Spear PE (ASpear@mail.ci.lubbock.tx.us)
Subject: FW: Projected Numbers

Paula Jo/Aubrey,
I received these this morning from Brownfield.

Thanks!
Kelly

From: WillieHerrera [mailto:wsherrera@windstream.net]
Sent: Friday, October 20, 2017 2:13 AM
To: Kelly Davila <Kdavila@spag.org>
Cc: Eldon <ejobe@valornet.com>; Mitch <mdmcelroy@windstream.net>; Dave <david.herrera@ci.brownfield.tx.us>
Subject: Projected Numbers

Kelly, these are the numbers we project.

2020 10,000 Population, 1600 acre feet/year, GPCD 143
2030 10,700 Population, 1680 acre feet/year, GPCD 140
2040 11,300 Population, 1751 acre feet/year, GPCD 138
2050 12,250 Population, 1865 acre feet/year, GPCD 136
2060 12,800 Population, 1921 acre feet/year, GPCD 134
2070 13,300 Population 1979 acre feet/year, GPCD 133

Thanks
Willie Herrera Jr.
City of Brownfield
Public Works Director
201 W. Broadway
Brownfield, Texas 79316
Office: (806)-637-4547 ext. 262
Fax (806)-637-1952
Email: wsherrera@windstream.net

Attachment F

Lemonds, Paula Jo

To: Shane McMinn
Subject: RE: Region O - Yoakum County Steam-Electric Demands

AMServiceURLStr: https://slingshot.hdrinc.com:443/CFSS/control?view=services/FTService

Paula Jo Lemonds, PG, PE
D 512.912.5127 F 512.912.5158

ONEHDRED
1917-2017

hdrinc.com/follow-us

From: Shane McMinn [mailto:shane@gsec.coop]
Sent: Tuesday, October 31, 2017 10:29 AM
To: Reed, Grady <Grady.Reed@hdrinc.com>; Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
Subject: RE: Region O - Yoakum County Steam-Electric Demands

This is the only fossil generating station in Hale County. There are wind farms being constructed in the area. I would use the 10,000,000 gallons for the projection. We currently do not foresee expansion at this site.

From: Reed, Grady [mailto:Grady.Reed@hdrinc.com]
Sent: Tuesday, October 31, 2017 9:40 AM
To: Shane McMinn <shane@gsec.coop>; Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
Subject: RE: Region O - Yoakum County Steam-Electric Demands

Shane,

Abernathy has not been reporting the sales. Is this the only electric generating station in Hale County? If so, we could just try to revise the demand to a number that you all feel is a good number to use. 10,000,000 gallons a year is about 31 acft/yr. Are you anticipating in growth in water demands during the planning period (out to 2070)?

Grady Reed
D 512-214-6154 M 512-563-6208

From: Shane McMinn [mailto:shane@gsec.coop]
Sent: Tuesday, October 31, 2017 8:43 AM
To: Lemonds, Paula Jo
Cc: Reed, Grady
Subject: RE: Region O - Yoakum County Steam-Electric Demands

Yes, the city is the main water supply for our generating units. We do have one well on-site used for potable water that has minimal usage.

I think it we be good for HDR to check with the city of Abernathy to see if their usage/estimates include the Golden Spread Antelope/Elk facility in order to avoid duplication.

From: Lemonds, Paula Jo [mailto:Paula.Lemonds@hdrinc.com]
Sent: Tuesday, October 31, 2017 8:16 AM
To: Shane McMinn <shane@gsec.coop>
Cc: Reed, Grady <Grady.Reed@hdrinc.com>
Subject: RE: Region O - Yoakum County Steam-Electric Demands

Thanks, Shane, for this information. So, the City of Abernathy supplies the station all of its water? If so, yes, we do need to check this.

Paula Jo Lemonds, PG, PE
D 512.912.5127 **F** 512.912.5158

ONEHDRED
1917-2017

hdrinc.com/follow-us

From: Shane McMinn [mailto:shane@gsec.coop]
Sent: Tuesday, October 31, 2017 7:48 AM
To: Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
Cc: Reed, Grady <Grady.Reed@hdrinc.com>
Subject: RE: Region O - Yoakum County Steam-Electric Demands

It is in gallons. I did some more checking with our experts, and the projection should actually be a little higher around 10,000,000 gallons/yr, but nowhere near 1800 acft/yr. We have 3 simple cycle units in Hale County and 18 closed loop combustion engines, but no steam generation. Our main water source is the city of Abernathy, so we need to ensure that the electric generation is not double counted with city usage.

From: Lemonds, Paula Jo [mailto:Paula.Lemonds@hdrinc.com]
Sent: Monday, October 30, 2017 3:47 PM
To: Shane McMinn <shane@gsec.coop>
Cc: Reed, Grady <Grady.Reed@hdrinc.com>
Subject: Fwd: Region O - Yoakum County Steam-Electric Demands

Shane, can you confirm units, please?

Begin forwarded message:

> **From:** "Reed, Grady" <Grady.Reed@hdrinc.com>
> **Date:** October 30, 2017 at 3:05:59 PM CDT
> **To:** "Lemonds, Paula Jo" <Paula.Lemonds@hdrinc.com>
> **Subject: RE: Region O - Yoakum County Steam-Electric Demands**
>
> Are we sure this is in gallons? The 2015 usage would be 1 acft if that total is for the year. The current projection for Hale County is 1,799 acft/yr.
>
> **Grady Reed**
> **D** 512-214-6154 **M** 512-563-6208

From: Lemonds, Paula Jo
Sent: Monday, October 30, 2017 12:03 PM
To: Reed, Grady
Subject: FW: Region O - Yoakum County Steam-Electric Demands

Hi Grady,
Can you compare these numbers below with S-E values for Hale County, please? And, if we need to update them, can you make tables similar to the Yoakum County revision request, please?

Paula Jo Lemonds, PG, PE
D 512.912.5127 **F** 512.912.5158

hdrinc.com/follow-us

From: Shane McMinn [mailto:shane@gsec.coop]
Sent: Monday, October 30, 2017 11:59 AM
To: Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>; Aubrey Spear (ASpear@mail.ci.lubbock.tx.us) <ASpear@mail.ci.lubbock.tx.us>; dhutcheson@wolfforthtx.us; mkirkpa410@aol.com; Rainwater, Ken <ken.rainwater@ttu.edu>; Jason Coleman <jason.coleman@hpwd.org>
Subject: RE: Region O - Yoakum County Steam-Electric Demands

Paula Jo,

Here is the data from Golden Spread's Antelope Elk Energy Center north of Abernathy in Hale County.

Year	Gallons
2016	1,715,856
2015	365,021
2014	286,021
2013	168,344

We had a large amount of construction going on in 2016 along with filling a large tank, and expect usage going forward to be closer to 2015 levels.

Shane McMinn, PE
Manager of Engineering Services
Office: 806-337-1297

From: Lemonds, Paula Jo [mailto:Paula.Lemonds@hdrinc.com]
Sent: Thursday, October 05, 2017 10:10 AM
To: Shane McMinn <shane@gsec.coop>; Aubrey Spear (ASpear@mail.ci.lubbock.tx.us) <ASpear@mail.ci.lubbock.tx.us>; dhutcheson@wolfforthtx.us; mkirkpa410@aol.com; Rainwater, Ken <ken.rainwater@ttu.edu>; Jason Coleman <jason.coleman@hpwd.org>
Cc: Amber Blount <amber@sandylandwater.com>
Subject: RE: Region O - Yoakum County Steam-Electric Demands

Thank you for the explanation, Shane.

Paula Jo Lemonds, PG, PE
D 512.912.5127 **F** 512.912.5158

hdrinc.com/follow-us

From: Shane McMinn [mailto:shane@gsec.coop]
Sent: Thursday, October 5, 2017 10:09 AM
To: Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>; Aubrey Spear (ASpear@mail.ci.lubbock.tx.us) <ASpear@mail.ci.lubbock.tx.us>; dhutcheson@wolfforthtx.us; mkirkpa410@aol.com; Rainwater, Ken <ken.rainwater@ttu.edu>; Jason Coleman <jason.coleman@hpwd.org>
Cc: Amber Blount <amber@sandylandwater.com>
Subject: RE: Region O - Yoakum County Steam-Electric Demands

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Cc: Amber Blount <amber@sandylandwater.com>
Subject: RE: Region O - Yoakum County Steam-Electric Demands

Shane,
Thank you for sending these. Upon first review of these, I have a question: What happened in 2015 to make usage so much less than other years?

Paula Jo Lemonds, PG, PE
D 512.912.5127 **F** 512.912.5158

hdrinc.com/follow-us

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Paula Jo,

Here is the historical usage for the Golden Spread Mustang electric generating plant in Yoakum County. I hope to have the numbers for our Antelope/Elk facility in Hale County next week.

Mustang Service Water Totals (gallons):

2016	424,142,881
2015	13,196,761
2014	527,183,864
2013	553,336,390
2012	780,226,071
2011	767,344,198
2010	682,702,144

Shane McMinn, PE
Manager of Engineering Services
Office: 806-337-1297
Golden Spread Electric Cooperative, Inc.
A Touchstone Energy® Cooperative

From: Lemonds, Paula Jo [mailto:Paula.Lemonds@hdrinc.com]
Sent: Tuesday, August 29, 2017 12:11 PM
To: Aubrey Spear (ASpear@mail.ci.lubbock.tx.us) <ASpear@mail.ci.lubbock.tx.us>; Shane McMinn <shane@gsec.coop>; dhutcheson@wolfforthtx.us; mkirkpa410@aol.com; Rainwater, Ken <ken.rainwater@ttu.edu>; Jason Coleman <jason.coleman@hpwd.org>
Cc: Amber Blount <amber@sandylandwater.com>
Subject: RE: Region O - Yoakum County Steam-Electric Demands

All,
I spoke with Bill Billingsley at the TWDB this morning. Below is information he shared via email for Mustang Station in Yoakum County. Shane, any further estimates of water use that Golden Spread could provide would help with a revision request for the steam-electric demand projection for Yoakum County. Thank you.

From: Bill Billingsley [mailto:Bill.Billingsley@twdb.texas.gov]
Sent: Tuesday, August 29, 2017 11:21 AM
To: Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
Cc: Yun Cho <Yun.Cho@twdb.texas.gov>; Taylor Christian <Taylor.Christian@twdb.texas.gov>
Subject: RE: Steam-Electric Question

Paula,

Good to hear from you.

Yes, we did begin to survey this plant this year for 2016 water use data. They are survey number **1104191 GOLDEN SPREAD ELECTRIC COOPERATIVE INC-MUSTANG STATION.**

They show to have pumped 424,142,881 gallons (1301 ac-ft) from the Ogallala in Yoakum County for 2016. Unfortunately, that is the only year that we have any water use data for.

Please let me know if you have any specific questions about the 2016 data.

Bill

From: Lemonds, Paula Jo [mailto:Paula.Lemonds@hdrinc.com]
Sent: Tuesday, August 29, 2017 11:16 AM

To: Bill Billingsley
Subject: Steam-Electric Question

Bill,
Thank you for the conversation. If you can find water use data for Mustang Station in Yoakum County that would be very helpful. Thanks!
https://www.gsec.coop/Public/Plants/Mustang.aspx

Paula Jo Lemonds, PG, PE
D 512.912.5127 **F** 512.912.5158

ONEHDRED
1917-2017

hdrinc.com/follow-us

From: Lemonds, Paula Jo
Sent: Wednesday, August 23, 2017 10:36 AM
To: Aubrey Spear (ASpear@mail.ci.lubbock.tx.us) <ASpear@mail.ci.lubbock.tx.us>; 'smcminn@gsec.coop' <smcminn@gsec.coop>; 'dhutcheson@wolfforthtx.us' <dhutcheson@wolfforthtx.us>; 'mkirkpa410@aol.com' <mkirkpa410@aol.com>; Rainwater, Ken <ken.rainwater@ttu.edu>; 'Jason Coleman' <jason.coleman@hpwd.org>
Cc: 'Amber Blount' <amber@sandylandwater.com>
Subject: RE: Region O - Yoakum County Steam-Electric Demands

All,

I received a call from Amber Blount with Sandyland UWCD this morning after sending her the presentations from yesterday. She attended the Region O meeting yesterday but had to leave at lunch time. She said that regarding the zero Yoakum County Steam-Electric Demands, she spoke with the TWDB earlier this year. They assured her that they had received the water use data from Mustang Station in March. However, if you all recall, the draft steam-electric projections for Yoakum County do not reflect any water use.

I will contact TWDB and ask if they still do have / can find water use data for Mustang Station, which we can use for a revision request.

Thank you for the follow up, Amber.

Paula Jo Lemonds, PG, PE
D 512.912.5127 **F** 512.912.5158

ONEHDRED
1917-2017

hdrinc.com/follow-us

From: Amber Blount [mailto:amber@sandylandwater.com]
Sent: Wednesday, August 23, 2017 9:58 AM
To: Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
Subject: RE: Region O - PDF - Muni and Non-Muni Demands

Paula Jo

Thank you so much for getting these to me. I hated that I had to leave before your presentation.

I will for sure let you know if I have any comments or questions!

Amber Blount
District Manager
Sandy Land UWCD
PO Box 130
1012 Ave F
Plains, TX 79355
806-456-2155

From: Lemonds, Paula Jo [mailto:Paula.Lemonds@hdrinc.com]
Sent: Wednesday, August 23, 2017 9:38 AM
To: amber@sandylandwater.com
Subject: Region O - PDF - Muni and Non-Muni Demands

Amber,
Thank you for attending the Region O meeting yesterday. Please find attached the Municipal and Non-Municipal Demand Projection presentations from yesterday's meeting. The Planning Group discussed splitting into smaller groups to address specific demands (i.e., mining, manufacturing, irrigation). If you have feedback, we would like to hear it. I believe Jason Coleman was heading up an agricultural interest group. And certainly, please let me know, as well.

Paula Jo Lemonds, PG, PE
Water Resources Engineer | Associate

ONEHDRED
1917-2017

HDR
4401 West Gate Blvd., Suite 400
Austin, TX 78745
D 512.912.5127 | **F** 512.912.5158
paula.lemonds@hdrinc.com

hdrinc.com/follow-us

Attachment F

Lemonds, Paula Jo

From:	Bill Billingsley <Bill.Billingsley@twdb.texas.gov>
Sent:	Tuesday, October 31, 2017 9:23 AM
To:	Temple McKinnon; Reed, Grady
Cc:	Lemonds, Paula Jo
Subject:	RE: Abernathy Question
Attachments:	2016_0006600_Historical_FinalWaterUseSurvey.pdf

David,

Please find attached the 2016 water use survey that the City of Abernathy submitted. I looked back to 2010 and they did not report any sales. The City can amend their surveys. They would just need to make corrections on the survey itself and send back to us. They can get copies of past surveys by following the instructions below.

Water Use Survey: 0006600 CITY OF ABERNATHY

- For copies of past surveys, click on Historical Water Use Surveys and select today's date from the calendar icon
- Enter the desired survey year from the dropdown menu.
- Enter SurveyNo. **0006600** (This number must total 7 digits so add the correct number of preceding zeros "000" if needed to make 7 digits.)
- After these three parameters are entered, click on 'View Report' on the top right of the screen to run the report.
- The survey can then be printed or exported and saved as a PDF.

Let me know if you have any question.

Thanks,
Bill Billingsley

Texas Water Development Board

Bill Billingsley

Manager, Water Use Survey

Texas Water Development Board
P.O. Box 13231
Austin, Texas 78711-3231

Phone: 512.936.0885
Fax: 512.436.8468
www.twdb.texas.gov

From: Temple McKinnon
Sent: Tuesday, October 31, 2017 9:14 AM
To: Reed, Grady; Bill Billingsley

Cc: Lemonds, Paula Jo
Subject: RE: Abernathy Question

Sure if we have it.
Bill, can y'all please assist?
Thx
t

From: Reed, Grady [mailto:Grady.Reed@hdrinc.com]
Sent: Tuesday, October 31, 2017 9:12 AM
To: Temple McKinnon <Temple.McKinnon@twdb.texas.gov>
Cc: Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
Subject: Abernathy Question

Temple,

Is it possible for us to get the detailed water use response for the City of Abernathy? I could not find it available online. The City of Abernathy provides water to a local electric power plant and we want to make sure that the water sold to the power plant has been excluded from the City's demands.

Thanks,
Grady

Grady Reed
Project Manager

Please note new contact information below.

HDR
1290 Wonder World Drive, Suite 1230
San Marcos, TX 78666
D 512-214-6154 **M** 512-563-6208
Grady.Reed@hdrinc.com

Date/Time Survey Submitted: 1/9/2017 3:35:01 PM

Attachment F

TEXAS WATER DEVELOPMENT BOARD
WATER USE SURVEY

WATER USE IN CALENDAR YEAR: 2016

SYSTEM NAME:	CITY OF ABERNATHY			**SURVEY NUMBER:**	0006600
OPERATOR NAME:				**PRIMARY USED COUNTY:**	HALE
MULTIPLE SURVEY ORG:				**PRIMARY USED RIVER BASIN:**	BRAZOS
MAILING ADDRESS 1:	PO BOX 310			**ORGANIZATION MAIN PHONE:**	806-298-2546
MAILING ADDRESS 2:				**MAIN EMAIL:**	
CITY/STATE/ZIP:	ABERNATHY	TX	79311-	**WEB:**	
PWS NAME:	CITY OF ABERNATHY			**PWS CODE:**	950001

INTAKE:

Water Type	County	Basin	Aquifer	Well Name (if applicable)	Metered or Estimated	Brackish / Saline (Y or N)	% Treated Prior to Intake	Total Volume (gallons)
GROUND WATER SELF SUPPLIED	HALE	BRAZOS	OGALLALA AQUIFER		M	N	0.00	127,514,000

JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
7,287,000	7,479,000	9,432,000	9,958,000	12,213,000	14,189,000	17,028,000	14,873,000	9,204,000	10,901,000	7,906,000	7,044,000

SALES:

BUYER	SALE TYPE (MUNICIPAL or INDUSTRIAL)	COUNTY NAME	BASIN NAME	WATER TYPE	AQUIFER NAME (if GW)	SURFACE WATER Name (if SW)	RAW or TREATED	TOTAL VOLUME (GALLONS)
ANTELOPE-ELK STATION	I			GROUND WATER			Treated	0

COUNTY CONNECTIONS:

COUNTY NAME	TOTAL CONNECTIONS
HALE	882
LUBBOCK	294

CONNECTIONS & USAGE:	CONNECTIONS	VOLUME (GALLONS)
TOTAL METERED RETAIL:	1,176	111,668,000
Residential - Single Family	1,062	82,285,000
Residential - Multi Family	5	793,000
Institutional	15	11,840,000
Commercial	93	16,181,000
Industrial	1	569,000
Agriculture	0	0
Reuse	0	0
TOTAL UNMETERED:	0	0

WATER SYSTEM INFORMATION:

Estimated full-time residential population served directly by this system	3,000

Attachment G

Lemonds, Paula Jo

From: Shane McMinn <shane@gsec.coop>
Sent: Thursday, October 5, 2017 10:09 AM
To: Lemonds, Paula Jo; Aubrey Spear (ASpear@mail.ci.lubbock.tx.us); dhutcheson@wolfforthtx.us; mkirkpa410@aol.com; Rainwater, Ken; Jason Coleman
Cc: Amber Blount
Subject: RE: Region O - Yoakum County Steam-Electric Demands

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Paula Jo Lemonds, PG, PE
D 512.912.5127 **F** 512.912.5158

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https://www.gsec.coop/Public/Plants/Mustang.aspx

Paula Jo Lemonds, PG, PE
D 512.912.5127 F 512.912.5158

hdrinc.com/follow-us

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Sent: Wednesday, August 23, 2017 10:36 AM
To: Aubrey Spear (ASpear@mail.ci.lubbock.tx.us) <ASpear@mail.ci.lubbock.tx.us>; 'smcminn@gsec.coop' <smcminn@gsec.coop>; 'dhutcheson@wolfforthtx.us' <dhutcheson@wolfforthtx.us>; 'mkirkpa410@aol.com' <mkirkpa410@aol.com>; Rainwater, Ken <ken.rainwater@ttu.edu>; 'Jason Coleman' <jason.coleman@hpwd.org>
Cc: 'Amber Blount' <amber@sandylandwater.com>
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Paula Jo Lemonds, PG, PE
D 512.912.5127 F 512.912.5158

hdrinc.com/follow-us

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Sent: Wednesday, August 23, 2017 9:58 AM
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Amber Blount
District Manager
Sandy Land UWCD
PO Box 130
1012 Ave F
Plains, TX 79355

806-456-2155

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Paula Jo Lemonds, PG, PE
Water Resources Engineer | Associate

ONEHDRED
1917-2017

HDR
4401 West Gate Blvd., Suite 400
Austin, TX 78745
D 512.912.5127 | **F** 512.912.5158
paula.lemonds@hdrinc.com

hdrinc.com/follow-us

Attachment G

Lemonds, Paula Jo

From:	Yun Cho <Yun.Cho@twdb.texas.gov>
Sent:	Tuesday, December 12, 2017 2:42 PM
To:	Simone Kiel; Lemonds, Paula Jo
Cc:	William Alfaro; Sarah Backhouse; Temple McKinnon
Subject:	Steam Electric Demand

Hi Simone and Paula,

For some reason, our water use survey data had incorrect location information for steam electric power facilities. We apologize that we did not catch these earlier. We found another error that the facility use was reported to Moore county in Region A, which should have been counted in Lamb County in Region O. As a result, the Moore County demand are revised to zero and Lamb County steam electric projection will go up accordingly.

Here are the updated Steam Electric draft projections for Region A & Region O for your reference.

Region A:

		2021 RWP Draft Projections						*2021 RWP Draft Projections-Revisions*					
Region	**County**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
A	HUTCHINSON	4,504	4,504	4,504	4,504	4,504	4,504	-	-	-	-	-	-
A	MOORE	3,942	3,942	3,942	3,942	3,942	3,942	-	-	-	-	-	-
A	POTTER	19,856	19,856	19,856	19,856	19,856	19,856	18,554	18,554	18,554	18,554	18,554	18,554
Region A Total		28,302	28,302	28,302	28,302	28,302	28,302	18,554	18,554	18,554	18,554	18,554	18,554

Region O:

		2021 RWP Draft Projections						*2021 RWP Draft Projections-Revisions*					
Region	**County**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
O	HALE	1,799	1,799	1,799	1,799	1,799	1,799	1,799	1,799	1,799	1,799	1,799	1,799
O	LAMB	13,450	13,450	13,450	13,450	13,450	13,450	16,745	16,745	16,745	16,745	16,745	16,745
O	LUBBOCK	5,694	5,694	5,694	5,694	5,694	5,694	5,694	5,694	5,694	5,694	5,694	5,694

O	YOAKUM	-	-	-	-	-	-	1,302	1,302	1,302	1,302	1,302	1,302
Region O Total		20,943	20,943	20,943	20,943	20,943	20,943	25,540	25,540	25,540	25,540	25,540	25,540

Your justification for change can be 'TWDB water use survey data correction'. Please let me know if you have any questions.
Thanks.

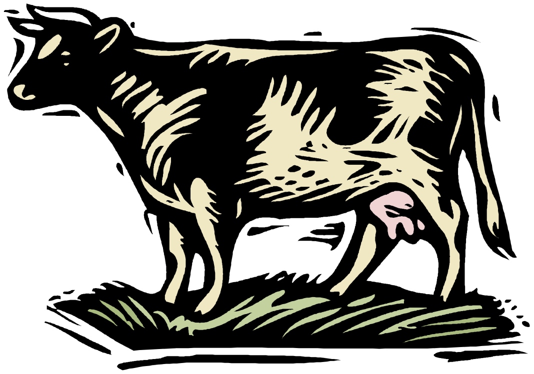
Yun

Yun Cho
Manager, Economic & Demographic Analysis Section
Water Use, Projections & Planning
Texas Water Development Board
P.O. Box 13231, Austin, TX 78711-3231
512-463-3025 | yun.cho@twdb.texas.gov | www.twdb.texas.gov

Region 0 – Llano Estacado Regional Water Planning Group

Livestock Water Demands Analysis

Presented by:
Ben Weinheimer, P.E.
Vice President
Texas Cattle Feeders Association
November 15, 2017



Estimated SB5 Livestock Water Demands



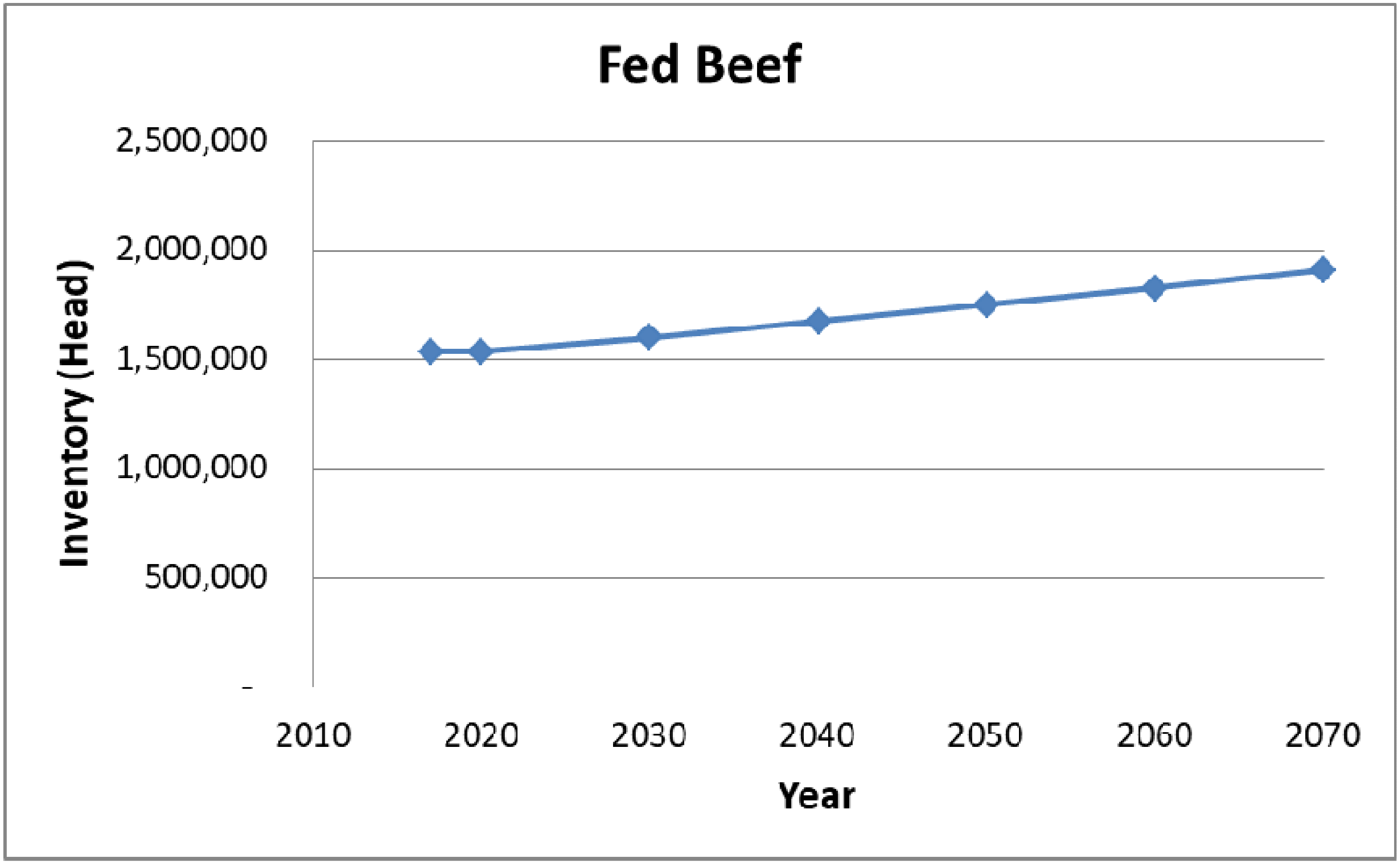
Region O Livestock Water Use Projections Were Made Based on the Results of a Livestock Industry Meeting Held at the Texas Cattle Feeders on August 30th.

Special thanks for in-kind contributions and guidance from: Dr. Steve Amosson and Dr. Ted McCollum, Texas A&M AgriLife Extension Service, Amarillo, TX

SB5 Fed Cattle Inventory and Projections

- **SB5 Inventory:** Ben Weinheimer, TCFA, set the current inventory (2017) by county in consultation with Region O feedlots.
- **Water Use:** 12.5 gal./day
- **Projected Inventories:**
  - **SB5 Projections:** Bailey, Castro, Deaf Smith, Lamb, Parmer and Swisher are expected to have 5% decadal growth, 2020 – 2070.

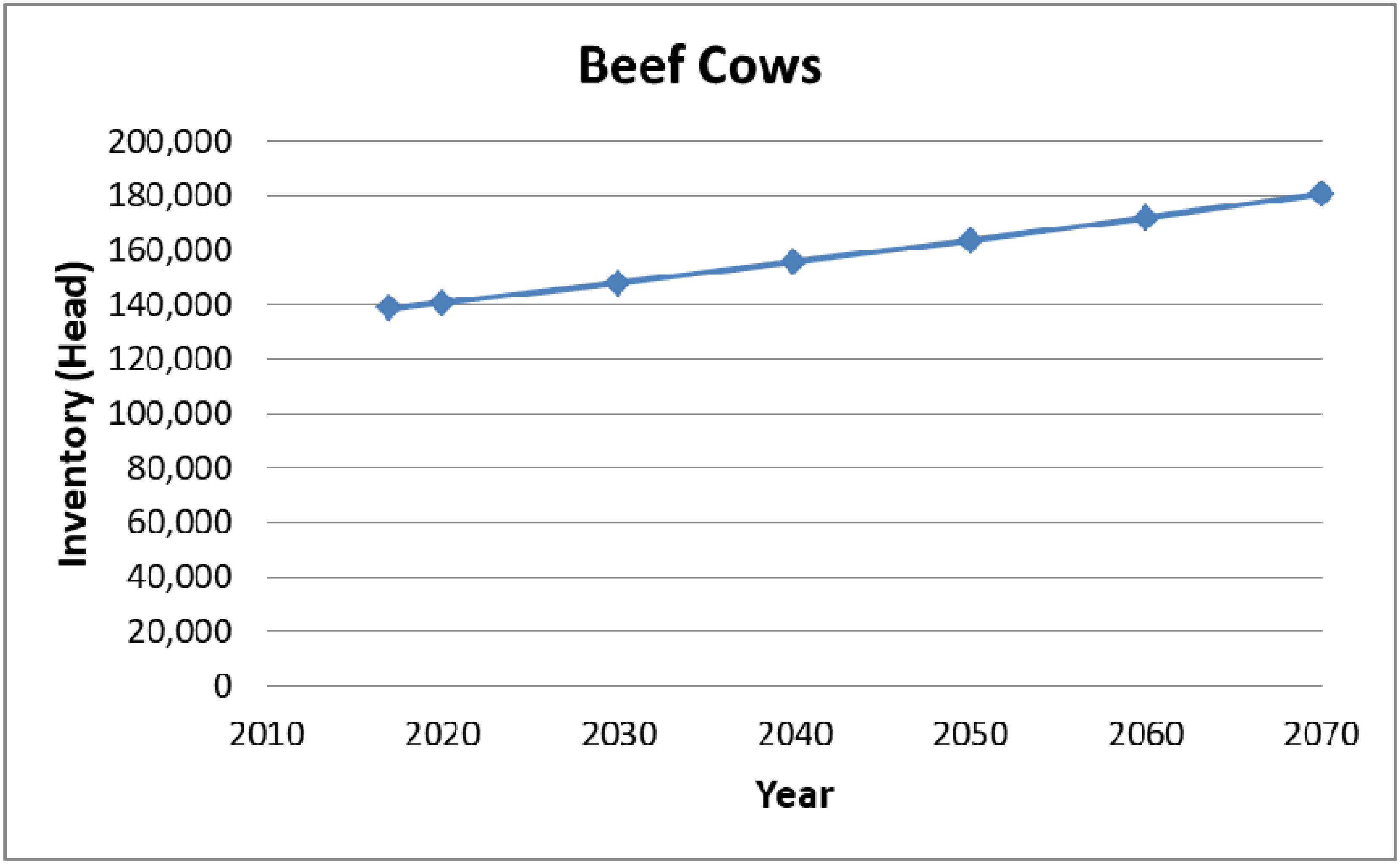
Region O Fed Beef Inventories, 2017-2070



SB5 Beef Cow Inventory and Projections

- **SB5 Inventory:** Inventories were updated by county using TASS 2017 estimates. Missing county inventories were estimated by taking the total cattle inventory, less the fed cattle inventory, then assuming that 50% of the remaining cattle were beef cows.
- **Water Use:** 20.0 gal./day
- **Projected Inventories:**
  - **SB5 Projections:** Beef cow inventories are expected to grow 0.5% annually throughout the planning horizon.

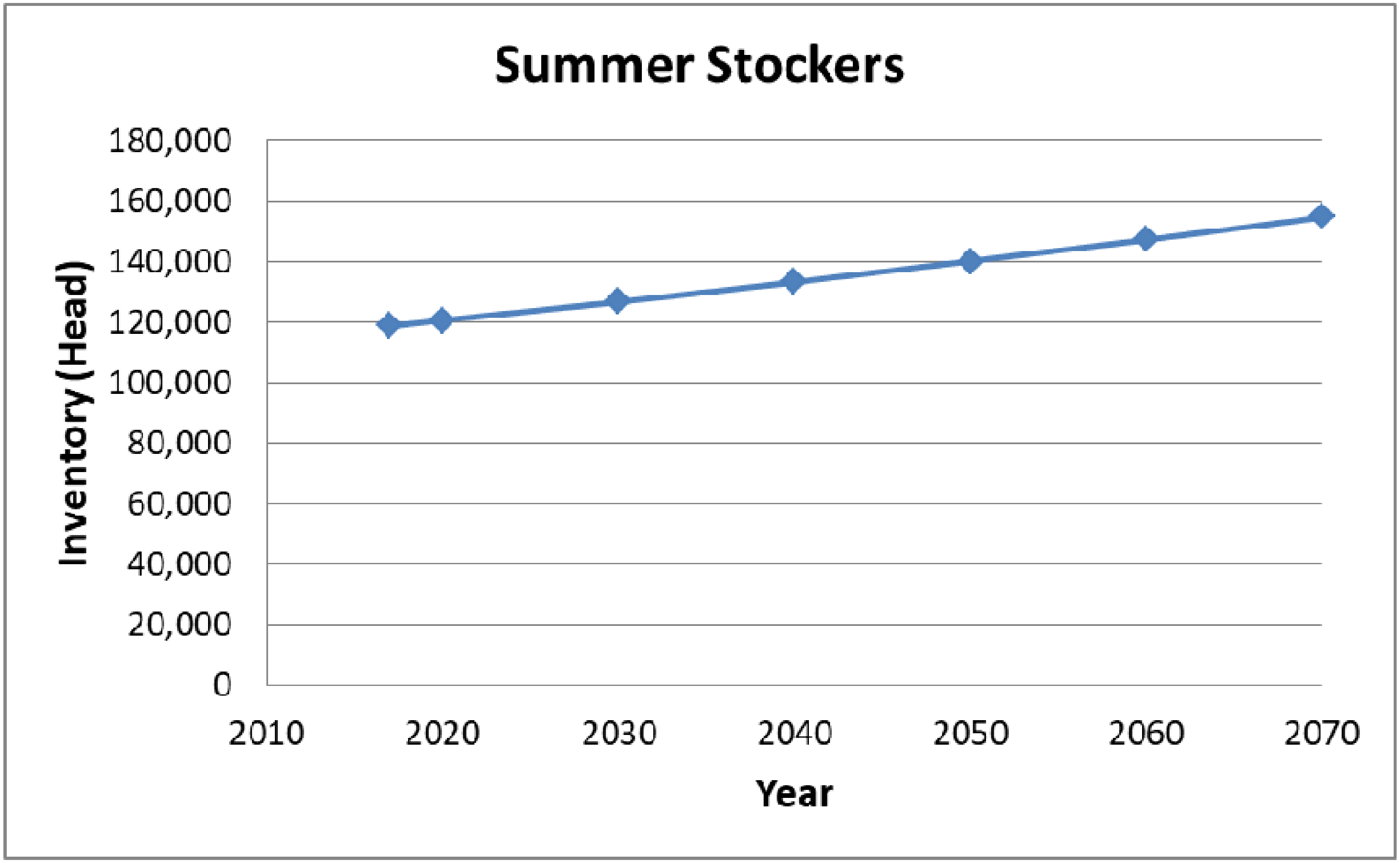
Region O Beef Cow Inventories, 2017-2070



SB5 Summer Stocker Inventory and Projections

- **SB5 Inventory:** Inventories were derived by using the ("Beef Cows@100% stocking rate") minus ("Beef Cows@75% stocking rate") times 2. Note that the baseline Beef Cows 75% stocking rate was sourced from Texas Ag Statistics Service, Sept. 2017. Assumptions based on consultation with Dr. Ted McCollum, Texas A&M AgriLife Beef Cattle Specialist.
- **Water Use:** 10.0 gal./day
- **Projected Inventories:**
  - **SB5 Projections:** Summer Stocker inventories are expected to grow 0.5% annually throughout the planning horizon.

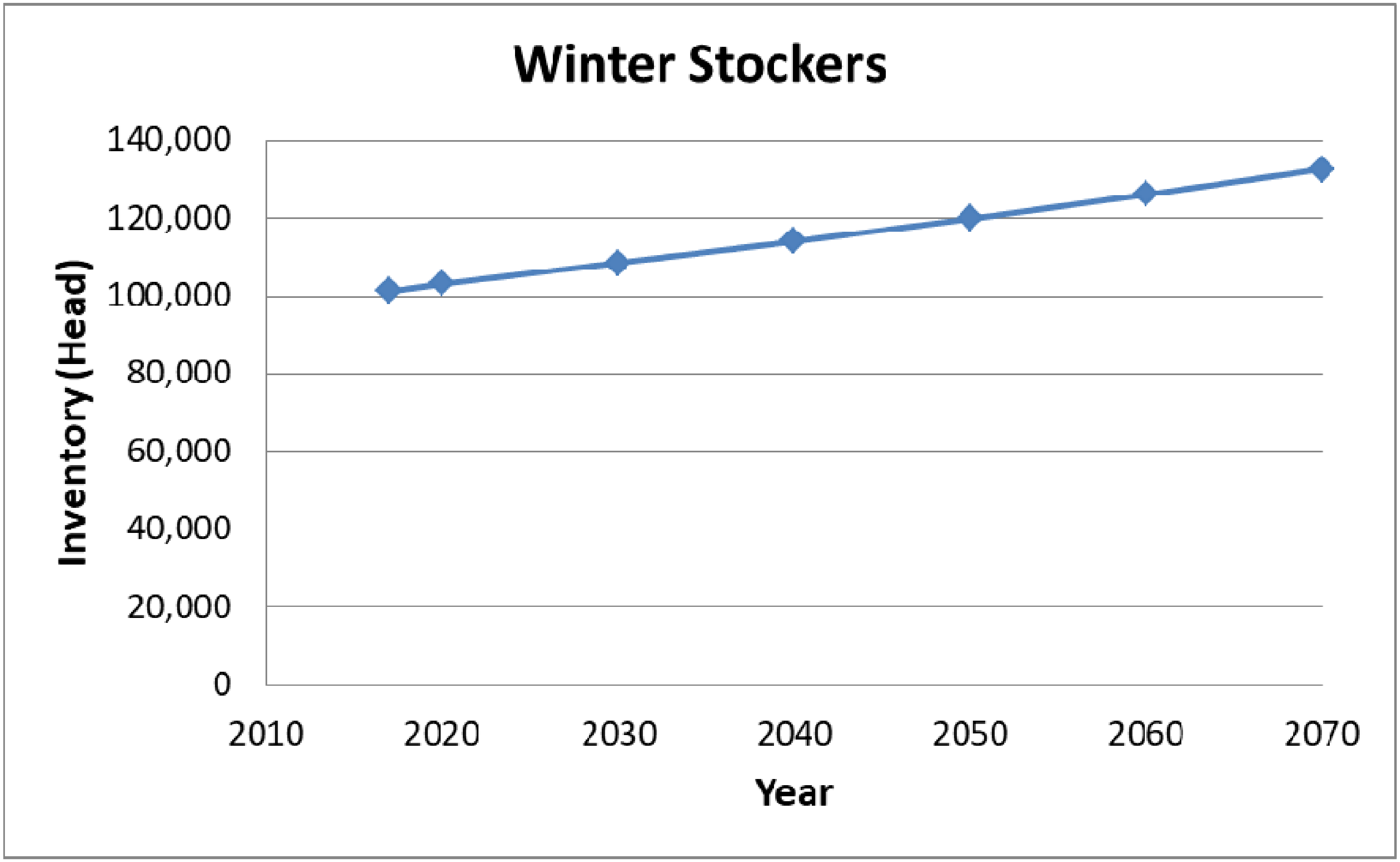
Region O Summer Stocker Inventories, 2017-2070



SB5 Winter Stocker Inventory and Projections

- **SB5 Inventory:** Inventories were derived based on the 2016 FSA irrigated and dryland wheat acres planted by county. Stocking rates were determined via typical stocking rates for wheat pastures.
- **Water Use:** 8.0 gal./day
- **Projected Inventories:**
  - **SB5 Projections:** Winter Stocker inventories are expected to grow 0.5% annually throughout the planning horizon.

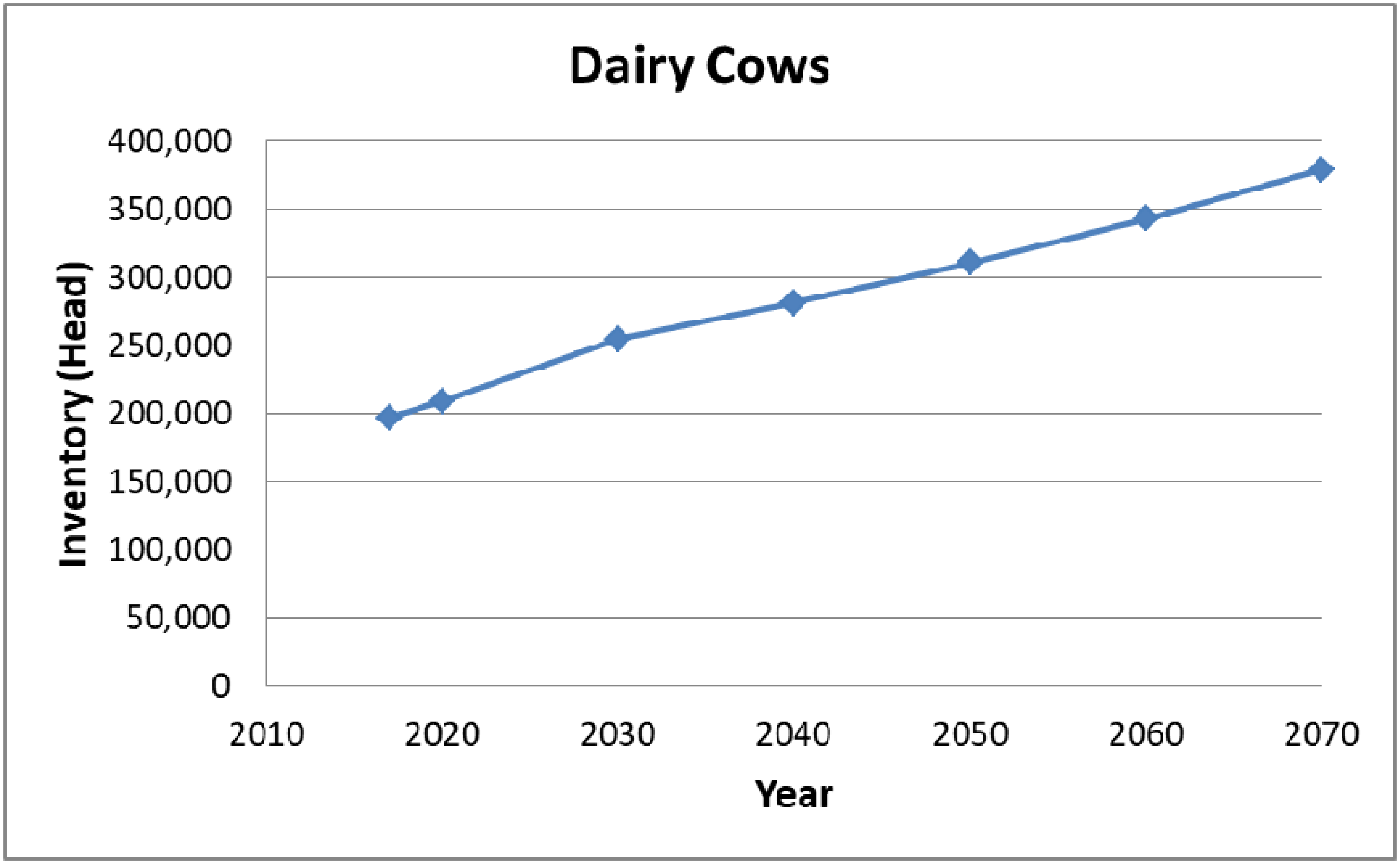
Region O Winter Stocker Inventories, 2017-2070



SB5 Dairy Cow Inventory and Projections

- **SB5 Inventory:** Inventories were derived from Milk Market Administrator records in 2016 for counties with three or more dairies. Counties with fewer dairies, direct contact was made to obtain inventories. All data was developed in consultation with Dr. Ellen Jordan, Texas A&M AgriLife Dairy Cattle Specialist.
- **Water Use:** 65.0 gal./day
- **Projected Inventories:**
  - **SB5 Projections:** Dairy cow inventories are expected to grow 2.0% annually until 2030 and 1.0% annually after 2030 through the remainder of the planning horizon.

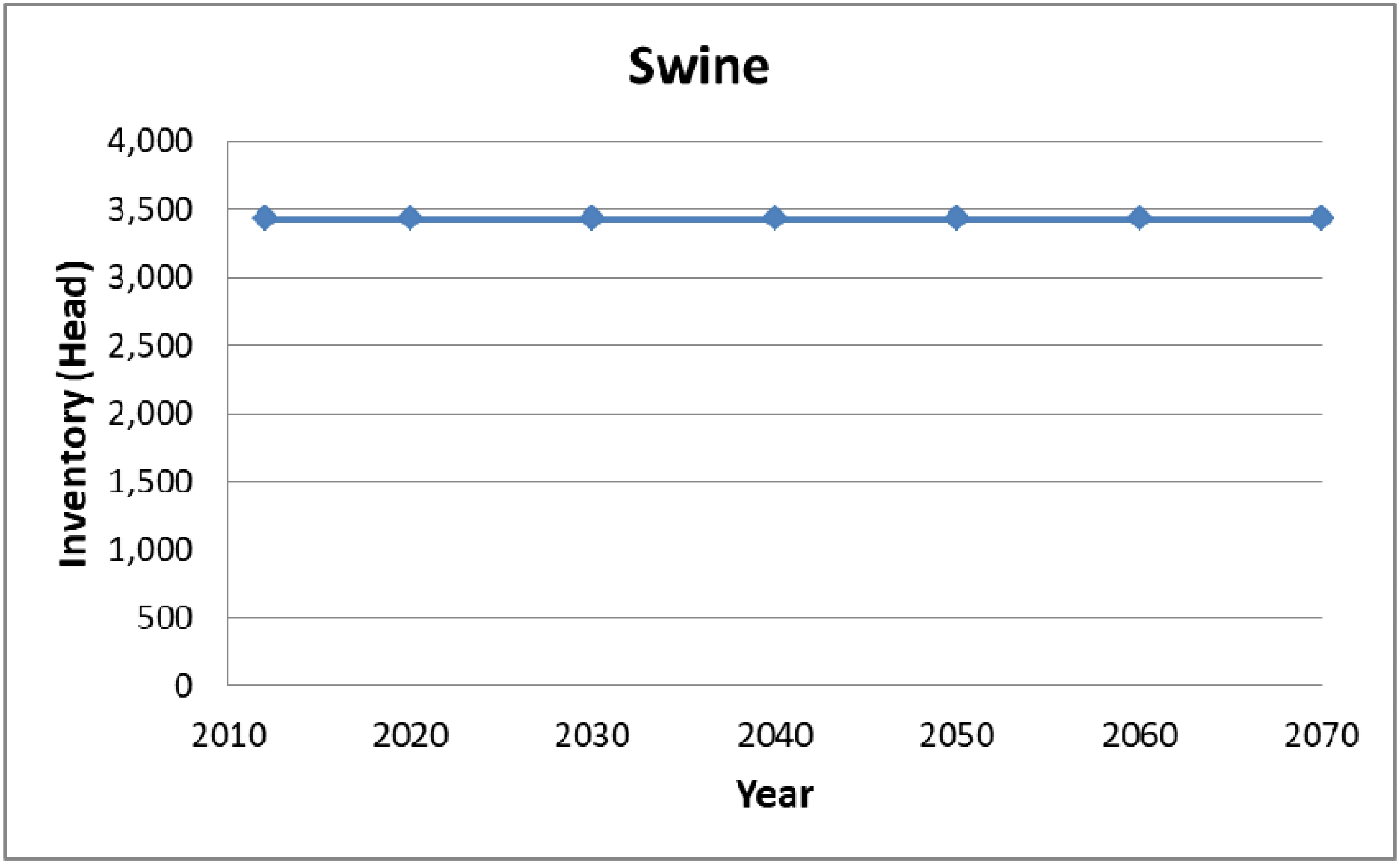
Region O Dairy Cow Inventories, 2017-2070



SB5 Swine Inventory and Projections

- **SB5 Inventory:** 2012 Census of Agriculture Data.
- **Water Use:** 5 gal./day
- **Projected Inventories:**
  - **SB5 Projections:** No further growth is anticipated in the Swine Industry through the planning horizon.

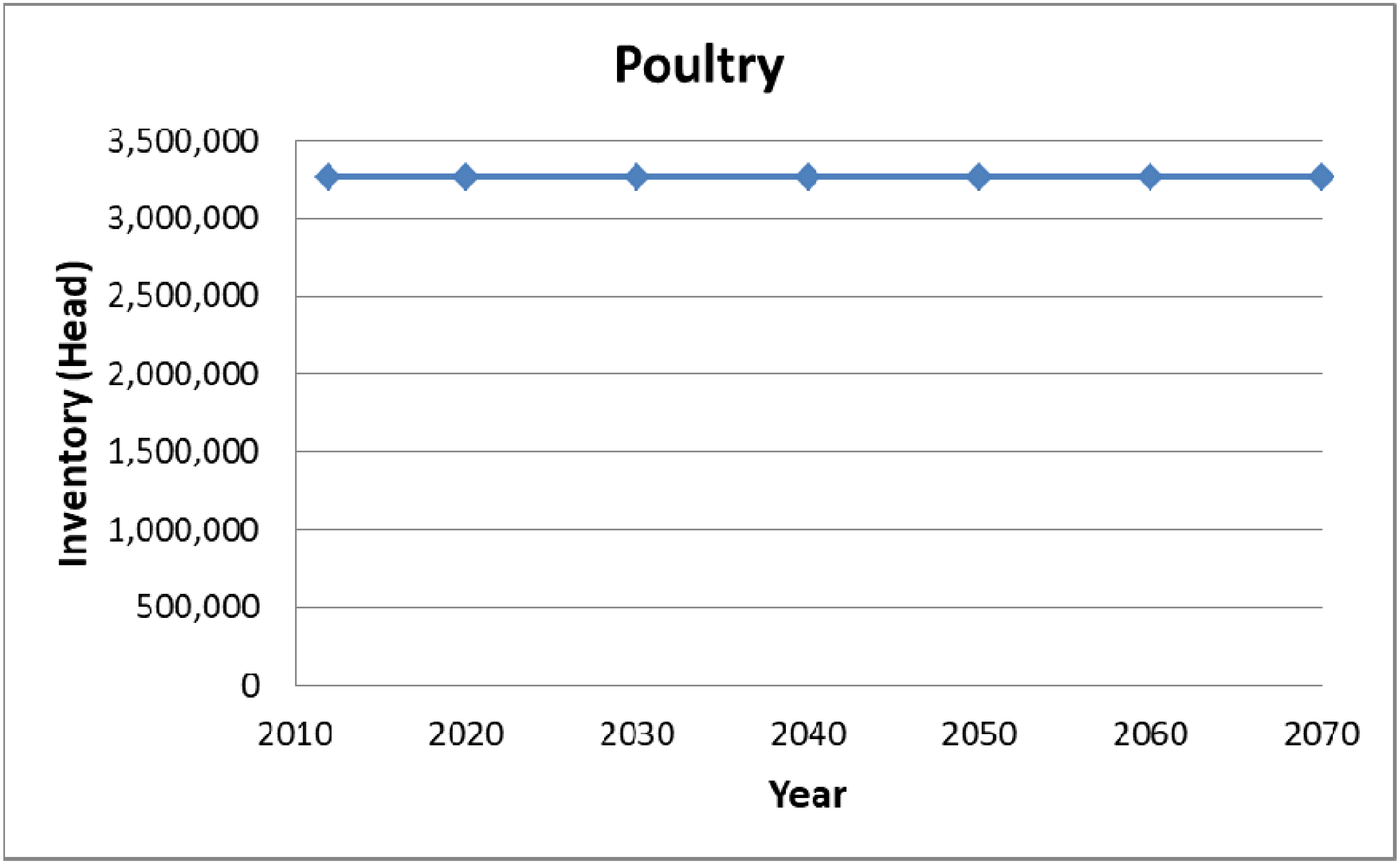
Region O Swine Inventories, 2017-2070



SB5 Poultry Inventory and Projections

- **SB5 Inventory:** Inventories were updated based on the 2012 Census of Agriculture.
- **Water Use:** 0.09 gal./day
- **Projected Inventories:**
  - **SB5 Projections:** No further growth is anticipated in the Swine Industry through the planning horizon.

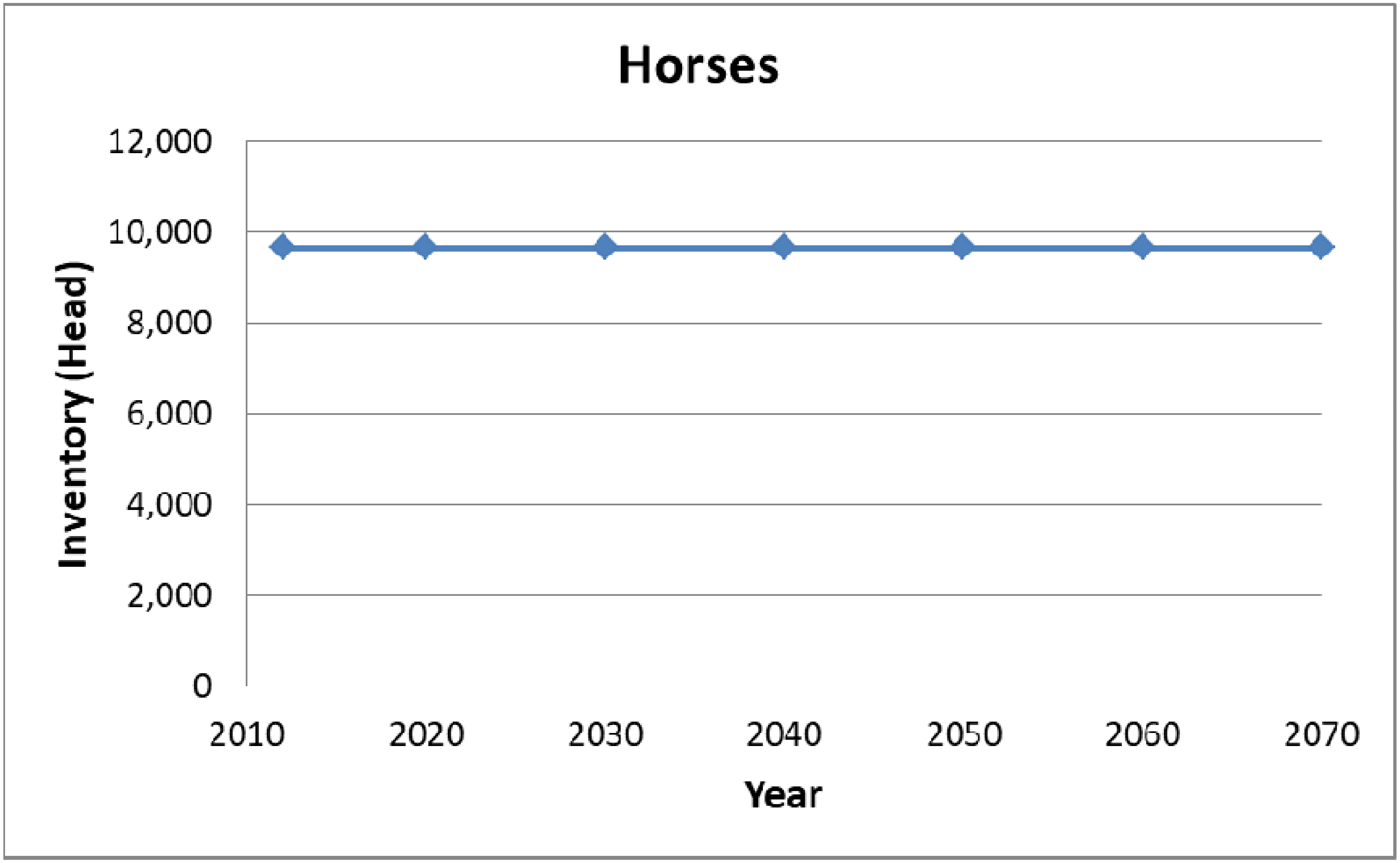
Region O Poultry Inventories, 2017-2070

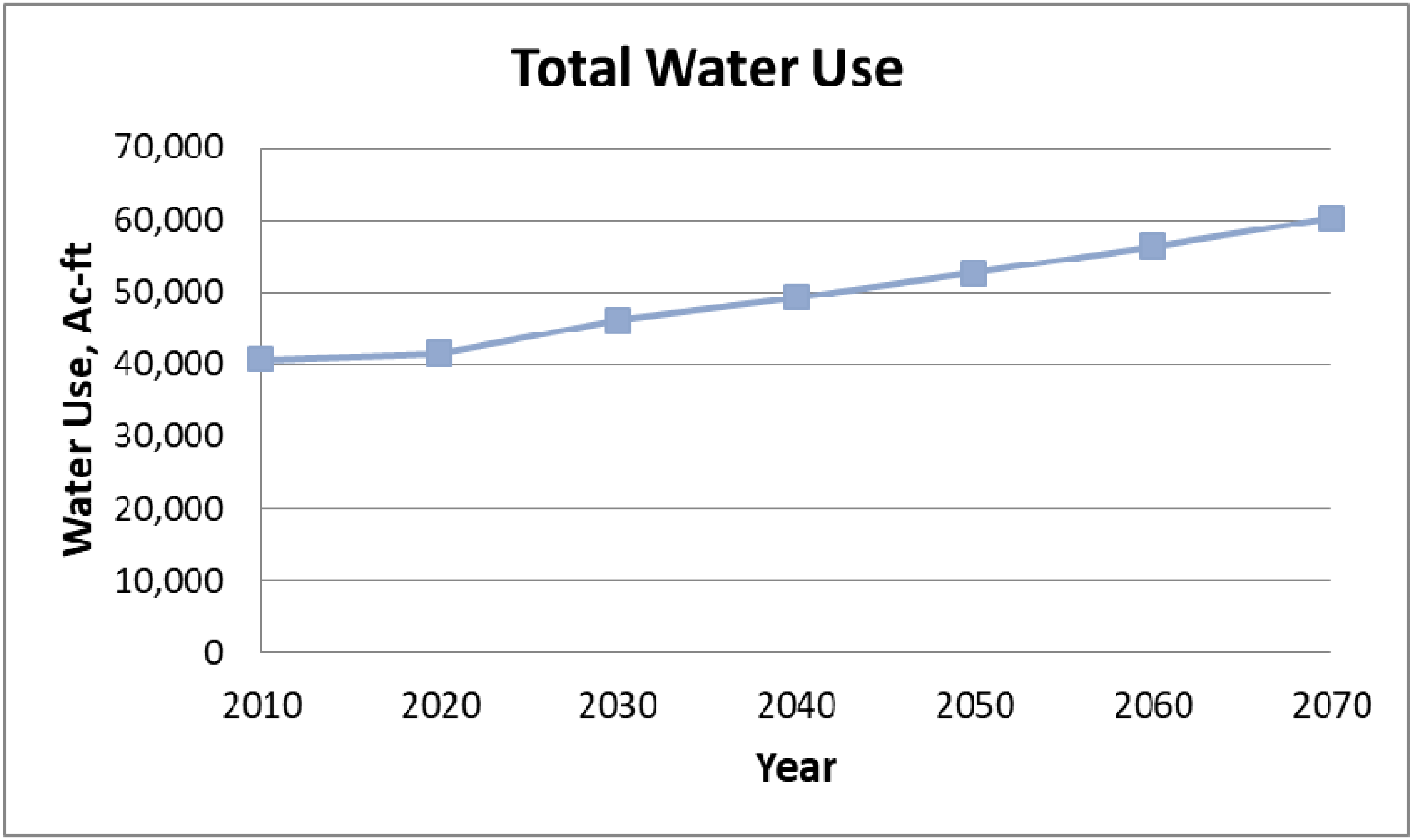


SB5 Equine Inventory and Projections

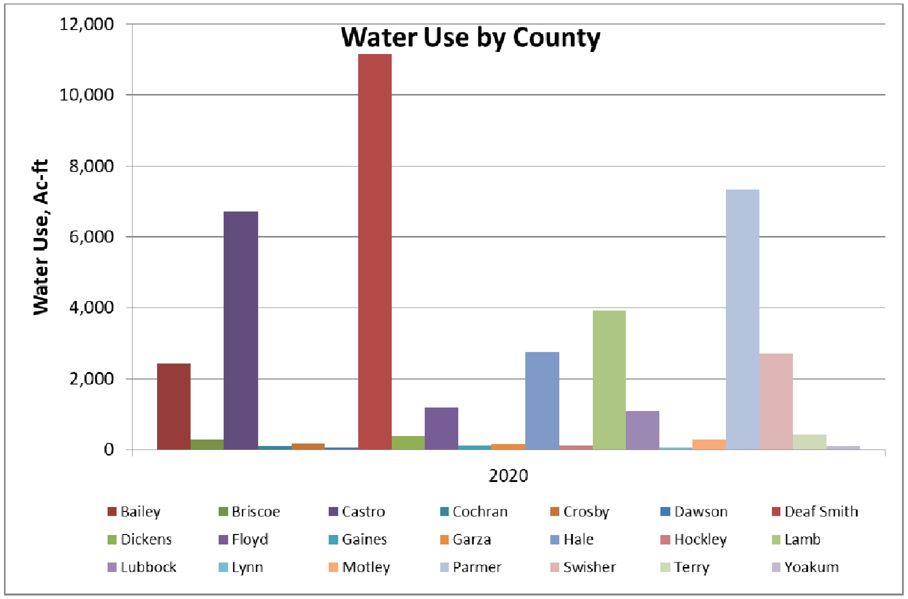
- **SB5 Inventory:** Inventories were updated based on the 2012 Census of Agriculture and include; horses, ponies, mules, donkeys and burrows.
- **Water Use:** 12.0 gal./day
- **Projected Inventories:**
  - **SB5 Projections:** No growth rate is expected.

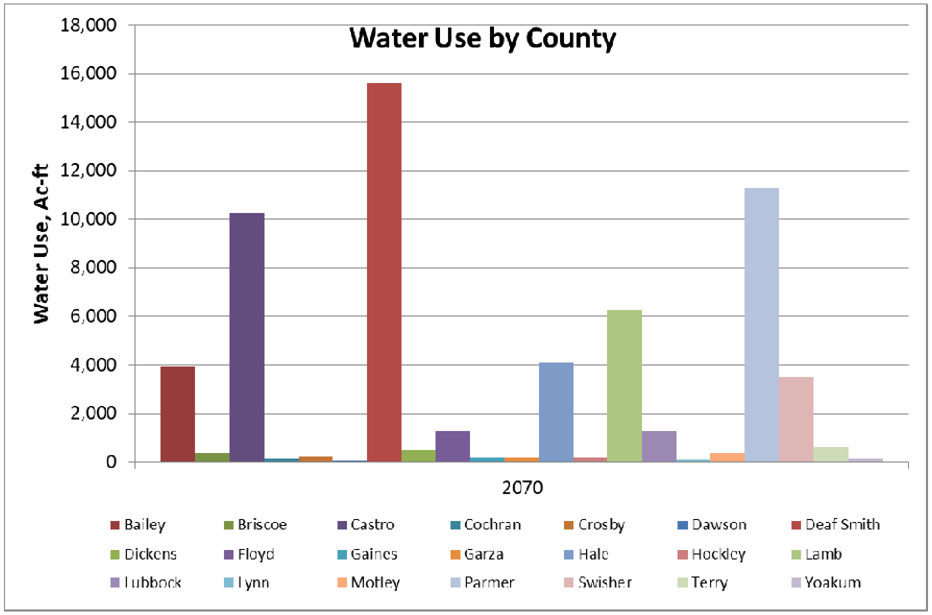
Region O Equine Inventories, 2017-2070




Total Water Use
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Water Use, Ac-ft
2010
2020
2030
2040
2050
2060
2070
Year

Projected Livestock Water Use by County 2020 & 2070



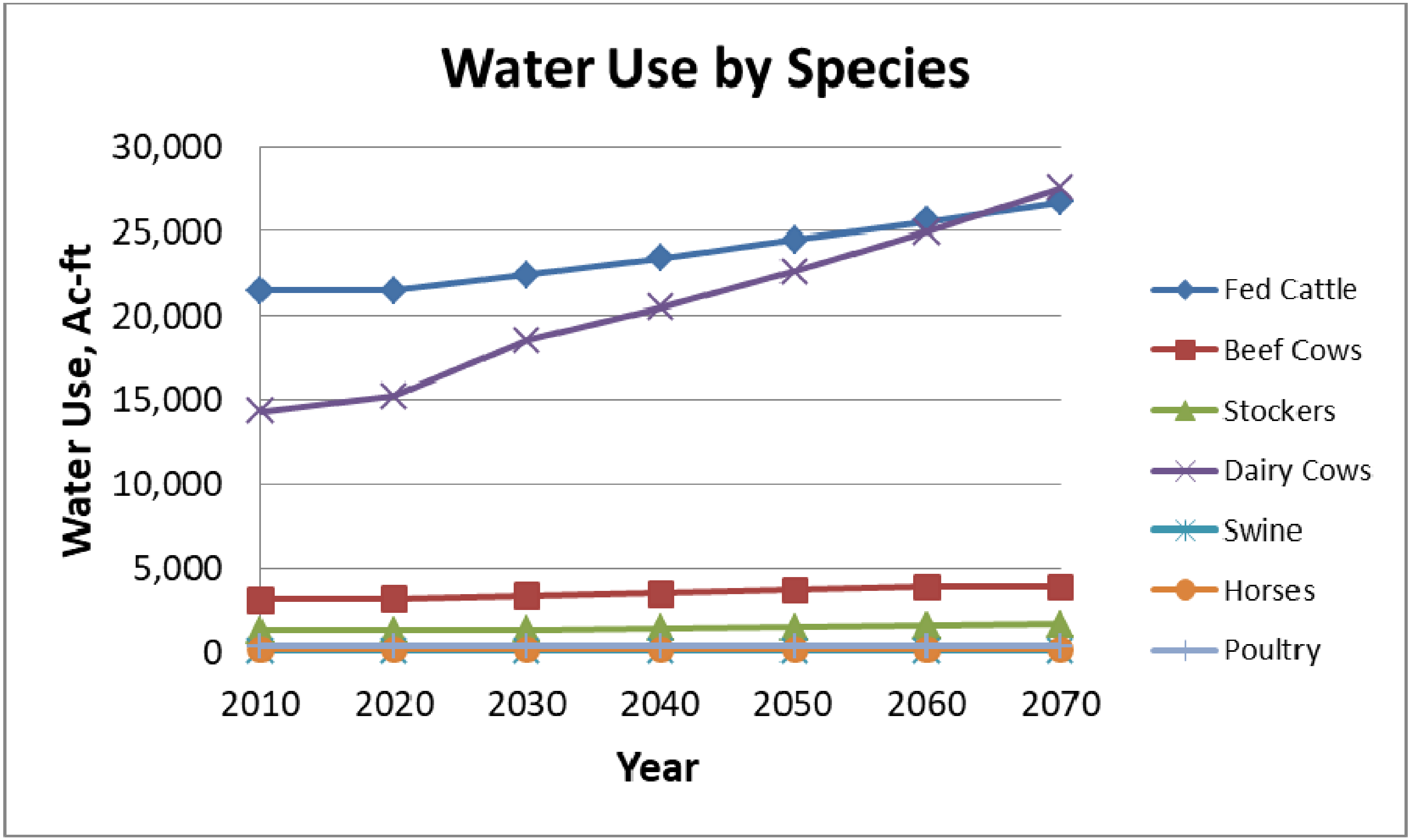


Total Livestock Water Use by County in Region O, 2017 - 2070, Ac-ft							
County	**Baseline**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Bailey	2,333	2,428	2,821	3,070	3,341	3,639	3,958
Briscoe	281	286	300	315	331	347	352
Castro	6,533	6,721	7,589	8,179	8,820	9,517	10,261
Cochran	101	102	106	109	113	117	118
Crosby	168	171	179	188	197	207	209
Dawson	52	53	55	58	61	64	65
Deaf Smith	11,017	11,170	12,157	12,933	13,766	14,661	15,604
Dickens	381	387	406	426	447	470	475
Floyd	1,161	1,168	1,189	1,212	1,237	1,262	1,268
Gaines	122	123	126	129	133	136	137
Garza	146	148	155	162	170	179	181
Hale	2,657	2,752	3,111	3,325	3,561	3,820	4,098
Hockley	132	133	138	144	150	156	157
Lamb	3,804	3,940	4,529	4,910	5,325	5,780	6,271
Lubbock	1,074	1,088	1,138	1,173	1,212	1,253	1,287
Lynn	64	65	68	71	74	78	79
Motley	272	276	290	305	320	336	340
Parmer	7,123	7,339	8,318	8,967	9,674	10,444	11,276
Swisher	2,723	2,728	2,864	3,007	3,157	3,314	3,469
Terry	409	420	461	492	526	562	586
Yoakum	90	91	96	101	106	111	113
Total	**40,643**	**41,589**	**46,096**	**49,276**	**52,721**	**56,453**	**60,304**

County	% Change RWP Requested 2021 Proj. vs 2017 SWP Proj.					
	2020	2030	2040	2050	2060	2070
BAILEY	4	-6	0	8	15	24
BRISCOE	-5	-3	-1	1	3	1
CASTRO	15	7	12	18	24	31
COCHRAN	-81	-81	-81	-82	-82	-83
CROSBY	-35	-33	-31	-30	-28	-29
DAWSON	-62	-61	-60	-60	-59	-59
DEAF SMITH	-11	-15	-13	-10	-8	-5
DICKENS	3	6	9	11	14	13
FLOYD	58	53	49	45	41	35
GAINES	-48	-50	-51	-52	-53	-55
GARZA	-51	-49	-48	-47	-45	-48
HALE	35	17	23	30	38	45
HOCKLEY	-44	-45	-45	-46	-46	-48
LAMB	33	44	53	63	73	83
LUBBOCK	39	28	28	27	27	26
LYNN	-54	-54	-53	-52	-51	-52
MOTLEY	-43	-41	-39	-37	-35	-36
PARMER	30	20	27	34	41	49
SWISHER	15	15	15	15	15	15
TERRY	56	60	59	58	58	48
YOAKUM	-67	-66	-65	-64	-63	-65
Region Total	7	3	7	11	15	19

County	% Change RWP Requested 2021 Proj. vs 2021 TWDB Proj.					
	2020	2030	2040	2050	2060	2070
BAILEY	-21	-29	-24	-19	-13	-7
BRISCOE	0	2	5	7	9	7
CASTRO	-36	-41	-38	-34	-31	-27
COCHRAN	-77	-77	-77	-78	-78	-79
CROSBY	-11	-9	-6	-4	-1	-3
DAWSON	-64	-63	-63	-62	-61	-62
DEAF SMITH	-5	-9	-7	-4	-2	1
DICKENS	27	31	34	37	40	39
FLOYD	-8	-11	-14	-16	-18	-22
GAINES	-35	-37	-38	-40	-41	-43
GARZA	-33	-31	-29	-27	-26	-29
HALE	-23	-33	-29	-25	-21	-16
HOCKLEY	-66	-67	-67	-67	-68	-69
LAMB	-12	-4	2	8	15	22
LUBBOCK	54	42	41	41	41	39
LYNN	-20	-19	-18	-17	-16	-17
MOTLEY	-25	-23	-21	-18	-16	-16
PARMER	-25	-31	-27	-23	-19	-15
SWISHER	-16	-16	-16	-16	-16	-16
TERRY	39	43	42	41	41	32
YOAKUM	-33	-31	-28	-26	-24	-28
Region Total	-19	-24	-21	-17	-14	-11

Water Use by Species



Summary & Conclusion

- Region O livestock water use is projected to be up slightly from the SB4 projections due to changes in inventory and projected future growth
- County level livestock water use projections varies considerably from the TWDB projections
- **Conclusion:** 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 available in publicly available data systems to delineate confined livestock operations.

Attachment H

2021 RWP Draft Water Demand Projections - Livestock (in acre-feet)

		Historical Use Estimates						2017 SWP Projections					
Region	County	2010	2011	2012	2013	2014	2015	2020	2030	2040	2050	2060	2070
O	BAILEY	2,727	3,022	3,279	3,152	3,284	3,419	2,335	3,013	3,057	3,104	3,153	3,204
O	BRISCOE	305	320	320	236	246	248	302	310	319	328	338	348
O	CASTRO	9,701	11,062	11,180	10,076	10,646	10,620	5,848	7,120	7,290	7,468	7,655	7,851
O	COCHRAN	400	493	495	400	404	407	536	562	590	620	651	684
O	CROSBY	218	224	204	152	158	161	262	268	274	281	287	294
O	DAWSON	219	233	172	63	48	48	139	143	147	151	155	159
O	DEAF SMITH	11,118	12,855	13,031	10,916	10,947	10,988	12,555	14,304	14,807	15,335	15,889	16,471
O	DICKENS	299	295	257	327	345	350	375	383	392	402	412	422
O	FLOYD	1,157	1,339	1,323	1,282	1,269	1,301	738	775	814	854	897	942
O	GAINES	216	226	200	152	154	142	238	250	262	276	289	304
O	GARZA	302	315	204	151	127	128	299	305	312	320	328	346
O	HALE	3,102	3,403	3,332	3,838	4,106	4,166	2,045	2,660	2,697	2,736	2,778	2,821
O	HOCKLEY	398	454	382	367	374	387	238	250	262	276	289	304
O	LAMB	3,741	4,107	4,189	4,812	5,451	5,500	2,969	3,136	3,204	3,275	3,349	3,427
O	LUBBOCK	731	838	810	572	581	602	780	887	918	951	985	1,021
O	LYNN	88	91	82	75	71	74	141	146	150	155	160	165
O	MOTLEY	426	420	370	321	313	297	481	490	499	509	519	529
O	PARMER	8,609	10,216	10,788	9,670	9,801	9,842	5,634	6,908	7,067	7,234	7,409	7,593
O	SWISHER	2,978	3,538	3,401	3,135	3,210	3,295	2,362	2,481	2,605	2,735	2,872	3,015
O	TERRY	231	261	206	398	417	450	270	288	309	332	356	395
O	YOAKUM	174	177	162	89	83	83	281	286	290	296	301	322
	Region Total	47,140	53,889	54,387	50,184	52,035	52,508	38,828	44,965	46,265	47,638	49,072	50,617

		2021 TWDB Draft Projections						2021 RWP Revision Request						% Change RWP Requested 2021 Proj. vs 2017 SWP Proj.						% Change RWP Requested 2021 Proj. vs 2021 TWDB Proj.					
Region	County	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
O	BAILEY	3,093	3,991	4,049	4,111	4,176	4,244	2,428	2,821	3,070	3,341	3,639	3,958	4	-6	0	8	15	24	-21	-29	-24	-19	-13	-7
O	BRISCOE	285	293	301	310	319	329	286	300	315	331	347	352	-5	-3	-1	1	3	1	0	2	5	7	9	7
O	CASTRO	10,533	12,824	13,130	13,451	13,788	14,141	6,721	7,589	8,179	8,820	9,517	10,261	15	7	12	18	24	31	-36	-41	-38	-34	-31	-27
O	COCHRAN	438	460	483	507	532	559	102	106	109	113	117	118	-81	-81	-81	-82	-82	-83	-77	-77	-77	-78	-78	-79
O	CROSBY	191	196	200	205	209	215	171	179	188	197	207	209	-35	-33	-31	-30	-28	-29	-11	-9	-6	-4	-1	-3
O	DAWSON	147	151	155	160	164	168	53	55	58	61	64	65	-62	-61	-60	-60	-59	-59	-64	-63	-63	-62	-61	-62
O	DEAF SMITH	11,773	13,414	13,885	14,380	14,900	15,446	11,170	12,157	12,933	13,766	14,661	15,604	-11	-15	-13	-10	-8	-5	-5	-9	-7	-4	-2	1
O	DICKENS	305	311	318	327	335	343	387	406	426	447	470	475	3	6	9	11	14	13	27	31	34	37	40	39
O	FLOYD	1,274	1,338	1,405	1,474	1,548	1,626	1,168	1,189	1,212	1,237	1,262	1,268	58	53	49	45	41	35	-8	-11	-14	-16	-18	-22
O	GAINES	190	199	209	220	230	242	123	126	129	133	136	137	-48	-50	-51	-52	-53	-55	-35	-37	-38	-40	-41	-43
O	GARZA	220	224	229	235	241	254	148	155	162	170	179	181	-51	-49	-48	-47	-45	-48	-33	-31	-29	-27	-26	-29
O	HALE	3,556	4,626	4,690	4,758	4,831	4,906	2,752	3,111	3,325	3,561	3,820	4,098	35	17	23	30	38	45	-23	-33	-29	-25	-21	-16
O	HOCKLEY	395	415	435	458	480	505	133	138	144	150	156	157	-44	-45	-45	-46	-46	-48	-66	-67	-67	-67	-68	-69
O	LAMB	4,460	4,711	4,813	4,920	5,031	5,148	3,940	4,529	4,910	5,325	5,780	6,271	33	44	53	63	73	83	-12	-4	2	8	15	22
O	LUBBOCK	706	803	831	861	892	925	1,088	1,138	1,173	1,212	1,253	1,287	39	28	28	27	27	26	54	42	41	41	40	39
O	LYNN	81	84	87	89	92	95	65	68	71	74	78	79	-54	-54	-53	-52	-51	-52	-20	-19	-18	-17	-16	-17
O	MOTLEY	370	377	384	392	399	407	276	290	305	320	336	340	-43	-41	-39	-37	-35	-36	-25	-23	-21	-18	-16	-16
O	PARMER	9,817	12,037	12,314	12,605	12,910	13,230	7,339	8,318	8,967	9,674	10,444	11,276	30	20	27	34	41	49	-25	-31	-27	-23	-19	-15
O	SWISHER	3,252	3,416	3,587	3,766	3,955	4,152	2,728	2,864	3,007	3,157	3,314	3,469	15	15	15	15	15	15	-16	-16	-16	-16	-16	-16
O	TERRY	303	323	346	372	399	443	420	461	492	526	562	586	56	60	59	58	58	48	39	43	42	41	41	32
O	YOAKUM	137	139	141	144	147	157	91	96	101	106	111	113	-67	-66	-65	-64	-63	-65	-33	-31	-28	-26	-24	-28
	Region Total	**51,526**	**60,332**	**61,992**	**63,745**	**65,578**	**67,535**	**41,589**	**46,096**	**49,276**	**52,721**	**56,453**	**60,304**	7	3	7	11	15	19	-19	-24	-21	-17	-14	-11

Attachment I

Lemonds, Paula Jo

From: Jacob Hernandez <jhernandez@mesauwcd.org>
Sent: Tuesday, December 19, 2017 10:20 AM
To: Lemonds, Paula Jo
Subject: Re: Region O - Future Frac Sand Mine in Dawson County

He stated that the mine plans to use 1100 gpm. That total will be for all 3 wells combined. Well within the limits of 4ac/ft. Again they have 3520 ac. He is gathering information for me on the recycling plant as well so I will forward that to you as soon as I can.

On Tue, Dec 19, 2017 at 9:38 AM, Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com> wrote:

> Thank you, Jacob. Did Gil give any indication for the amount of water they will use at the mine?
>
> **Paula Jo Lemonds,** PG, PE
>
> D 512.912.5127 F 512.912.5158
>
> hdrinc.com/follow-us
>
> **From:** Jacob Hernandez [mailto:jhernandez@mesauwcd.org]
> **Sent:** Tuesday, December 19, 2017 8:50 AM
> **To:** Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
> **Subject:** Re: Region O - Future Frac Sand Mine in Dawson County
>
> Paula,
>
> Here is my contact for the US Silica project.
>
> Gil Van Deventer
>
> Hydrologist
>
> Trident Environmental
>
> PO Box 12177

Odessa, TX 79768

432-638-2177

gil@trident-environmental.com

Great guy to talk to and has plenty of information for us. Please let me know if there is anything else you need from Me or Megan.

Thanks and have a great day and Merry Christmas!

Jacob

On Wed, Dec 13, 2017 at 10:01 AM, Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com> wrote:

> Jacob, Megan,
>
> It looks like you may not have received the attachments with Amber's email. Please find attached the two files that I originally attached yesterday. As I mentioned below, there is an increase in mining demand through 2030 and then it decreases slightly through 2040 to 1,000 acft/yr. Below is some new information that Jacob shared. It may be worth a revision to the mining demands given this information.   Based on his note below, if the mine only pumped 300 GPM, that is still about 480 acft/yr. The projection for 2030 is 1,164 acft/yr (see attached Mining Summary_Dawson.xlsx with the TWDB demand projections in it).   I think the most useful information right now would be discussing with US Silica to determine their water needs. Thank you for reaching out them, Jacob.
>
> Jacob wrote:
>
> **From:** Jacob Hernandez [mailto:jhernandez@mesauwcd.org]
> **Sent:** Tuesday, December 12, 2017 1:53 PM
> **To:** Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
> **Subject:** US Silica Sand Mine
>
> Paula,
>
> Here is the latest information I have for the Sand Mine:
>
> 1. 3520 Acres have been purchased out of Blk. M, Sections 76, 78, 79, S/2 of 80, 94, and 109

2. Three wells will be drilled for the US Silica site. According to Nathan Tafoya, (Exec Dir. of Lamesa Economic Development Board). Each well is expected to pump around 300 GPM. When fully operational they are expecting number to go up but could not provide me with an estimate of GPM. I do not expect that they will close to those numbers. The wells have not been drilled as of todays date. They are expecting to drill in the Spring of 2018.

3. I have a call into Brad Lutter who is the Director of Operations for US Silica (281-394-9582). He has yet to return my call.   I will let you know when he does.

4. They are expecting about 70-120 additional workers to join their work crew. There will be no man camps at the site which means that the workers will need to find housing in town or the local area.

What other information can I get you that would be useful. Let me know and I will get it to you. Thanks and have a great day.

Jacob Hernandez

Mesa UWCD

jhernandez@mesauwcd.org

mmires@mesauwcd.org

806-872-9205

Paula Jo Lemonds, PG, PE

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From: Amber Blount [mailto:amber@sandylandwater.com]
Sent: Tuesday, December 12, 2017 1:03 PM
To: Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>; 'Megan Mires' <mmires@mesauwcd.org>; Jacob Hernandez <jhernandez@mesauwcd.org>
Cc: 'Jason Coleman' <jason.coleman@hpwd.org>; 'Aubrey Spear' <ASpear@mail.ci.lubbock.tx.us>
Subject: RE: Region O - Future Frac Sand Mine in Dawson County

Hi Paula Jo,

Megan & Jacob's emails were not correct. I have corrected them on this reply.

Jacob & Megan: See Paula Jo's email below.

Amber Blount

District Manager

Sandy Land UWCD

PO Box 130

1012 Ave F

Plains, TX 79355

806-456-2155

From: Lemonds, Paula Jo [mailto:Paula.Lemonds@hdrinc.com]
Sent: Tuesday, December 12, 2017 12:21 PM
To: megan@mesauwcd.org; jason@mesauwcd.org
Cc: Jason Coleman <jason.coleman@hpwd.org>; Amber Blount <amber@sandylandwater.com>; Aubrey Spear (ASpear@mail.ci.lubbock.tx.us) <ASpear@mail.ci.lubbock.tx.us>
Subject: Region O - Future Frac Sand Mine in Dawson County

Hi Megan and Jason,

At the Region O Regional Water Planning Group meeting on November 15th, the water needs of a future frac sand mine in Dawson County were discussed. You all had mentioned that Mesa had granted or was considering permits for the company.

After the meeting, I contacted TWDB staff and received the attached Mining Water Use Report (HistoricalMining_DawsonCounty_from TWDB.xlsx). It shows pumping by Key Energy Services Inc-Lamesa Brine Station from 2000 to 2016, and a “Non-Surveyed Estimate” category.

The TWDB stated: “The 2017 SWP projection was based on the 5 year average water use (2005-2009) as a baseline and projected trend was developed through a TWDB-contracted study, Oil & Gas Water Use in Texas: Update to the 2011 Mining Water Use Report, done by the Bureau of Economic Geology (BEG). The BEG estimated recent mining water use and projected that use across the planning horizon using data collected from trade organizations, government agencies, and other industry representatives. The overall trend change for the later decade was largely based on the oil and gas industry outlook.”

Draft mining water demand projections were carried forward from the 2017 SWP, and the TWDB did not develop new projections for mining for this round. Please also find attached the TWDB water demand projections for the mining use category. Mining water use in Dawson County increases through 2030 and then decreases to 2070. With this information and estimations from TWDB for ‘non-surveyed’ water use, my recommendation is to keep the mining use for Dawson County as estimated by the TWDB. How does this work for you all?

If you have any questions, you can certainly give me a call or email.

Paula Jo Lemonds, PG, PE

Water Resources Engineer | Associate

ONEHDRED
1917-2017

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2021 Llano Estacado Region O Regional Water Plan

Technical Memorandum

September 2018

South Plains Association Of Governments

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HDR

2021 Llano Estacado (Region O) Regional Water Plan

Technical Memorandum

September 2018

STATE OF TEXAS
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Paula Jo Mudd Lemonds 9/7/2018

Paula Jo Lemonds, P.E., P.G.

9/7/2018

Zachary A. Stein, P.E.

HDR Engineering, Inc.
TBPE Firm No. F-754.
TBPG Firm No. 50226

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Memo

Date:	September 10, 2018
Project:	2021 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:	**2021 Regional Water Plan Technical Memorandum**

Introduction

The Texas Water Development Board (TWDB) regional water plan development guidance,[1] requires that a Technical Memorandum be submitted to the TWDB. The Llano Estacado Regional Water Planning Group (LERWPG) submits this memorandum to fulfill the TWDB requirements for the 2021 Regional Water Plan (RWP) development. This memorandum includes documentation of the LERWPG's preliminary analysis of water demand projections, water availability, existing water supplies, and water needs and a declaration of the LERWPG's intent not to pursue simplified planning.

At a regular meeting of the LERWPG on August 8, 2018, and during a public comment period 14 days following the meeting, the LERWPG received comments from the public. No public comments were received at the LERWPG meeting or during the official comment period.

1.0 TWDB DB22 Reports

The TWDB's regional water plan development guidance,[2] describes the State Water Planning Database (DB22) 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 RWPGs will complete and submit, via the DB22 interface, all data generated or updated during the current cycle of planning to the TWDB in accordance with TWDB specifications prior to submitting the Technical Memorandum and IPP.

This section includes the following TWDB DB22 reports that are required for the Technical Memorandum:

- Population Projections (TWDB DB22 Report #1),
- Water Demand Projections (TWDB DB22 Report #2),
- WUG Category Summary (TWDB DB22 Report #3),
- Source Water Availability (TWDB DB22 Report #4),

[1] TWDB, 2018. Second Amended General Guidelines for Fifth Cycle of Regional Water Plan Development.
[2] Ibid.

- WUG Existing Water Supplies (TWDB DB22 Report #5),
- WUG Identified Water Needs/Surpluses (TWDB DB22 Report #6),
- Source Water Balance (TWDB DB22 Report #9),
- WUG Data Comparison to 2016 RWP (TWDB DB22 Report #10a), and
- Source Data Comparison to 2016 RWP (TWDB DB22 Report #10b)

TWDB DB22 Report Numbers 7 and 8 will be developed at a later date for inclusion into the 2021 RWP. Data entered by RWPGs into DB22 is rounded to the nearest whole number to avoid cumulative data errors.

1.1 WUG Population Projections

The TWDB DB22 WUG population projection report presenting population projections by WUG, county, and river basin are included in Appendix A.

1.2 WUG Water Demand Reports

The TWDB DB22 water demand report presenting water demand projections by WUG, county, and river basin are included in Appendix B.

1.3 WUG Category Summary Report

The TWDB DB22 WUG Category Summary report presenting population, demands, supplies, and needs by WUG category is included in Appendix C.

1.4 Source Water Availability Report

The TWDB DB22 Source Water Availability report presenting water availability by source is included in Appendix D.

1.5 WUG Existing Water Supplies Report

The TWDB DB22 Existing Water Supplies report presenting existing water supplies by WUG, county, and river basin is included in Appendix E.

1.6 WUG Identified Water Needs/Surpluses Report

The TWDB DB22 Identified Water Needs/Surpluses report presenting identified water needs by WUG, county, and river basin is included in Appendix F.

1.7 Source Water Balance Report

The TWDB DB22 Source Water Balance report with the condition that the total has to be zero or greater than zero, except for those sources that are thereby revealed in IPPs as potentially overallocated and create potential interregional conflicts, is included in Appendix G.

1.8 WUG Data Comparison to 2016 RWP Report

The TWDB DB22 WUG Data Comparison report presents availability, supply, demands, and needs compared to the 2016 RWP report is included in Appendix H.

1.9 Source Data Comparison to 2016 RWP Report

The TWDB DB22 Comparison of Availability, Supply, Demands, and Needs to 2016 RWP report presenting sources at an aggregated level and WUG supplies, demands, and needs at a county level is included in Appendix I.

2.0 Surface Water Availability

The LERWPG met on January 23, 2018, and discussed the process to determine the amount of surface water available from existing water rights and future water management strategies. During this meeting, Region O discussed specific variations from the standard TWDB guidance that will be employed to develop the 2021 LERWP.

The guidance provided by the TWDB in the base scope of work for the Fifth 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. This section includes model modification assumptions and yields used in developing the 2021 Llano Estacado Regional Water Plan.

2.1 Written Summary of Water Availability Models

Information regarding the WAM simulations used in determining surface water availability are included in this section. The model input and output files used to date are submitted with this memorandum as an electronic appendix, Appendix J.

For Red River Basin WAM simulations, the unmodified WAM was used. The Red River WAM ends in 1998 and does not include the most recent drought, so run of river reliabilities may be less than the modeled values.

Hydrologic Variances

In a letter dated March 28, 2018, Region O 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 May 18, 2018, TWDB approved the variances as described in this section.

For Lake Alan Henry (LAH) analyses, Region O received approval from the TWDB to conduct analyses using a stand-alone WAM developed specifically for LAH. In response to the ongoing drought in the mid-2000s, the City of Lubbock requested that HDR perform a yield analysis of LAH that extended through 2006 in order to better account for the impacts of that drought cycle. Additionally, a recent (2005) hydrographic survey of LAH by the TWDB indicates that the capacity of LAH has been reduced from its permitted capacity of 115,937 to 94,808 acre-feet (acft). This is due to sedimentation in the reservoir pool and inaccuracies in the determination of the storage capacity during initial construction.

Region O also received approval from the TWDB 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. A complete summary of the approved modifications to the Brazos G WAM approved by the TWDB for use in the regional water planning process for Region G and Region O are included in Appendix K and Appendix L, respectively. These appendices include both the hydrologic variance request from the respective planning group and the subsequent approval letter from the TWDB.

2.2 Versions and Dates of WAM Simulations

This section lists the versions and dates of WAM simulations completed to calculate available surface water supply for Region O.

Brazos River Basin

For Brazos River Basin supply calculations, three models were used:

1. Unmodified Brazos WAM (TCEQ Run 3 including updated sediment conditions),
2. Brazos G WAM modified with TWDB-approved hydrologic variances,
3. Lake Alan Henry WAM (reservoir-specific model with TWDB-approved hydrologic variances

The modifications to the Brazos WAM simulations are described in Section 2.1. Table 2-1 summarizes the yield simulations completed.

Note that the unmodified WAM yields for Lake Alan Henry are much lower, even though they do not include hydrology from the new drought. The reason for this is that the Possum Kingdom Reservoir subordination is not included in the unmodified WAM. A subordination agreement states that contrary to the normal prior appropriation water right permit system in effect in general, as an exception, a water right is not required to curtail diversions or storage to pass inflows through its reservoir to maintain stream flows for a senior right.[3] A Brazos G WAM simulation for Lake Alan Henry was not completed because the Lake Alan Henry WAM was created specifically to determine the supply available from Lake Alan Henry.

Red River Basin

For Red River Basin WAM simulations, the unmodified WAM was used.

Dates of WAM Simulations

The yield simulations were run on July 23, 2018, and August 6, 2018, by HDR staff.

---

[3] Wurbs, Ralph A., 2015. Water Rights Analysis Package (WRAP) Modeling System Reference Manual. TR-255, Texas Water Resources Institute, College Station, Texas.

Table 2-1. 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	Unmodified Brazos WAM	Lake Alan Henry	HDR	July 23, 2018	2020 Firm	10,800
					2070 Firm	10,400
	Lake Alan Henry WAM	Lake Alan Henry	HDR	July 23, 2018	2020 Firm	21,050
					2070 Firm	20,400
	Lake Alan Henry WAM	Lake Alan Henry	HDR	July 23, 2018	2020 2-Yr Safe	13,275
					2070 2-Yr Safe	12,250
	Unmodified Brazos WAM	White River	HDR	August 6, 2018	2020 and 2070 Firm	0
	Brazos G WAM	Brazos Run of River	HDR	August 6, 2018	2020 and 2070	0
Red	Unmodified Red WAM	Mackenzie	HDR	August 6, 2018	2020 and 2070	4,530
	Unmodified Red WAM	Red Run of River	HDR	August 6, 2018	2020 and 2070	137

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 2021 Region O RWP.

Non-MAG Availability

MAG reports for the Region O RWPA did not include availabilities for “Other Aquifer.” To calculate RWPG-estimated availability, or non-MAG availability, for the “Other Aquifer” designation in the 2021 Regional Water Plan, the methodology used 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 2015.
- Well capacity is assumed to be the maximum annual pumpage during this time period.

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 (31 TAC §357.12(b)). This section describes the documented process used by the LERWPG to identify potentially feasible WMSs. On January 23, 2018, the LERWPG formally considered the process for identifying, evaluating and selecting WMSs as described below.

Process for identifying, evaluating and selecting WMSs:

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.

Then, an initial list of potentially feasible strategies is determined. Additional WMSs are included if local interests request them and the planning schedule and budget allow for the addition.

5.0 Potentially Feasible Water Management Strategies

A single tabular list of all potentially feasible WMSs identified by the LERWPG to date is included in Table 5-1.

Table 5-1. Tabular list of potentially feasible WMSs identified by the LERWPG to date

Potentially Feasible Water Management Strategies
Municipal water conservation
Non-municipal water conservation
Reclaimed wastewater supplies and reuse
Local groundwater development
Water loss reduction
Groundwater desalination
LAH Water District Water Supply
Bailey County Well Field capacity maintenance
Jim Bertram Lake 7
Lake Alan Henry Phase 2
North Fork scalping operation
South Lubbock well field
Potable reuse
Wolfforth CRMWA lease from Slaton
Direct potable reuse to North Water Treatment Plant
Direct potable reuse to South Water Treatment Plant
North Fork diversion at CR 7300
North Fork diversion to Lake Alan Henry pump station
Post Reservoir
Reclaimed water to aquifer storage and recovery
South Fork discharge
Transportation of water between counties of surplus and need
Brackish well field in Lubbock area
CRMWA aquifer storage and recovery
CRMWA II (Roberts County Wellfield)
Chloride control project
Enhanced recharge project

6.0 Simplified Planning Declaration

The TWDB guidelines for planning[4] state:

> The Senate Bill 1511, 85th Legislative Session, provided RWPGs the option to implement simplified planning if there are no significant changes to the water availability, water supplies, or water demands in the regional water planning area. The TWDB has revised 31 TAC §357.10(33) to define the Technical Memorandum and 31 TAC §357.12 to add this

[4] TWDB, 2018. Second Amended General Guidelines for Fifth Cycle of Regional Water Plan Development.

new simplified planning provision to the previously existing simplified planning rule, which had required that an RWPG determine in its analysis of water needs that there are sufficient existing water supplies in the regional water planning area to meet water needs for the 50-year planning period. The rule identifies the Technical Memorandum (the mid-point analysis of water demand projections, source availability, WUG supplies, and WUG needs calculations) as the decision point for an RWPG to declare its intent whether or not to pursue simplified planning in accordance with either simplified planning provision (adequate existing supplies or no significant changes in water demands, source availability, or WUG supplies). The threshold(s) for significant changes are to be defined by the RWPG however, significance may not be based solely on aggregated, region-wide comparisons without consideration of sub-regional changes. Simplified planning, by either provision, may only be implemented during off-census planning cycles.

The LERWPG will not pursue simplified planning for the development of the 2021 Region O RWP.

7.0 Summary of Public Comments

To comply with the 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 this Technical Memorandum was considered for approval by the LERWPG. Public comments were also accepted at the meeting where this Technical Memorandum was considered for approval by the LERWPG, held on August 8, 2018. No public comments were received at the meeting or during the official comment period.

Appendix A. TWDB DB22 Report #1 – WUG Population Projections

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Region O Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
MULESHOE	5,769	6,452	7,131	7,833	8,527	9,208
COUNTY-OTHER	2,243	2,510	2,775	3,047	3,317	3,582
BRAZOS BASIN TOTAL	**8,012**	**8,962**	**9,906**	**10,880**	**11,844**	**12,790**
BAILEY COUNTY TOTAL	**8,012**	**8,962**	**9,906**	**10,880**	**11,844**	**12,790**
QUITAQUE	420	420	420	420	420	420
SILVERTON	754	755	755	755	755	755
COUNTY-OTHER	499	498	498	498	498	498
RED BASIN TOTAL	**1,673**	**1,673**	**1,673**	**1,673**	**1,673**	**1,673**
BRISCOE COUNTY TOTAL	**1,673**	**1,673**	**1,673**	**1,673**	**1,673**	**1,673**
DIMMITT	4,825	5,237	5,533	5,806	6,019	6,191
HART MUNICIPAL WATER SYSTEM	1,194	1,296	1,369	1,437	1,489	1,532
COUNTY-OTHER	1,398	1,518	1,603	1,683	1,745	1,794
BRAZOS BASIN TOTAL	**7,417**	**8,051**	**8,505**	**8,926**	**9,253**	**9,517**
NAZARETH	352	382	404	423	439	452
COUNTY-OTHER	1,121	1,217	1,285	1,349	1,399	1,438
RED BASIN TOTAL	**1,473**	**1,599**	**1,689**	**1,772**	**1,838**	**1,890**
CASTRO COUNTY TOTAL	**8,890**	**9,650**	**10,194**	**10,698**	**11,091**	**11,407**
MORTON PWS	2,168	2,224	2,216	2,166	2,216	2,230
WHITEFACE	501	529	533	526	541	546
COUNTY-OTHER	490	557	577	581	605	615
BRAZOS BASIN TOTAL	**3,159**	**3,310**	**3,326**	**3,273**	**3,362**	**3,391**
COUNTY-OTHER	332	377	391	394	410	416
COLORADO BASIN TOTAL	**332**	**377**	**391**	**394**	**410**	**416**
COCHRAN COUNTY TOTAL	**3,491**	**3,687**	**3,717**	**3,667**	**3,772**	**3,807**
CROSBYTON	1,922	2,067	2,188	2,311	2,444	2,563
LORENZO	1,260	1,380	1,480	1,583	1,704	1,786
RALLS	2,075	2,223	2,343	2,465	2,590	2,717
COUNTY-OTHER	1,263	1,347	1,415	1,484	1,554	1,641
BRAZOS BASIN TOTAL	**6,520**	**7,017**	**7,426**	**7,843**	**8,292**	**8,707**
COUNTY-OTHER	6	6	7	7	7	8
RED BASIN TOTAL	**6**	**6**	**7**	**7**	**7**	**8**
CROSBY COUNTY TOTAL	**6,526**	**7,023**	**7,433**	**7,850**	**8,299**	**8,715**
ODONNELL	128	134	139	142	148	151
COUNTY-OTHER	30	33	35	36	38	40
BRAZOS BASIN TOTAL	**158**	**167**	**174**	**178**	**186**	**191**
LAMESA	9,755	10,098	10,333	10,377	10,678	10,874
COUNTY-OTHER	4,894	5,312	5,670	5,885	6,234	6,510
COLORADO BASIN TOTAL	**14,649**	**15,410**	**16,003**	**16,262**	**16,912**	**17,384**
DAWSON COUNTY TOTAL	**14,807**	**15,577**	**16,177**	**16,440**	**17,098**	**17,575**
COUNTY-OTHER	8	9	11	12	13	15

Region O Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
CANADIAN BASIN TOTAL	**8**	**9**	**11**	**12**	**13**	**15**
HEREFORD	17,150	19,799	22,694	25,978	28,558	31,379
COUNTY-OTHER	4,993	5,765	6,609	7,564	8,316	9,137
RED BASIN TOTAL	**22,143**	**25,564**	**29,303**	**33,542**	**36,874**	**40,516**
DEAF SMITH COUNTY TOTAL	**22,151**	**25,573**	**29,314**	**33,554**	**36,887**	**40,531**
SPUR	1,041	1,041	1,041	1,041	1,041	1,041
COUNTY-OTHER	894	890	886	882	878	875
BRAZOS BASIN TOTAL	**1,935**	**1,931**	**1,927**	**1,923**	**1,919**	**1,916**
RED RIVER AUTHORITY OF TEXAS	45	50	55	59	64	68
COUNTY-OTHER	184	183	182	182	181	180
RED BASIN TOTAL	**229**	**233**	**237**	**241**	**245**	**248**
DICKENS COUNTY TOTAL	**2,164**	**2,164**	**2,164**	**2,164**	**2,164**	**2,164**
FLOYDADA	3,242	3,242	3,242	3,242	3,242	3,242
LOCKNEY	2,029	2,156	2,236	2,321	2,388	2,444
COUNTY-OTHER	1,070	1,270	1,396	1,534	1,641	1,730
BRAZOS BASIN TOTAL	**6,341**	**6,668**	**6,874**	**7,097**	**7,271**	**7,416**
COUNTY-OTHER	528	626	689	757	810	854
RED BASIN TOTAL	**528**	**626**	**689**	**757**	**810**	**854**
FLOYD COUNTY TOTAL	**6,869**	**7,294**	**7,563**	**7,854**	**8,081**	**8,270**
SEAGRAVES	2,558	2,700	2,871	3,060	3,164	3,273
SEMINOLE	7,102	7,893	8,834	9,855	10,648	11,475
COUNTY-OTHER	11,656	15,153	19,292	23,739	27,854	32,138
COLORADO BASIN TOTAL	**21,316**	**25,746**	**30,997**	**36,654**	**41,666**	**46,886**
GAINES COUNTY TOTAL	**21,316**	**25,746**	**30,997**	**36,654**	**41,666**	**46,886**
POST	6,012	6,452	6,841	7,098	7,466	7,770
COUNTY-OTHER	1,065	1,058	1,058	1,068	1,103	1,135
BRAZOS BASIN TOTAL	**7,077**	**7,510**	**7,899**	**8,166**	**8,569**	**8,905**
GARZA COUNTY TOTAL	**7,077**	**7,510**	**7,899**	**8,166**	**8,569**	**8,905**
ABERNATHY	2,263	2,360	2,401	2,381	2,444	2,469
HALE CENTER	2,252	2,252	2,252	2,252	2,252	2,252
PETERSBURG MUNICIPAL WATER SYSTEM	1,252	1,306	1,329	1,317	1,352	1,366
PLAINVIEW	24,624	25,685	26,123	25,905	26,587	26,874
COUNTY-OTHER	7,923	8,362	8,542	8,452	8,734	8,853
BRAZOS BASIN TOTAL	**38,314**	**39,965**	**40,647**	**40,307**	**41,369**	**41,814**
HALE COUNTY TOTAL	**38,314**	**39,965**	**40,647**	**40,307**	**41,369**	**41,814**
ANTON	1,235	1,313	1,361	1,370	1,431	1,470
LEVELLAND	14,839	15,785	16,359	16,467	17,202	17,676
COUNTY-OTHER	7,273	7,739	8,021	8,072	8,434	8,665
BRAZOS BASIN TOTAL	**23,347**	**24,837**	**25,741**	**25,909**	**27,067**	**27,811**
SUNDOWN	1,538	1,636	1,696	1,707	1,783	1,832

Region O Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
COUNTY-OTHER	245	261	270	272	284	292
COLORADO BASIN TOTAL	**1,783**	**1,897**	**1,966**	**1,979**	**2,067**	**2,124**
HOCKLEY COUNTY TOTAL	**25,130**	**26,734**	**27,707**	**27,888**	**29,134**	**29,935**
AMHERST	799	877	930	963	1,018	1,059
EARTH	1,099	1,125	1,131	1,118	1,134	1,137
LITTLEFIELD	6,642	6,642	6,642	6,642	6,642	6,642
OLTON	2,250	2,275	2,266	2,218	2,229	2,217
SUDAN	1,042	1,127	1,182	1,213	1,273	1,316
COUNTY-OTHER	2,783	3,129	3,287	3,265	3,495	3,604
BRAZOS BASIN TOTAL	**14,615**	**15,175**	**15,438**	**15,419**	**15,791**	**15,975**
LAMB COUNTY TOTAL	**14,615**	**15,175**	**15,438**	**15,419**	**15,791**	**15,975**
ABERNATHY	786	874	961	1,054	1,142	1,229
IDALOU	2,425	2,534	2,647	2,772	2,883	2,993
LUBBOCK	261,706	294,862	329,597	356,227	381,205	403,901
NEW DEAL	869	951	1,036	1,125	1,210	1,294
RANSOM CANYON	1,171	1,257	1,344	1,438	1,525	1,612
SHALLOWATER	2,820	3,192	3,562	3,956	4,334	4,709
SLATON	6,179	6,257	6,352	6,467	6,547	6,621
WOLFFORTH	4,577	5,577	6,569	7,614	8,633	9,647
COUNTY-OTHER	29,236	28,473	26,252	34,285	42,291	52,310
BRAZOS BASIN TOTAL	**309,769**	**343,977**	**378,320**	**414,938**	**449,770**	**484,316**
LUBBOCK COUNTY TOTAL	**309,769**	**343,977**	**378,320**	**414,938**	**449,770**	**484,316**
ODONNELL	765	805	807	803	843	862
TAHOKA PUBLIC WATER SYSTEM	2,832	2,978	2,987	2,973	3,122	3,190
COUNTY-OTHER	2,601	2,737	2,745	2,733	2,870	2,931
BRAZOS BASIN TOTAL	**6,198**	**6,520**	**6,539**	**6,509**	**6,835**	**6,983**
COUNTY-OTHER	81	85	85	85	89	91
COLORADO BASIN TOTAL	**81**	**85**	**85**	**85**	**89**	**91**
LYNN COUNTY TOTAL	**6,279**	**6,605**	**6,624**	**6,594**	**6,924**	**7,074**
MATADOR	643	643	643	643	643	643
RED RIVER AUTHORITY OF TEXAS	23	26	28	31	33	35
COUNTY-OTHER	546	543	541	538	536	534
RED BASIN TOTAL	**1,212**	**1,212**	**1,212**	**1,212**	**1,212**	**1,212**
MOTLEY COUNTY TOTAL	**1,212**	**1,212**	**1,212**	**1,212**	**1,212**	**1,212**
BOVINA	2,082	2,304	2,506	2,701	2,931	3,142
FARWELL	1,507	1,668	1,813	1,956	2,122	2,274
COUNTY-OTHER	1,980	2,193	2,383	2,570	2,789	2,989
BRAZOS BASIN TOTAL	**5,569**	**6,165**	**6,702**	**7,227**	**7,842**	**8,405**
FRIONA	4,437	4,913	5,340	5,759	6,251	6,698

Region O Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
COUNTY-OTHER	1,418	1,570	1,706	1,841	1,998	2,141
RED BASIN TOTAL	**5,855**	**6,483**	**7,046**	**7,600**	**8,249**	**8,839**
PARMER COUNTY TOTAL	**11,424**	**12,648**	**13,748**	**14,827**	**16,091**	**17,244**
COUNTY-OTHER	384	403	409	407	427	436
BRAZOS BASIN TOTAL	**384**	**403**	**409**	**407**	**427**	**436**
HAPPY	649	682	692	687	721	738
TULIA	4,879	5,123	5,198	5,166	5,422	5,542
COUNTY-OTHER	2,345	2,462	2,499	2,484	2,605	2,664
RED BASIN TOTAL	**7,873**	**8,267**	**8,389**	**8,337**	**8,748**	**8,944**
SWISHER COUNTY TOTAL	**8,257**	**8,670**	**8,798**	**8,744**	**9,175**	**9,380**
COUNTY-OTHER	69	72	77	74	78	82
BRAZOS BASIN TOTAL	**69**	**72**	**77**	**74**	**78**	**82**
BROWNFIELD	10,000	10,700	11,300	12,250	12,800	13,300
COUNTY-OTHER	3,530	3,685	3,944	3,784	3,969	4,153
COLORADO BASIN TOTAL	**13,530**	**14,385**	**15,244**	**16,034**	**16,769**	**17,453**
TERRY COUNTY TOTAL	**13,599**	**14,457**	**15,321**	**16,108**	**16,847**	**17,535**
DENVER CITY	5,072	5,736	6,327	6,955	7,618	8,249
PLAINS	1,702	1,926	2,124	2,335	2,557	2,769
COUNTY-OTHER	2,146	2,427	2,677	2,942	3,226	3,493
COLORADO BASIN TOTAL	**8,920**	**10,089**	**11,128**	**12,232**	**13,401**	**14,511**
YOAKUM COUNTY TOTAL	**8,920**	**10,089**	**11,128**	**12,232**	**13,401**	**14,511**
REGION O TOTAL POPULATION	**540,495**	**594,391**	**645,980**	**697,869**	**750,858**	**801,719**

Appendix B. TWDB DB22 Report #2 – WUG Water Demand Projections

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Region O Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MULESHOE	1,173	1,283	1,397	1,523	1,655	1,787
COUNTY-OTHER	277	296	320	351	381	411
LIVESTOCK	2,428	2,821	3,070	3,341	3,639	3,958
IRRIGATION	88,108	88,108	72,000	63,505	58,659	55,616
BRAZOS BASIN TOTAL	**91,986**	**92,508**	**76,787**	**68,720**	**64,334**	**61,772**
BAILEY COUNTY TOTAL	**91,986**	**92,508**	**76,787**	**68,720**	**64,334**	**61,772**
QUITAQUE	106	104	102	102	101	101
SILVERTON	128	124	121	120	120	120
COUNTY-OTHER	159	156	154	154	154	154
LIVESTOCK	286	300	315	331	347	352
IRRIGATION	26,417	26,417	20,687	17,833	16,225	15,231
RED BASIN TOTAL	**27,096**	**27,101**	**21,379**	**18,540**	**16,947**	**15,958**
BRISCOE COUNTY TOTAL	**27,096**	**27,101**	**21,379**	**18,540**	**16,947**	**15,958**
DIMMITT	1,091	1,159	1,205	1,254	1,299	1,335
HART MUNICIPAL WATER SYSTEM	175	183	188	197	203	209
COUNTY-OTHER	204	213	221	231	240	246
LIVESTOCK	4,974	5,616	6,053	6,528	7,043	7,594
IRRIGATION	246,911	246,911	195,321	164,462	151,177	144,884
BRAZOS BASIN TOTAL	**253,355**	**254,082**	**202,988**	**172,672**	**159,962**	**154,268**
NAZARETH	134	144	150	157	163	168
COUNTY-OTHER	164	171	177	186	192	198
MANUFACTURING	61	66	66	66	66	66
LIVESTOCK	1,747	1,973	2,126	2,292	2,474	2,667
IRRIGATION	132,952	132,952	105,172	88,556	81,402	78,014
RED BASIN TOTAL	**135,058**	**135,306**	**107,691**	**91,257**	**84,297**	**81,113**
CASTRO COUNTY TOTAL	**388,413**	**389,388**	**310,679**	**263,929**	**244,259**	**235,381**
MORTON PWS	477	477	471	459	469	472
WHITEFACE	118	122	121	120	123	124
COUNTY-OTHER	182	204	211	212	221	224
MINING	8	11	11	8	6	4
LIVESTOCK	70	73	75	78	81	81
IRRIGATION	67,626	67,626	57,664	51,479	46,346	42,821
BRAZOS BASIN TOTAL	**68,481**	**68,513**	**58,553**	**52,356**	**47,246**	**43,726**
COUNTY-OTHER	124	139	143	144	150	152
MINING	146	197	199	155	109	77
LIVESTOCK	32	33	34	35	36	37
IRRIGATION	31,823	31,823	27,136	24,225	21,810	20,151
COLORADO BASIN TOTAL	**32,125**	**32,192**	**27,512**	**24,559**	**22,105**	**20,417**
COCHRAN COUNTY TOTAL	**100,606**	**100,705**	**86,065**	**76,915**	**69,351**	**64,143**
CROSBYTON	301	313	323	340	359	376
LORENZO	231	246	258	275	296	310
RALLS	311	322	331	345	362	379
COUNTY-OTHER	149	153	160	167	175	184
MANUFACTURING	2	3	3	3	3	3
MINING	626	617	549	477	413	358
LIVESTOCK	167	175	184	192	202	204

Region O Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
IRRIGATION	103,321	103,321	103,321	81,768	70,915	65,013
BRAZOS BASIN TOTAL	**105,108**	**105,150**	**105,129**	**83,567**	**72,725**	**66,827**
COUNTY-OTHER	1	1	1	1	1	1
MINING	368	363	322	280	243	210
LIVESTOCK	4	4	4	5	5	5
IRRIGATION	4,262	4,262	4,262	3,373	2,925	2,682
RED BASIN TOTAL	**4,635**	**4,630**	**4,589**	**3,659**	**3,174**	**2,898**
CROSBY COUNTY TOTAL	**109,743**	**109,780**	**109,718**	**87,226**	**75,899**	**69,725**
ODONNELL	18	18	18	18	19	20
COUNTY-OTHER	4	4	4	4	4	5
LIVESTOCK	1	1	1	1	1	1
IRRIGATION	1,045	1,045	1,045	903	827	781
BRAZOS BASIN TOTAL	**1,068**	**1,068**	**1,068**	**926**	**851**	**807**
LAMESA	2,240	2,268	2,279	2,284	2,346	2,389
COUNTY-OTHER	602	628	651	666	704	734
MINING	1,812	1,812	1,812	1,812	1,812	1,812
LIVESTOCK	52	54	57	60	63	64
IRRIGATION	105,267	105,267	105,267	90,896	83,299	78,662
COLORADO BASIN TOTAL	**109,973**	**110,029**	**110,066**	**95,718**	**88,224**	**83,661**
DAWSON COUNTY TOTAL	**111,041**	**111,097**	**111,134**	**96,644**	**89,075**	**84,468**
COUNTY-OTHER	1	1	1	1	1	2
LIVESTOCK	112	122	130	138	147	157
IRRIGATION	2,101	2,101	1,628	1,383	1,255	1,183
CANADIAN BASIN TOTAL	**2,214**	**2,224**	**1,759**	**1,522**	**1,403**	**1,342**
HEREFORD	3,857	4,354	4,917	5,589	6,136	6,739
COUNTY-OTHER	589	650	723	820	899	986
MANUFACTURING	1,002	1,107	1,107	1,107	1,107	1,107
LIVESTOCK	11,058	12,035	12,803	13,628	14,514	15,447
IRRIGATION	207,915	207,915	161,073	136,891	124,191	117,036
RED BASIN TOTAL	**224,421**	**226,061**	**180,623**	**158,035**	**146,847**	**141,315**
DEAF SMITH COUNTY TOTAL	**226,635**	**228,285**	**182,382**	**159,557**	**148,250**	**142,657**
SPUR	180	174	172	172	171	171
COUNTY-OTHER	120	115	111	110	109	109
MINING	10	10	10	10	10	10
LIVESTOCK	238	250	262	275	290	293
IRRIGATION	5,155	5,155	5,155	5,155	5,155	5,155
BRAZOS BASIN TOTAL	**5,703**	**5,704**	**5,710**	**5,722**	**5,735**	**5,738**
RED RIVER AUTHORITY OF TEXAS	11	12	13	14	15	16
COUNTY-OTHER	25	24	23	23	23	23
MINING	2	2	2	2	2	2
LIVESTOCK	149	156	164	172	180	182
IRRIGATION	3,884	3,884	3,884	3,884	3,884	3,884
RED BASIN TOTAL	**4,071**	**4,078**	**4,086**	**4,095**	**4,104**	**4,107**
DICKENS COUNTY TOTAL	**9,774**	**9,782**	**9,796**	**9,817**	**9,839**	**9,845**
FLOYDADA	572	554	546	545	544	544
LOCKNEY	277	283	285	295	303	310
COUNTY-OTHER	129	145	158	173	185	195

Region O Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MINING	214	217	215	214	213	214
LIVESTOCK	894	910	928	947	966	971
IRRIGATION	46,380	46,380	36,899	31,963	29,122	27,444
BRAZOS BASIN TOTAL	**48,466**	**48,489**	**39,031**	**34,137**	**31,333**	**29,678**
COUNTY-OTHER	63	71	78	86	91	96
MINING	272	275	274	272	271	271
LIVESTOCK	274	279	284	290	296	297
IRRIGATION	82,457	82,457	65,601	56,826	51,774	48,791
RED BASIN TOTAL	**83,066**	**83,082**	**66,237**	**57,474**	**52,432**	**49,455**
FLOYD COUNTY TOTAL	**131,532**	**131,571**	**105,268**	**91,611**	**83,765**	**79,133**
SEAGRAVES	423	433	450	474	489	506
SEMINOLE	2,348	2,571	2,847	3,160	3,411	3,675
COUNTY-OTHER	1,400	1,760	2,202	2,688	3,148	3,630
MANUFACTURING	1,512	1,587	1,587	1,587	1,587	1,587
MINING	1,829	2,400	2,071	1,527	1,051	776
LIVESTOCK	123	126	129	133	136	137
IRRIGATION	362,482	362,482	328,442	306,787	291,887	282,438
COLORADO BASIN TOTAL	**370,117**	**371,359**	**337,728**	**316,356**	**301,709**	**292,749**
GAINES COUNTY TOTAL	**370,117**	**371,359**	**337,728**	**316,356**	**301,709**	**292,749**
POST	792	827	860	884	927	964
COUNTY-OTHER	135	128	125	126	129	133
MANUFACTURING	2	2	2	2	2	2
MINING	395	544	438	334	234	164
LIVESTOCK	148	155	162	170	179	181
IRRIGATION	10,353	10,353	10,353	10,353	10,353	10,353
BRAZOS BASIN TOTAL	**11,825**	**12,009**	**11,940**	**11,869**	**11,824**	**11,797**
GARZA COUNTY TOTAL	**11,825**	**12,009**	**11,940**	**11,869**	**11,824**	**11,797**
ABERNATHY	536	547	549	540	553	559
HALE CENTER	281	271	264	260	259	259
PETERSBURG MUNICIPAL WATER SYSTEM	321	329	329	325	333	336
PLAINVIEW	4,587	4,664	4,650	4,562	4,672	4,722
COUNTY-OTHER	1,031	1,048	1,040	1,013	1,044	1,058
MANUFACTURING	4,383	5,076	5,076	5,076	5,076	5,076
MINING	1,168	1,152	1,022	886	766	662
STEAM ELECTRIC POWER	31	31	31	31	31	31
LIVESTOCK	2,752	3,111	3,325	3,561	3,820	4,098
IRRIGATION	307,440	307,440	263,617	241,892	231,023	225,295
BRAZOS BASIN TOTAL	**322,530**	**323,669**	**279,903**	**258,146**	**247,577**	**242,096**
IRRIGATION	3,102	3,102	2,660	2,441	2,331	2,273
RED BASIN TOTAL	**3,102**	**3,102**	**2,660**	**2,441**	**2,331**	**2,273**
HALE COUNTY TOTAL	**325,632**	**326,771**	**282,563**	**260,587**	**249,908**	**244,369**
ANTON	160	164	165	165	171	176
LEVELLAND	2,441	2,520	2,553	2,547	2,654	2,727
COUNTY-OTHER	891	914	922	915	953	979
MANUFACTURING	576	691	691	691	691	691
MINING	16	16	15	15	14	13
LIVESTOCK	113	118	123	128	133	134

Region O Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
IRRIGATION	122,709	122,709	90,961	77,949	71,808	68,479
BRAZOS BASIN TOTAL	**126,906**	**127,132**	**95,430**	**82,410**	**76,424**	**73,199**
SUNDOWN	417	435	447	449	469	482
COUNTY-OTHER	30	31	31	31	32	33
MINING	2	2	2	2	2	2
LIVESTOCK	20	20	21	22	23	23
IRRIGATION	9,157	9,157	6,788	5,817	5,358	5,110
COLORADO BASIN TOTAL	**9,626**	**9,645**	**7,289**	**6,321**	**5,884**	**5,650**
HOCKLEY COUNTY TOTAL	**136,532**	**136,777**	**102,719**	**88,731**	**82,308**	**78,849**
AMHERST	102	107	110	113	119	124
EARTH	191	190	186	183	186	186
LITTLEFIELD	987	956	927	916	914	914
OLTON	466	461	451	437	438	436
SUDAN	250	264	273	278	292	301
COUNTY-OTHER	401	434	451	447	477	492
MANUFACTURING	807	940	940	940	940	940
MINING	586	579	513	445	385	333
STEAM ELECTRIC POWER	13,450	13,450	13,450	13,450	13,450	13,450
LIVESTOCK	3,940	4,529	4,910	5,325	5,780	6,271
IRRIGATION	259,451	259,451	218,589	203,951	197,509	194,185
BRAZOS BASIN TOTAL	**280,631**	**281,361**	**240,800**	**226,485**	**220,490**	**217,632**
LAMB COUNTY TOTAL	**280,631**	**281,361**	**240,800**	**226,485**	**220,490**	**217,632**
ABERNATHY	186	203	220	239	258	278
IDALOU	434	441	451	467	485	503
LUBBOCK	46,775	51,386	56,443	60,464	64,576	68,389
NEW DEAL	113	120	128	137	147	158
RANSOM CANYON	336	355	376	400	424	448
SHALLOWATER	422	464	507	558	610	662
SLATON	745	725	712	711	717	725
WOLFFORTH	765	912	1,061	1,223	1,384	1,546
COUNTY-OTHER	3,797	3,580	3,229	4,169	5,129	6,339
MANUFACTURING	856	1,011	1,011	1,011	1,011	1,011
MINING	6,354	6,425	5,913	5,302	4,763	4,314
STEAM ELECTRIC POWER	5,694	5,694	5,694	5,694	5,694	5,694
LIVESTOCK	1,088	1,138	1,173	1,212	1,253	1,287
IRRIGATION	144,866	144,866	132,596	124,312	118,397	114,260
BRAZOS BASIN TOTAL	**212,431**	**217,320**	**209,514**	**205,899**	**204,848**	**205,614**
LUBBOCK COUNTY TOTAL	**212,431**	**217,320**	**209,514**	**205,899**	**204,848**	**205,614**
ODONNELL	106	107	105	105	109	112
TAHOKA PUBLIC WATER SYSTEM	476	486	477	470	492	503
COUNTY-OTHER	302	305	296	289	303	309
MINING	1,084	1,234	1,167	960	768	614
LIVESTOCK	60	63	66	69	72	73
IRRIGATION	82,991	82,991	82,991	82,991	82,991	82,991
BRAZOS BASIN TOTAL	**85,019**	**85,186**	**85,102**	**84,884**	**84,735**	**84,602**
COUNTY-OTHER	9	9	9	9	9	10

Region O Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MINING	82	93	88	73	58	46
LIVESTOCK	5	5	5	5	6	6
IRRIGATION	5,930	5,930	5,930	5,930	5,930	5,930
COLORADO BASIN TOTAL	**6,026**	**6,037**	**6,032**	**6,017**	**6,003**	**5,992**
LYNN COUNTY TOTAL	**91,045**	**91,223**	**91,134**	**90,901**	**90,738**	**90,594**
MATADOR	224	221	219	218	218	218
RED RIVER AUTHORITY OF TEXAS	6	6	7	7	8	8
COUNTY-OTHER	98	94	92	92	91	91
MINING	240	213	205	198	179	161
LIVESTOCK	276	290	305	320	336	340
IRRIGATION	9,426	9,426	9,426	9,426	9,426	9,426
RED BASIN TOTAL	**10,270**	**10,250**	**10,254**	**10,261**	**10,258**	**10,244**
MOTLEY COUNTY TOTAL	**10,270**	**10,250**	**10,254**	**10,261**	**10,258**	**10,244**
BOVINA	373	402	429	458	496	531
FARWELL	393	426	457	490	531	569
COUNTY-OTHER	385	415	443	475	514	551
LIVESTOCK	5,871	6,654	7,173	7,739	8,355	9,020
IRRIGATION	191,424	191,424	165,947	153,526	146,303	142,274
BRAZOS BASIN TOTAL	**198,446**	**199,321**	**174,449**	**162,688**	**156,199**	**152,945**
FRIONA	801	864	922	985	1,067	1,143
COUNTY-OTHER	276	298	317	340	368	394
MANUFACTURING	1,666	1,841	1,841	1,841	1,841	1,841
LIVESTOCK	1,468	1,664	1,794	1,935	2,089	2,256
IRRIGATION	47,801	47,801	41,439	38,338	36,534	35,528
RED BASIN TOTAL	**52,012**	**52,468**	**46,313**	**43,439**	**41,899**	**41,162**
PARMER COUNTY TOTAL	**250,458**	**251,789**	**220,762**	**206,127**	**198,098**	**194,107**
COUNTY-OTHER	50	51	50	50	52	53
LIVESTOCK	136	143	150	158	166	173
IRRIGATION	24,372	24,372	19,808	17,581	16,340	15,578
BRAZOS BASIN TOTAL	**24,558**	**24,566**	**20,008**	**17,789**	**16,558**	**15,804**
HAPPY	99	100	100	98	102	105
TULIA	865	883	876	863	903	923
COUNTY-OTHER	307	308	306	303	317	324
LIVESTOCK	2,592	2,721	2,857	2,999	3,148	3,296
IRRIGATION	111,024	111,024	90,233	80,087	74,435	70,962
RED BASIN TOTAL	**114,887**	**115,036**	**94,372**	**84,350**	**78,905**	**75,610**
SWISHER COUNTY TOTAL	**139,445**	**139,602**	**114,380**	**102,139**	**95,463**	**91,414**
COUNTY-OTHER	9	9	9	9	9	9
MINING	25	37	38	29	21	15
LIVESTOCK	19	20	22	23	25	26
IRRIGATION	8,639	8,639	7,295	6,735	6,445	6,276
BRAZOS BASIN TOTAL	**8,692**	**8,705**	**7,364**	**6,796**	**6,500**	**6,326**
BROWNFIELD	1,604	1,665	1,718	1,841	1,919	1,993
COUNTY-OTHER	436	435	456	436	456	478
MANUFACTURING	14	17	17	17	17	17
MINING	330	488	505	387	272	191

Region O Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
LIVESTOCK	401	441	470	503	537	560
IRRIGATION	164,146	164,146	138,606	127,969	122,446	119,251
COLORADO BASIN TOTAL	**166,931**	**167,192**	**141,772**	**131,153**	**125,647**	**122,490**
TERRY COUNTY TOTAL	**175,623**	**175,897**	**149,136**	**137,949**	**132,147**	**128,816**
DENVER CITY	1,423	1,579	1,720	1,888	2,066	2,236
PLAINS	438	486	529	578	632	685
COUNTY-OTHER	263	287	310	336	368	398
MINING	1,300	1,334	1,147	957	783	641
STEAM ELECTRIC POWER	1,910	1,910	1,910	1,910	1,910	1,910
LIVESTOCK	91	96	101	106	111	113
IRRIGATION	161,693	161,693	138,141	127,049	121,210	117,681
COLORADO BASIN TOTAL	**167,118**	**167,385**	**143,858**	**132,824**	**127,080**	**123,664**
YOAKUM COUNTY TOTAL	**167,118**	**167,385**	**143,858**	**132,824**	**127,080**	**123,664**
REGION O TOTAL DEMAND	**3,367,953**	**3,381,960**	**2,927,996**	**2,663,087**	**2,526,590**	**2,452,931**

Appendix C. TWDB DB22 Report #3 – WUG Category Summary

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Region O Water User Group (WUG) Category Summary*

MUNICIPAL	2020	2030	2040	2050	2060	2070
POPULATION	445,261	491,921	538,163	575,363	612,430	645,875
DEMAND (acre-feet per year)	82,286	88,710	95,415	101,302	107,715	113,672
EXISTING SUPPLIES (acre-feet per year)	115,797	115,646	115,084	113,284	109,674	107,658
NEEDS (acre-feet per year)	4,345	9,335	14,966	20,923	28,664	35,051

COUNTY-OTHER	2020	2030	2040	2050	2060	2070
POPULATION	95,234	102,470	107,817	122,506	138,428	155,844
DEMAND (acre-feet per year)	12,613	13,077	13,424	15,057	16,929	19,001
EXISTING SUPPLIES (acre-feet per year)	18,011	18,011	18,011	18,011	18,011	18,011
NEEDS (acre-feet per year)	0	10	452	938	1,398	1,880

MANUFACTURING	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	10,881	12,341	12,341	12,341	12,341	12,341
EXISTING SUPPLIES (acre-feet per year)	5,982	5,982	5,982	5,982	5,982	5,982
NEEDS (acre-feet per year)	5,454	6,482	6,482	6,482	6,482	6,482

MINING	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	16,869	18,021	16,518	14,345	12,375	10,890
EXISTING SUPPLIES (acre-feet per year)	15,097	15,097	15,097	15,097	15,097	15,097
NEEDS (acre-feet per year)	10,118	10,503	9,517	8,145	6,908	6,016

STEAM ELECTRIC POWER	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	21,085	21,085	21,085	21,085	21,085	21,085
EXISTING SUPPLIES (acre-feet per year)	27,795	27,795	27,795	25,555	25,555	25,555
NEEDS (acre-feet per year)	0	0	0	0	0	0

LIVESTOCK	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	41,589	46,096	49,276	52,721	56,453	60,304
EXISTING SUPPLIES (acre-feet per year)	59,836	59,836	59,836	59,836	59,836	59,514
NEEDS (acre-feet per year)	112	122	844	2,041	3,794	5,825

IRRIGATION	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	3,182,630	3,182,630	2,719,937	2,446,236	2,299,692	2,215,638
EXISTING SUPPLIES (acre-feet per year)	2,734,172	1,852,341	1,329,074	1,047,743	896,737	810,663
NEEDS (acre-feet per year)	686,345	1,415,306	1,422,699	1,418,084	1,417,882	1,416,649

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Category Summary 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 category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

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Appendix D. TWDB DB22 Report #4 – Source Water Availability

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Region O Source Availability

GROUNDWATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY *	2020	2030	2040	2050	2060	2070
DOCKUM AQUIFER	BAILEY	BRAZOS	FRESH	833	833	833	833	833	833
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	425	425	425	425	425	425
DOCKUM AQUIFER	COCHRAN	BRAZOS	FRESH	104	104	104	104	104	104
DOCKUM AQUIFER	COCHRAN	COLORADO	FRESH	868	868	868	868	868	868
DOCKUM AQUIFER	CROSBY	BRAZOS	FRESH	3,858	3,858	3,858	3,858	3,858	3,858
DOCKUM AQUIFER	CROSBY	RED	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	DEAF SMITH	CANADIAN	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	DEAF SMITH	RED	FRESH	4,401	4,401	4,401	4,401	4,401	4,401
DOCKUM AQUIFER	DICKENS	BRAZOS	FRESH	100	100	100	100	100	100
DOCKUM AQUIFER	DICKENS	RED	FRESH	100	100	100	100	100	100
DOCKUM AQUIFER	FLOYD	BRAZOS	FRESH	2,976	2,976	2,976	2,976	2,976	2,976
DOCKUM AQUIFER	FLOYD	RED	FRESH	250	250	250	250	250	250
DOCKUM AQUIFER	GAINES	COLORADO	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	GARZA	BRAZOS	BRACKISH	911	911	911	911	911	911
DOCKUM AQUIFER	HALE	BRAZOS	FRESH	1,092	1,092	1,092	1,092	1,092	1,092
DOCKUM AQUIFER	HALE	RED	FRESH	29	29	29	29	29	29
DOCKUM AQUIFER	HOCKLEY	BRAZOS	FRESH	890	890	890	890	890	890
DOCKUM AQUIFER	HOCKLEY	COLORADO	FRESH	167	167	167	167	167	167
DOCKUM AQUIFER	LAMB	BRAZOS	FRESH	923	923	923	923	923	923
DOCKUM AQUIFER	LUBBOCK	BRAZOS	FRESH	1,086	1,086	1,086	1,086	1,086	1,086
DOCKUM AQUIFER	LYNN	BRAZOS	FRESH	791	791	791	791	791	791
DOCKUM AQUIFER	LYNN	COLORADO	FRESH	121	121	121	121	121	121
DOCKUM AQUIFER	MOTLEY	RED	FRESH	93	93	93	92	92	92
DOCKUM AQUIFER	PARMER	BRAZOS	FRESH	3,152	3,152	3,152	3,152	2,392	2,291
DOCKUM AQUIFER	PARMER	RED	FRESH	2,298	2,298	2,298	2,298	2,298	2,298
DOCKUM AQUIFER	SWISHER	BRAZOS	FRESH	25	25	25	25	25	25
DOCKUM AQUIFER	SWISHER	RED	FRESH	1,551	1,551	1,551	1,551	1,551	1,551
OGALLALA AQUIFER	DICKENS	BRAZOS	FRESH	500	500	500	500	500	500
OGALLALA AQUIFER	DICKENS	RED	FRESH	800	800	800	800	800	800
OGALLALA AQUIFER	MOTLEY	RED	FRESH	409	409	409	409	409	409
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	BAILEY	BRAZOS	FRESH	97,679	67,307	51,199	42,704	37,858	34,815
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	BRISCOE	RED	FRESH	29,022	17,637	11,907	9,053	7,445	6,451
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	CASTRO	BRAZOS	FRESH	159,730	112,038	61,892	32,048	19,950	14,535
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	CASTRO	RED	FRESH	107,563	72,432	43,208	25,577	17,236	12,970
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	COCHRAN	BRAZOS	FRESH	26,117	21,555	18,919	17,399	16,483	15,900
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	COCHRAN	COLORADO	FRESH	75,645	57,597	45,584	38,008	31,376	26,775
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	CROSBY	BRAZOS	FRESH	162,630	108,077	68,110	46,363	35,547	29,723

*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.

Region O Source Availability

GROUNDWATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY *	2020	2030	2040	2050	2060	2070
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	CROSBY	RED	FRESH	3,693	3,503	3,068	2,373	1,888	1,567
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	DAWSON	BRAZOS	FRESH	1,699	1,456	1,329	1,256	1,210	1,178
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	DAWSON	COLORADO	FRESH	171,153	122,020	95,467	81,027	73,400	68,749
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	DEAF SMITH	RED	FRESH	206,336	137,403	90,088	65,661	52,833	45,606
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	FLOYD	BRAZOS	FRESH	144,643	69,038	43,219	30,165	23,203	19,428
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	FLOYD	RED	FRESH	25,808	25,101	24,583	23,926	22,995	22,109
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	GAINES	COLORADO	FRESH	277,954	218,338	184,298	162,643	147,743	138,294
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	GARZA	BRAZOS	FRESH	16,297	13,648	12,395	11,657	11,180	10,855
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	GARZA	COLORADO	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	HALE	BRAZOS	FRESH	219,639	114,473	70,305	48,453	37,543	31,804
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	HALE	RED	FRESH	472	455	358	266	197	150
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	HOCKLEY	BRAZOS	FRESH	130,832	85,716	66,206	56,994	52,150	49,382
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	HOCKLEY	COLORADO	FRESH	46,599	26,171	11,564	6,793	5,037	4,228
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	LAMB	BRAZOS	FRESH	223,477	112,082	71,220	56,582	50,140	46,816
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	LUBBOCK	BRAZOS	FRESH	151,056	121,404	109,134	100,850	94,935	90,798
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	LYNN	BRAZOS	FRESH	104,528	88,796	79,406	73,546	69,934	67,598
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	LYNN	COLORADO	FRESH	8,079	7,355	6,088	5,057	4,414	4,042
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	PARMER	BRAZOS	FRESH	78,257	50,870	34,925	26,034	20,971	17,881
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	PARMER	RED	FRESH	73,758	40,228	24,334	17,703	14,499	12,655
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	SWISHER	BRAZOS	FRESH	25,301	10,833	6,160	4,109	3,092	2,534
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	SWISHER	RED	FRESH	103,982	60,806	40,124	29,802	23,926	20,249
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	TERRY	BRAZOS	FRESH	8,367	7,167	6,548	6,142	5,864	5,670
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	TERRY	COLORADO	FRESH	182,401	125,610	99,345	88,554	83,019	79,849
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	YOAKUM	COLORADO	FRESH	138,940	92,952	69,400	58,308	52,469	48,940
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

*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.

Region O Source Availability

GROUNDWATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY *	2020	2030	2040	2050	2060	2070
OTHER AQUIFER	MOTLEY	RED	BRACKISH	13,000	13,000	13,000	13,000	13,000	13,000
SEYMOUR AQUIFER	BRISCOE	RED	BRACKISH	313	313	313	313	313	313
SEYMOUR AQUIFER	MOTLEY	RED	FRESH	4,843	6,679	4,843	4,830	3,972	3,961
GROUNDWATER TOTAL SOURCE AVAILABILITY				**3,091,566**	**2,083,813**	**1,540,292**	**1,258,948**	**1,106,814**	**1,019,716**

REUSE SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY *	2020	2030	2040	2050	2060	2070
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
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
REUSE TOTAL SOURCE AVAILABILITY				**48,945**	**51,353**	**53,806**	**55,497**	**56,998**	**58,252**

SURFACE WATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY *	2020	2030	2040	2050	2060	2070
ALAN HENRY LAKE/RESERVOIR	RESERVOIR	BRAZOS	FRESH	20,600	20,320	20,020	19,700	19,380	18,720
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
BRAZOS RUN-OF-RIVER	CROSBY	BRAZOS	FRESH	0	0	0	0	0	0
MACKENZIE LAKE/RESERVOIR	RESERVOIR	RED	FRESH	4,530	4,530	4,530	4,530	4,530	4,530
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	3,650	3,650	3,650	3,650	3,650	3,650
SURFACE WATER TOTAL SOURCE AVAILABILITY				**28,898**	**28,618**	**28,318**	**27,998**	**27,678**	**27,018**

	2020	2030	2040	2050	2060	2070
REGION O TOTAL SOURCE AVAILABILITY	**3,169,409**	**2,163,784**	**1,622,416**	**1,342,443**	**1,191,490**	**1,104,986**

*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.

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Appendix E. TWDB DB22 Report #5 – WUG Existing Water Supplies

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Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
MULESHOE	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | BAILEY COUNTY	3,056	3,056	3,056	3,056	3,056	3,056
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | BAILEY COUNTY	411	411	411	411	411	411
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | BAILEY COUNTY	3,077	3,077	3,077	3,077	3,077	3,077
IRRIGATION	O	DIRECT REUSE	825	825	825	825	825	825
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | BAILEY COUNTY	71,985	41,613	25,505	17,010	12,164	9,121
		BRAZOS BASIN TOTAL	**79,354**	**48,982**	**32,874**	**24,379**	**19,533**	**16,490**
		BAILEY COUNTY TOTAL	**79,354**	**48,982**	**32,874**	**24,379**	**19,533**	**16,490**
QUITAQUE	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | 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	199	199	199	199	199	199
COUNTY-OTHER	O	RED RUN-OF-RIVER	20	20	20	20	20	20
LIVESTOCK	O	DOCKUM AQUIFER | BRISCOE COUNTY	0	0	0	0	0	0
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | BRISCOE COUNTY	115	115	115	115	115	115
LIVESTOCK	O	OTHER AQUIFER | BRISCOE COUNTY	238	238	238	238	238	238
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | BRISCOE COUNTY	28,589	17,204	11,474	8,620	7,012	6,018
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	313	313	313	313	313	313
		RED BASIN TOTAL	**34,686**	**23,301**	**17,571**	**14,717**	**13,109**	**12,115**
		BRISCOE COUNTY TOTAL	**34,686**	**23,301**	**17,571**	**14,717**	**13,109**	**12,115**
DIMMITT	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CASTRO COUNTY	3,923	3,923	3,923	3,923	3,923	3,923
HART MUNICIPAL WATER SYSTEM	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CASTRO COUNTY	559	559	559	559	559	559
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CASTRO COUNTY	255	255	255	255	255	255
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CASTRO COUNTY	7,596	7,596	7,596	7,596	7,596	7,596
IRRIGATION	O	DIRECT REUSE	4,031	4,031	4,031	4,031	4,031	4,031
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CASTRO COUNTY	147,397	99,705	49,559	19,715	7,617	2,202
		BRAZOS BASIN TOTAL	**163,761**	**116,069**	**65,923**	**36,079**	**23,981**	**18,566**
NAZARETH	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CASTRO COUNTY	552	552	552	552	552	552
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CASTRO COUNTY	205	205	205	205	205	205
MANUFACTURING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CASTRO COUNTY	95	95	95	95	95	95
LIVESTOCK	O	DOCKUM AQUIFER | CASTRO COUNTY	425	425	425	425	425	425
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CASTRO COUNTY	3,318	3,318	3,318	3,318	3,318	3,318
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CASTRO COUNTY	103,393	68,262	39,038	21,407	13,066	8,800
		RED BASIN TOTAL	**107,988**	**72,857**	**43,633**	**26,002**	**17,661**	**13,395**
		CASTRO COUNTY TOTAL	**271,749**	**188,926**	**109,556**	**62,081**	**41,642**	**31,961**
MORTON PWS	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | COCHRAN COUNTY	598	598	598	598	598	598

Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
WHITEFACE	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | COCHRAN COUNTY	313	313	313	313	313	313
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | COCHRAN COUNTY	228	228	228	228	228	228
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | COCHRAN COUNTY	90	90	90	90	90	90
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | COCHRAN COUNTY	307	307	307	307	307	307
IRRIGATION	O	DIRECT REUSE	267	267	267	267	267	267
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | COCHRAN COUNTY	24,581	20,019	17,383	15,863	14,947	14,364
		BRAZOS BASIN TOTAL	**26,384**	**21,822**	**19,186**	**17,666**	**16,750**	**16,167**
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | COCHRAN COUNTY	155	155	155	155	155	155
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | COCHRAN COUNTY	222	222	222	222	222	222
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | COCHRAN COUNTY	367	367	367	367	367	367
IRRIGATION	O	DIRECT REUSE	27	27	27	27	27	27
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | COCHRAN COUNTY	49,785	49,785	44,840	37,264	30,632	26,031
		COLORADO BASIN TOTAL	**50,556**	**50,556**	**45,611**	**38,035**	**31,403**	**26,802**
		COCHRAN COUNTY TOTAL	**76,940**	**72,378**	**64,797**	**55,701**	**48,153**	**42,969**
CROSBYTON	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CROSBY COUNTY	382	382	382	382	382	382
LORENZO	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CROSBY COUNTY	904	904	904	904	904	904
RALLS	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CROSBY COUNTY	233	233	233	233	233	233
COUNTY-OTHER	O	DOCKUM AQUIFER | CROSBY COUNTY	2	2	2	2	2	2
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CROSBY COUNTY	183	183	183	183	183	183
COUNTY-OTHER	O	OTHER AQUIFER | CROSBY COUNTY	2	2	2	2	2	2
MANUFACTURING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CROSBY COUNTY	3	3	3	3	3	3
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CROSBY COUNTY	1,183	1,183	1,183	1,183	1,183	1,183
LIVESTOCK	O	DOCKUM AQUIFER | CROSBY COUNTY	84	84	84	84	84	84
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CROSBY COUNTY	66	66	66	66	66	66
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 AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CROSBY COUNTY	150,886	104,239	64,272	42,525	31,709	25,885
IRRIGATION	O	OTHER AQUIFER | CROSBY COUNTY	8,405	8,405	8,405	8,405	8,405	8,405
		BRAZOS BASIN TOTAL	**166,571**	**119,924**	**79,957**	**58,210**	**47,394**	**41,570**
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CROSBY COUNTY	1	1	1	1	1	1
MINING		NO WATER SUPPLY ASSOCIATED WITH WUG	0	0	0	0	0	0
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CROSBY COUNTY	6	6	6	6	6	6
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CROSBY COUNTY	3,686	3,496	3,061	2,366	1,881	1,560

Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
		RED BASIN TOTAL	**3,693**	**3,503**	**3,068**	**2,373**	**1,888**	**1,567**
		CROSBY COUNTY TOTAL	**170,264**	**123,427**	**83,025**	**60,583**	**49,282**	**43,137**
ODONNELL	A	MEREDITH LAKE/RESERVOIR	4	4	4	4	4	4
ODONNELL	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DAWSON COUNTY	17	17	17	17	17	17
ODONNELL	A	OGALLALA AQUIFER | ROBERTS COUNTY	12	11	10	8	8	8
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DAWSON COUNTY	5	5	5	5	5	5
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DAWSON COUNTY	1	1	1	1	1	1
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DAWSON COUNTY	1,578	1,335	1,208	1,135	1,089	1,057
		BRAZOS BASIN TOTAL	**1,617**	**1,373**	**1,245**	**1,170**	**1,124**	**1,092**
LAMESA	A	MEREDITH LAKE/RESERVOIR	429	438	490	560	555	554
LAMESA	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DAWSON COUNTY	723	723	723	723	723	723
LAMESA	A	OGALLALA AQUIFER | ROBERTS COUNTY	1,130	1,157	1,208	1,264	1,128	1,127
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DAWSON COUNTY	745	745	745	745	745	745
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DAWSON COUNTY	266	266	266	266	266	266
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DAWSON COUNTY	200	200	200	200	200	200
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DAWSON COUNTY	156,857	120,086	93,533	79,093	71,466	66,815
		COLORADO BASIN TOTAL	**160,350**	**123,615**	**97,165**	**82,851**	**75,083**	**70,430**
		DAWSON COUNTY TOTAL	**161,967**	**124,988**	**98,410**	**84,021**	**76,207**	**71,522**
COUNTY-OTHER	O	DOCKUM AQUIFER | DEAF SMITH COUNTY	2	2	2	2	2	2
LIVESTOCK	O	DOCKUM AQUIFER | DEAF SMITH COUNTY	0	0	0	0	0	0
IRRIGATION		NO WATER SUPPLY ASSOCIATED WITH WUG	0	0	0	0	0	0
		CANADIAN BASIN TOTAL	**2**	**2**	**2**	**2**	**2**	**2**
HEREFORD	O	DOCKUM AQUIFER | DEAF SMITH COUNTY	3,422	3,422	3,422	3,422	3,422	3,422
HEREFORD	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DEAF SMITH COUNTY	3,337	3,337	3,337	3,337	3,337	3,337
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DEAF SMITH COUNTY	986	986	986	986	986	986
MANUFACTURING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DEAF SMITH COUNTY	4	4	4	4	4	4
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DEAF SMITH COUNTY	12,089	12,089	12,089	12,089	12,089	12,089
IRRIGATION	O	DIRECT REUSE	2,810	2,810	2,810	2,810	2,810	2,810
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DEAF SMITH COUNTY	189,620	120,687	73,372	48,945	36,167	28,990
		RED BASIN TOTAL	**212,268**	**143,335**	**96,020**	**71,593**	**58,815**	**51,638**
		DEAF SMITH COUNTY TOTAL	**212,270**	**143,337**	**96,022**	**71,595**	**58,817**	**51,640**
SPUR	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CROSBY COUNTY	224	224	224	224	224	224
COUNTY-OTHER	O	OGALLALA AQUIFER | DICKENS COUNTY	12	12	12	12	12	12
COUNTY-OTHER	O	OTHER AQUIFER | DICKENS COUNTY	138	138	138	138	138	138
MINING	O	OGALLALA AQUIFER | DICKENS COUNTY	18	18	18	18	18	18
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

Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
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	OGALLALA AQUIFER | DICKENS COUNTY	378	378	378	378	378	378
IRRIGATION	O	OTHER AQUIFER | DICKENS COUNTY	5,518	5,518	5,518	5,518	5,518	5,518
		BRAZOS BASIN TOTAL	**6,611**	**6,611**	**6,611**	**6,611**	**6,611**	**6,611**
RED RIVER AUTHORITY OF TEXAS	O	OTHER AQUIFER | DICKENS COUNTY	11	12	13	14	15	16
COUNTY-OTHER	O	OGALLALA AQUIFER | DICKENS COUNTY	9	9	9	9	9	9
COUNTY-OTHER	O	OTHER AQUIFER | DICKENS COUNTY	22	22	22	22	22	22
MINING	O	OGALLALA AQUIFER | DICKENS COUNTY	11	11	11	11	11	11
LIVESTOCK	O	DOCKUM AQUIFER | DICKENS COUNTY	24	24	24	24	24	24
LIVESTOCK	O	OGALLALA AQUIFER | DICKENS COUNTY	12	12	12	12	12	12
LIVESTOCK	O	OTHER AQUIFER | DICKENS COUNTY	150	150	150	150	150	150
IRRIGATION	O	DOCKUM AQUIFER | DICKENS COUNTY	25	25	25	25	25	25
IRRIGATION	O	OGALLALA AQUIFER | DICKENS COUNTY	768	768	768	768	768	768
IRRIGATION	O	OTHER AQUIFER | DICKENS COUNTY	3,665	3,665	3,665	3,665	3,665	3,665
		RED BASIN TOTAL	**4,697**	**4,698**	**4,699**	**4,700**	**4,701**	**4,702**
		DICKENS COUNTY TOTAL	**11,308**	**11,309**	**11,310**	**11,311**	**11,312**	**11,313**
FLOYDADA	O	MACKENZIE LAKE/RESERVOIR	155	155	155	155	155	155
FLOYDADA	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | 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
LOCKNEY	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | FLOYD COUNTY	464	464	464	464	464	464
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | FLOYD COUNTY	196	196	196	196	196	196
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | FLOYD COUNTY	217	217	217	217	217	217
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | FLOYD COUNTY	971	971	971	971	971	971
IRRIGATION	O	DIRECT REUSE	449	449	449	449	449	449
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | FLOYD COUNTY	68,225	65,389	39,570	26,516	19,554	15,779
		BRAZOS BASIN TOTAL	**72,553**	**69,717**	**43,898**	**30,844**	**23,882**	**20,107**
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | FLOYD COUNTY	99	99	99	99	99	99
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | FLOYD COUNTY	275	275	275	275	275	275
LIVESTOCK	O	DOCKUM AQUIFER | FLOYD COUNTY	250	250	250	250	250	250
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | FLOYD COUNTY	337	337	337	337	337	337
LIVESTOCK	O	OTHER AQUIFER | FLOYD COUNTY	81	81	81	81	81	81
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | FLOYD COUNTY	25,097	24,390	23,872	23,215	22,284	21,398
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
		RED BASIN TOTAL	**41,561**	**40,854**	**40,336**	**39,679**	**38,748**	**37,862**
		FLOYD COUNTY TOTAL	**114,114**	**110,571**	**84,234**	**70,523**	**62,630**	**57,969**
SEAGRAVES	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | GAINES COUNTY	969	969	969	969	969	969
SEMINOLE	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | GAINES COUNTY	1,797	1,797	1,797	1,797	1,797	1,797

Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | GAINES COUNTY	1,750	1,750	1,750	1,750	1,750	1,750
MANUFACTURING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | GAINES COUNTY	544	544	544	544	544	544
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | GAINES COUNTY	7,729	7,729	7,729	7,729	7,729	7,729
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | GAINES COUNTY	203	203	203	203	203	203
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | GAINES COUNTY	264,961	205,345	171,305	149,650	134,750	125,301
		COLORADO BASIN TOTAL	**277,953**	**218,337**	**184,297**	**162,642**	**147,742**	**138,293**
		GAINES COUNTY TOTAL	**277,953**	**218,337**	**184,297**	**162,642**	**147,742**	**138,293**
POST	O	BRAZOS RUN-OF-RIVER	0	0	0	0	0	0
POST	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CROSBY COUNTY	658	658	658	658	658	658
POST	A	OGALLALA AQUIFER | ROBERTS COUNTY	306	306	306	306	306	306
COUNTY-OTHER	O	ALAN HENRY LAKE/RESERVOIR	25	25	25	25	25	25
COUNTY-OTHER	G	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM	0	0	0	0	0	0
COUNTY-OTHER	O	DOCKUM AQUIFER | GARZA COUNTY	30	30	30	30	30	30
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | GARZA COUNTY	116	116	116	116	116	116
MANUFACTURING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | CROSBY COUNTY	2	2	2	2	2	2
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | GARZA COUNTY	544	544	544	544	544	544
LIVESTOCK	O	DOCKUM AQUIFER | GARZA COUNTY	152	152	152	152	152	152
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | GARZA COUNTY	12	12	12	12	12	12
LIVESTOCK	O	OTHER AQUIFER | GARZA COUNTY	20	20	20	20	20	20
IRRIGATION	O	DOCKUM AQUIFER | GARZA COUNTY	234	234	234	234	234	234
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | GARZA COUNTY	13,384	12,976	11,723	10,985	10,508	10,183
IRRIGATION	O	OTHER AQUIFER | GARZA COUNTY	1,410	1,410	1,410	1,410	1,410	1,410
		BRAZOS BASIN TOTAL	**16,893**	**16,485**	**15,232**	**14,494**	**14,017**	**13,692**
		GARZA COUNTY TOTAL	**16,893**	**16,485**	**15,232**	**14,494**	**14,017**	**13,692**
ABERNATHY	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HALE COUNTY	1,379	1,355	1,326	1,288	1,267	1,241
HALE CENTER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HALE COUNTY	956	956	956	956	956	956
PETERSBURG MUNICIPAL WATER SYSTEM	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HALE COUNTY	594	594	594	594	594	594
PLAINVIEW	A	MEREDITH LAKE/RESERVOIR	613	675	692	712	707	705
PLAINVIEW	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HALE COUNTY	6,206	6,206	6,206	6,206	6,206	6,206
PLAINVIEW	A	OGALLALA AQUIFER | ROBERTS COUNTY	1,614	1,780	1,707	1,608	1,436	1,434
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HALE COUNTY	1,289	1,289	1,289	1,289	1,289	1,289
MANUFACTURING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HALE COUNTY	1,416	1,416	1,416	1,416	1,416	1,416
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HALE COUNTY	215	215	215	215	215	215
STEAM ELECTRIC POWER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HALE COUNTY	31	31	31	31	31	31

Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HALE COUNTY	3,715	3,715	3,715	3,715	3,715	3,715
IRRIGATION	O	DIRECT REUSE	5,477	5,477	5,477	5,477	5,477	5,477
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HALE COUNTY	203,359	98,193	54,025	32,173	21,263	15,524
		BRAZOS BASIN TOTAL	**226,864**	**121,902**	**77,649**	**55,680**	**44,572**	**38,803**
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HALE COUNTY	472	455	358	266	197	150
		RED BASIN TOTAL	**472**	**455**	**358**	**266**	**197**	**150**
		HALE COUNTY TOTAL	**227,336**	**122,357**	**78,007**	**55,946**	**44,769**	**38,953**
ANTON	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HOCKLEY COUNTY	835	835	835	835	835	835
LEVELLAND	A	MEREDITH LAKE/RESERVOIR	564	540	532	527	540	553
LEVELLAND	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HOCKLEY COUNTY	3,164	3,164	3,164	3,164	3,164	3,164
LEVELLAND	A	OGALLALA AQUIFER | ROBERTS COUNTY	1,486	1,424	1,313	1,189	1,096	1,124
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HOCKLEY COUNTY	1,114	1,114	1,114	1,114	1,114	1,114
MANUFACTURING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HOCKLEY COUNTY	700	700	700	700	700	700
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HOCKLEY COUNTY	1,311	1,311	1,311	1,311	1,311	1,311
LIVESTOCK	O	DOCKUM AQUIFER | HOCKLEY COUNTY	28	28	28	28	28	28
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HOCKLEY COUNTY	321	321	321	321	321	321
IRRIGATION	O	DIRECT REUSE	1,359	1,359	1,359	1,359	1,359	1,359
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HOCKLEY COUNTY	123,387	78,271	58,761	49,549	44,705	41,937
		BRAZOS BASIN TOTAL	**134,269**	**89,067**	**69,438**	**60,097**	**55,173**	**52,446**
SUNDOWN	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HOCKLEY COUNTY	860	860	860	860	860	860
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HOCKLEY COUNTY	38	38	38	38	38	38
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HOCKLEY COUNTY	236	236	236	236	236	236
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HOCKLEY COUNTY	59	59	59	59	59	59
IRRIGATION	O	DIRECT REUSE	162	162	162	162	162	162
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HOCKLEY COUNTY	13,825	13,825	10,371	5,600	3,844	3,035
		COLORADO BASIN TOTAL	**15,180**	**15,180**	**11,726**	**6,955**	**5,199**	**4,390**
		HOCKLEY COUNTY TOTAL	**149,449**	**104,247**	**81,164**	**67,052**	**60,372**	**56,836**
AMHERST	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LAMB COUNTY	234	234	234	234	234	234
EARTH	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LAMB COUNTY	690	690	690	690	690	690
LITTLEFIELD	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LAMB COUNTY	2,378	2,378	2,378	2,378	2,378	2,378
OLTON	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LAMB COUNTY	1,352	1,352	1,352	1,352	1,352	1,352
SUDAN	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LAMB COUNTY	419	419	419	419	419	419
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LAMB COUNTY	575	575	575	575	575	575
MANUFACTURING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LAMB COUNTY	1,000	1,000	1,000	1,000	1,000	1,000

Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LAMB COUNTY	108	108	108	108	108	108
STEAM ELECTRIC POWER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LAMB COUNTY	15,666	15,666	15,666	15,666	15,666	15,666
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LAMB COUNTY	5,225	5,225	5,225	5,225	5,225	5,225
IRRIGATION	O	DIRECT REUSE	7,199	7,199	7,199	7,199	7,199	7,199
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LAMB COUNTY	176,876	65,481	24,619	9,981	3,539	215
		BRAZOS BASIN TOTAL	**211,722**	**100,327**	**59,465**	**44,827**	**38,385**	**35,061**
		LAMB COUNTY TOTAL	**211,722**	**100,327**	**59,465**	**44,827**	**38,385**	**35,061**
ABERNATHY	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | HALE COUNTY	479	503	532	570	591	617
IDALOU	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LUBBOCK COUNTY	1,306	1,306	1,306	1,306	1,306	1,306
LUBBOCK	O	ALAN HENRY LAKE/RESERVOIR	7,630	7,630	7,630	7,630	7,630	7,630
LUBBOCK	G	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM	0	0	0	0	0	0
LUBBOCK	A	MEREDITH LAKE/RESERVOIR	8,723	8,769	9,264	9,565	9,494	9,470
LUBBOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | BAILEY COUNTY	1,906	1,735	1,488	1,203	880	0
LUBBOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LAMB COUNTY	2,156	1,985	1,738	1,453	1,130	0
LUBBOCK	A	OGALLALA AQUIFER | ROBERTS COUNTY	22,644	22,795	22,505	21,257	18,941	18,919
NEW DEAL	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LUBBOCK COUNTY	333	333	333	333	333	333
NEW DEAL	A	OGALLALA AQUIFER | ROBERTS COUNTY	153	153	153	153	153	153
RANSOM CANYON	O	ALAN HENRY LAKE/RESERVOIR	143	143	143	143	143	143
RANSOM CANYON	G	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM	0	0	0	0	0	0
RANSOM CANYON	O	BRAZOS RUN-OF-RIVER	0	0	0	0	0	0
RANSOM CANYON	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | BAILEY COUNTY	142	142	142	142	142	142
RANSOM CANYON	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LAMB COUNTY	142	142	142	142	142	142
RANSOM CANYON	A	OGALLALA AQUIFER | ROBERTS COUNTY	142	142	142	142	142	142
SHALLOWATER	G	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM	0	0	0	0	0	0
SHALLOWATER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | BAILEY COUNTY	250	250	250	250	250	250
SHALLOWATER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LUBBOCK COUNTY	416	416	416	416	416	416
SLATON	A	MEREDITH LAKE/RESERVOIR	344	322	310	301	298	298
SLATON	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LUBBOCK COUNTY	1,287	1,287	1,287	1,287	1,287	1,287
SLATON	A	OGALLALA AQUIFER | ROBERTS COUNTY	448	389	305	221	147	146
WOLFFORTH	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | 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	202	202
COUNTY-OTHER	G	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM	0	0	0	0	0	0
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | BAILEY COUNTY	202	202	202	202	202	202
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LAMB COUNTY	202	202	202	202	202	202

Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LUBBOCK COUNTY	5,534	5,534	5,534	5,534	5,534	5,534
COUNTY-OTHER	A	OGALLALA AQUIFER | ROBERTS COUNTY	200	200	200	200	200	200
MANUFACTURING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LUBBOCK COUNTY	335	335	335	335	335	335
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LUBBOCK COUNTY	982	982	982	982	982	982
STEAM ELECTRIC POWER	O	DIRECT REUSE	10,080	10,080	10,080	7,840	7,840	7,840
STEAM ELECTRIC POWER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LUBBOCK COUNTY	18	18	18	18	18	18
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LUBBOCK COUNTY	1,290	1,290	1,290	1,290	1,290	1,290
IRRIGATION	O	DIRECT REUSE	8,960	2,240	2,240	2,240	2,240	2,240
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LUBBOCK COUNTY	138,374	108,722	96,452	88,168	82,253	78,116
		BRAZOS BASIN TOTAL	**216,203**	**179,629**	**167,003**	**154,907**	**145,903**	**139,735**
		LUBBOCK COUNTY TOTAL	**216,203**	**179,629**	**167,003**	**154,907**	**145,903**	**139,735**
ODONNELL	A	MEREDITH LAKE/RESERVOIR	26	24	22	21	22	23
ODONNELL	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | DAWSON COUNTY	98	98	98	98	98	98
ODONNELL	A	OGALLALA AQUIFER | ROBERTS COUNTY	68	63	55	49	45	46
TAHOKA PUBLIC WATER SYSTEM	A	MEREDITH LAKE/RESERVOIR	117	109	102	96	99	101
TAHOKA PUBLIC WATER SYSTEM	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LYNN COUNTY	441	441	441	441	441	441
TAHOKA PUBLIC WATER SYSTEM	A	OGALLALA AQUIFER | ROBERTS COUNTY	307	288	251	216	202	206
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LYNN COUNTY	378	378	378	378	378	378
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LYNN COUNTY	449	449	449	449	449	449
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LYNN COUNTY	158	158	158	158	158	158
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 AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LYNN COUNTY	103,102	87,370	77,980	72,120	68,508	66,172
		BRAZOS BASIN TOTAL	**105,490**	**89,724**	**80,280**	**74,372**	**70,746**	**68,418**
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LYNN COUNTY	11	11	11	11	11	11
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LYNN COUNTY	93	93	93	93	93	93
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LYNN COUNTY	9	9	9	9	9	9
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | LYNN COUNTY	7,045	7,045	5,975	4,944	4,301	3,929
		COLORADO BASIN TOTAL	**7,158**	**7,158**	**6,088**	**5,057**	**4,414**	**4,042**
		LYNN COUNTY TOTAL	**112,648**	**96,882**	**86,368**	**79,429**	**75,160**	**72,460**
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	6	6	7	7	8	8
COUNTY-OTHER	O	OTHER AQUIFER | MOTLEY COUNTY	83	83	83	83	83	83
COUNTY-OTHER	O	SEYMOUR AQUIFER | MOTLEY COUNTY	39	39	39	39	39	39

Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
MINING	O	OGALLALA AQUIFER | MOTLEY COUNTY	104	104	104	104	104	104
MINING	O	SEYMOUR AQUIFER | MOTLEY COUNTY	140	140	140	140	140	140
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	33	33	33	32	32	32
IRRIGATION	O	OGALLALA AQUIFER | MOTLEY COUNTY	248	248	248	248	248	248
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
		RED BASIN TOTAL	**13,628**	**13,628**	**13,629**	**13,628**	**13,629**	**13,629**
		MOTLEY COUNTY TOTAL	**13,628**	**13,628**	**13,629**	**13,628**	**13,629**	**13,629**
BOVINA	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | PARMER COUNTY	571	571	571	571	571	571
FARWELL	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | PARMER COUNTY	858	858	858	858	858	858
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | PARMER COUNTY	551	551	551	551	551	551
LIVESTOCK	O	DOCKUM AQUIFER | PARMER COUNTY	900	900	900	900	900	900
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | PARMER COUNTY	8,163	8,163	8,163	8,163	8,163	8,163
IRRIGATION	O	DIRECT REUSE	401	401	401	401	401	401
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | PARMER COUNTY	68,114	40,727	24,782	15,891	10,828	7,738
		BRAZOS BASIN TOTAL	**79,558**	**52,171**	**36,226**	**27,335**	**22,272**	**19,182**
FRIONA	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | PARMER COUNTY	2,163	2,163	2,163	2,163	2,163	2,163
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | PARMER COUNTY	395	395	395	395	395	395
MANUFACTURING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | PARMER COUNTY	1,866	1,866	1,866	1,866	1,866	1,866
LIVESTOCK	O	DOCKUM AQUIFER | PARMER COUNTY	325	325	325	325	325	325
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | PARMER COUNTY	1,941	1,941	1,941	1,941	1,941	1,941
IRRIGATION	O	DIRECT REUSE	2,486	2,486	2,486	2,486	2,486	2,486
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | PARMER COUNTY	67,393	33,863	17,969	11,338	8,134	6,290
IRRIGATION	O	RED RUN-OF-RIVER	0	0	0	0	0	0
		RED BASIN TOTAL	**76,569**	**43,039**	**27,145**	**20,514**	**17,310**	**15,466**
		PARMER COUNTY TOTAL	**156,127**	**95,210**	**63,371**	**47,849**	**39,582**	**34,648**
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | SWISHER COUNTY	63	63	63	63	63	63
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | SWISHER COUNTY	2,793	2,793	2,793	2,793	2,793	2,471
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | SWISHER COUNTY	22,445	7,977	3,304	1,253	236	0
		BRAZOS BASIN TOTAL	**25,301**	**10,833**	**6,160**	**4,109**	**3,092**	**2,534**
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 AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | SWISHER COUNTY	529	529	529	529	529	529

Region O Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | SWISHER COUNTY	384	384	384	384	384	384
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | SWISHER COUNTY	3,296	3,296	3,296	3,296	3,296	3,296
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | SWISHER COUNTY	99,773	56,597	35,915	25,593	19,177	16,040
		RED BASIN TOTAL	**105,733**	**62,556**	**41,873**	**31,550**	**25,133**	**21,994**
		SWISHER COUNTY TOTAL	**131,034**	**73,389**	**48,033**	**35,659**	**28,225**	**24,528**
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | TERRY COUNTY	11	11	11	11	11	11
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | TERRY COUNTY	40	40	40	40	40	40
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | TERRY COUNTY	28	28	28	28	28	28
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | TERRY COUNTY	8,288	7,088	6,469	6,063	5,785	5,591
		BRAZOS BASIN TOTAL	**8,367**	**7,167**	**6,548**	**6,142**	**5,864**	**5,670**
BROWNFIELD	A	MEREDITH LAKE/RESERVOIR	368	349	351	356	353	353
BROWNFIELD	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | TERRY COUNTY	632	632	632	632	632	632
BROWNFIELD	A	OGALLALA AQUIFER | ROBERTS COUNTY	969	920	867	804	718	717
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | TERRY COUNTY	545	545	545	545	545	545
MANUFACTURING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | TERRY COUNTY	17	17	17	17	17	17
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | TERRY COUNTY	100	100	100	100	100	100
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | TERRY COUNTY	562	562	562	562	562	562
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | TERRY COUNTY	180,545	123,754	97,489	86,698	81,163	77,993
		COLORADO BASIN TOTAL	**183,738**	**126,879**	**100,563**	**89,714**	**84,090**	**80,919**
		TERRY COUNTY TOTAL	**192,105**	**134,046**	**107,111**	**95,856**	**89,954**	**86,589**
DENVER CITY	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | YOAKUM COUNTY	5,313	5,313	5,313	5,313	5,313	5,313
PLAINS	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | YOAKUM COUNTY	1,138	1,138	1,138	1,138	1,138	1,138
COUNTY-OTHER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | YOAKUM COUNTY	399	399	399	399	399	399
MINING	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | YOAKUM COUNTY	764	764	764	764	764	764
STEAM ELECTRIC POWER	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | YOAKUM COUNTY	2,000	2,000	2,000	2,000	2,000	2,000
LIVESTOCK	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | YOAKUM COUNTY	191	191	191	191	191	191
IRRIGATION	O	OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER | YOAKUM COUNTY	129,135	83,147	59,595	48,503	42,664	39,135
		COLORADO BASIN TOTAL	**138,940**	**92,952**	**69,400**	**58,308**	**52,469**	**48,940**
		YOAKUM COUNTY TOTAL	**138,940**	**92,952**	**69,400**	**58,308**	**52,469**	**48,940**
		REGION O TOTAL EXISTING WATER SUPPLY	**2,976,690**	**2,094,708**	**1,570,879**	**1,285,508**	**1,130,892**	**1,042,480**

Appendix F. TWDB DB22 Report #6 – WUG Identified Water Needs/Surpluses

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Region O Water User Group (WUG) Needs/Surplus*

	(NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
BAILEY COUNTY - BRAZOS BASIN						
MULESHOE	1,883	1,773	1,659	1,533	1,401	1,269
COUNTY-OTHER	134	115	91	60	30	0
LIVESTOCK	649	256	7	(264)	(562)	(881)
IRRIGATION	(15,298)	(45,670)	(45,670)	(45,670)	(45,670)	(45,670)
BRISCOE COUNTY - RED BASIN						
QUITAQUE	212	214	216	216	217	217
SILVERTON	0	4	7	8	8	8
COUNTY-OTHER	60	63	65	65	65	65
LIVESTOCK	67	53	38	22	6	1
IRRIGATION	7,251	(4,134)	(4,134)	(4,134)	(4,134)	(4,134)
CASTRO COUNTY - BRAZOS BASIN						
DIMMITT	2,832	2,764	2,718	2,669	2,624	2,588
HART MUNICIPAL WATER SYSTEM	384	376	371	362	356	350
COUNTY-OTHER	51	42	34	24	15	9
LIVESTOCK	2,622	1,980	1,543	1,068	553	2
IRRIGATION	(95,483)	(143,175)	(141,731)	(140,716)	(139,529)	(138,651)
CASTRO COUNTY - RED BASIN						
NAZARETH	418	408	402	395	389	384
COUNTY-OTHER	41	34	28	19	13	7
MANUFACTURING	34	29	29	29	29	29
LIVESTOCK	1,996	1,770	1,617	1,451	1,269	1,076
IRRIGATION	(29,559)	(64,690)	(66,134)	(67,149)	(68,336)	(69,214)
COCHRAN COUNTY - BRAZOS BASIN						
MORTON PWS	121	121	127	139	129	126
WHITEFACE	195	191	192	193	190	189
COUNTY-OTHER	46	24	17	16	7	4
MINING	82	79	79	82	84	86
LIVESTOCK	237	234	232	229	226	226
IRRIGATION	(42,778)	(47,340)	(40,014)	(35,349)	(31,132)	(28,190)
COCHRAN COUNTY - COLORADO BASIN						
COUNTY-OTHER	31	16	12	11	5	3
MINING	76	25	23	67	113	145
LIVESTOCK	335	334	333	332	331	330
IRRIGATION	17,989	17,989	17,731	13,066	8,849	5,907
CROSBY COUNTY - BRAZOS BASIN						
CROSBYTON	81	69	59	42	23	6
LORENZO	673	658	646	629	608	594
RALLS	(78)	(89)	(98)	(112)	(129)	(146)
COUNTY-OTHER	38	34	27	20	12	3
MANUFACTURING	1	0	0	0	0	0
MINING	557	566	634	706	770	825
LIVESTOCK	38	30	21	13	3	1
IRRIGATION	60,153	13,506	(26,461)	(26,655)	(26,618)	(26,540)

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Region O Water User Group (WUG) Needs/Surplus*

CROSBY COUNTY - RED BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	(368)	(363)	(322)	(280)	(243)	(210)
LIVESTOCK	2	2	2	1	1	1
IRRIGATION	(576)	(766)	(1,201)	(1,007)	(1,044)	(1,122)
DAWSON COUNTY - BRAZOS BASIN						
ODONNELL	15	14	13	11	10	9
COUNTY-OTHER	1	1	1	1	1	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	533	290	163	232	262	276
DAWSON COUNTY - COLORADO BASIN						
LAMESA	42	50	142	263	60	15
COUNTY-OTHER	143	117	94	79	41	11
MINING	(1,546)	(1,546)	(1,546)	(1,546)	(1,546)	(1,546)
LIVESTOCK	148	146	143	140	137	136
IRRIGATION	51,590	14,819	(11,734)	(11,803)	(11,833)	(11,847)
DEAF SMITH COUNTY - CANADIAN BASIN						
COUNTY-OTHER	1	1	1	1	1	0
LIVESTOCK	(112)	(122)	(130)	(138)	(147)	(157)
IRRIGATION	(2,101)	(2,101)	(1,628)	(1,383)	(1,255)	(1,183)
DEAF SMITH COUNTY - RED BASIN						
HEREFORD	2,902	2,405	1,842	1,170	623	20
COUNTY-OTHER	397	336	263	166	87	0
MANUFACTURING	(998)	(1,103)	(1,103)	(1,103)	(1,103)	(1,103)
LIVESTOCK	1,031	54	(714)	(1,539)	(2,425)	(3,358)
IRRIGATION	(15,485)	(84,418)	(84,891)	(85,136)	(85,214)	(85,236)
DICKENS COUNTY - BRAZOS BASIN						
SPUR	44	50	52	52	53	53
COUNTY-OTHER	30	35	39	40	41	41
MINING	8	8	8	8	8	8
LIVESTOCK	63	51	39	26	11	8
IRRIGATION	763	763	763	763	763	763
DICKENS COUNTY - RED BASIN						
RED RIVER AUTHORITY OF TEXAS	0	0	0	0	0	0
COUNTY-OTHER	6	7	8	8	8	8
MINING	9	9	9	9	9	9
LIVESTOCK	37	30	22	14	6	4
IRRIGATION	574	574	574	574	574	574
FLOYD COUNTY - BRAZOS BASIN						
FLOYDADA	1,384	1,402	1,410	1,411	1,412	1,412
LOCKNEY	262	256	254	244	236	229
COUNTY-OTHER	67	51	38	23	11	1
MINING	3	0	2	3	4	3
LIVESTOCK	77	61	43	24	5	0
IRRIGATION	22,294	19,458	3,120	(4,998)	(9,119)	(11,216)
FLOYD COUNTY - RED BASIN						
COUNTY-OTHER	36	28	21	13	8	3

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Region O Water User Group (WUG) Needs/Surplus*

MINING	3	0	1	3	4	4
LIVESTOCK	394	389	384	378	372	371
IRRIGATION	(41,938)	(42,645)	(26,307)	(18,189)	(14,068)	(11,971)
GAINES COUNTY - COLORADO BASIN						
SEAGRAVES	546	536	519	495	480	463
SEMINOLE	(551)	(774)	(1,050)	(1,363)	(1,614)	(1,878)
COUNTY-OTHER	350	(10)	(452)	(938)	(1,398)	(1,880)
MANUFACTURING	(968)	(1,043)	(1,043)	(1,043)	(1,043)	(1,043)
MINING	5,900	5,329	5,658	6,202	6,678	6,953
LIVESTOCK	80	77	74	70	67	66
IRRIGATION	(97,521)	(157,137)	(157,137)	(157,137)	(157,137)	(157,137)
GARZA COUNTY - BRAZOS BASIN						
POST	172	137	104	80	37	0
COUNTY-OTHER	36	43	46	45	42	38
MANUFACTURING	0	0	0	0	0	0
MINING	149	0	106	210	310	380
LIVESTOCK	36	29	22	14	5	3
IRRIGATION	4,675	4,267	3,014	2,276	1,799	1,474
HALE COUNTY - BRAZOS BASIN						
ABERNATHY	843	808	777	748	714	682
HALE CENTER	675	685	692	696	697	697
PETERSBURG MUNICIPAL WATER SYSTEM	273	265	265	269	261	258
PLAINVIEW	3,846	3,997	3,955	3,964	3,677	3,623
COUNTY-OTHER	258	241	249	276	245	231
MANUFACTURING	(2,967)	(3,660)	(3,660)	(3,660)	(3,660)	(3,660)
MINING	(953)	(937)	(807)	(671)	(551)	(447)
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	963	604	390	154	(105)	(383)
IRRIGATION	(98,604)	(203,770)	(204,115)	(204,242)	(204,283)	(204,294)
HALE COUNTY - RED BASIN						
IRRIGATION	(2,630)	(2,647)	(2,302)	(2,175)	(2,134)	(2,123)
HOCKLEY COUNTY - BRAZOS BASIN						
ANTON	675	671	670	670	664	659
LEVELLAND	2,773	2,608	2,456	2,333	2,146	2,114
COUNTY-OTHER	223	200	192	199	161	135
MANUFACTURING	124	9	9	9	9	9
MINING	1,295	1,295	1,296	1,296	1,297	1,298
LIVESTOCK	236	231	226	221	216	215
IRRIGATION	2,037	(43,079)	(30,841)	(27,041)	(25,744)	(25,183)
HOCKLEY COUNTY - COLORADO BASIN						
SUNDOWN	443	425	413	411	391	378
COUNTY-OTHER	8	7	7	7	6	5
MINING	234	234	234	234	234	234
LIVESTOCK	39	39	38	37	36	36
IRRIGATION	4,830	4,830	3,745	(55)	(1,352)	(1,913)
LAMB COUNTY - BRAZOS BASIN						
AMHERST	132	127	124	121	115	110

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Region O Water User Group (WUG) Needs/Surplus*

EARTH	499	500	504	507	504	504
LITTLEFIELD	1,391	1,422	1,451	1,462	1,464	1,464
OLTON	886	891	901	915	914	916
SUDAN	169	155	146	141	127	118
COUNTY-OTHER	174	141	124	128	98	83
MANUFACTURING	193	60	60	60	60	60
MINING	(478)	(471)	(405)	(337)	(277)	(225)
STEAM ELECTRIC POWER	2,216	2,216	2,216	2,216	2,216	2,216
LIVESTOCK	1,285	696	315	(100)	(555)	(1,046)
IRRIGATION	(75,376)	(186,771)	(186,771)	(186,771)	(186,771)	(186,771)
LUBBOCK COUNTY - BRAZOS BASIN						
ABERNATHY	293	300	312	331	333	339
IDALOU	872	865	855	839	821	803
LUBBOCK	(3,716)	(8,472)	(13,818)	(19,356)	(26,501)	(32,370)
NEW DEAL	373	366	358	349	339	328
RANSOM CANYON	233	214	193	169	145	121
SHALLOWATER	244	202	159	108	56	4
SLATON	1,334	1,273	1,190	1,098	1,015	1,006
WOLFFORTH	415	268	119	(43)	(204)	(366)
COUNTY-OTHER	2,543	2,760	3,111	2,171	1,211	1
MANUFACTURING	(521)	(676)	(676)	(676)	(676)	(676)
MINING	(5,372)	(5,443)	(4,931)	(4,320)	(3,781)	(3,332)
STEAM ELECTRIC POWER	4,404	4,404	4,404	2,164	2,164	2,164
LIVESTOCK	202	152	117	78	37	3
IRRIGATION	2,468	(33,904)	(33,904)	(33,904)	(33,904)	(33,904)
LYNN COUNTY - BRAZOS BASIN						
ODONNELL	86	78	70	63	56	55
TAHOKA PUBLIC WATER SYSTEM	389	352	317	283	250	245
COUNTY-OTHER	76	73	82	89	75	69
MINING	(635)	(785)	(718)	(511)	(319)	(165)
LIVESTOCK	98	95	92	89	86	85
IRRIGATION	20,457	4,725	(4,665)	(10,525)	(14,137)	(16,473)
LYNN COUNTY - COLORADO BASIN						
COUNTY-OTHER	2	2	2	2	2	1
MINING	11	0	5	20	35	47
LIVESTOCK	4	4	4	4	3	3
IRRIGATION	1,115	1,115	45	(986)	(1,629)	(2,001)
MOTLEY COUNTY - RED BASIN						
MATADOR	550	553	555	556	556	556
RED RIVER AUTHORITY OF TEXAS	0	0	0	0	0	0
COUNTY-OTHER	24	28	30	30	31	31
MINING	4	31	39	46	65	83
LIVESTOCK	99	85	70	55	39	35
IRRIGATION	2,681	2,681	2,681	2,680	2,680	2,680
PARMER COUNTY - BRAZOS BASIN						
BOVINA	198	169	142	113	75	40
FARWELL	465	432	401	368	327	289

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Region O Water User Group (WUG) Needs/Surplus*

COUNTY-OTHER	166	136	108	76	37	0
LIVESTOCK	3,192	2,409	1,890	1,324	708	43
IRRIGATION	(122,909)	(150,296)	(140,764)	(137,234)	(135,074)	(134,135)
PARMER COUNTY - RED BASIN						
FRIONA	1,362	1,299	1,241	1,178	1,096	1,020
COUNTY-OTHER	119	97	78	55	27	1
MANUFACTURING	200	25	25	25	25	25
LIVESTOCK	798	602	472	331	177	10
IRRIGATION	22,078	(11,452)	(20,984)	(24,514)	(25,914)	(26,752)
SWISHER COUNTY - BRAZOS BASIN						
COUNTY-OTHER	13	12	13	13	11	10
LIVESTOCK	2,657	2,650	2,643	2,635	2,627	2,298
IRRIGATION	(1,927)	(16,395)	(16,504)	(16,328)	(16,104)	(15,578)
SWISHER COUNTY - RED BASIN						
HAPPY	377	375	374	375	370	365
TULIA	939	921	928	941	901	881
COUNTY-OTHER	77	76	78	81	67	60
LIVESTOCK	704	575	439	297	148	0
IRRIGATION	(11,251)	(54,427)	(54,318)	(54,494)	(55,258)	(54,922)
TERRY COUNTY - BRAZOS BASIN						
COUNTY-OTHER	2	2	2	2	2	2
MINING	15	3	2	11	19	25
LIVESTOCK	9	8	6	5	3	2
IRRIGATION	(351)	(1,551)	(826)	(672)	(660)	(685)
TERRY COUNTY - COLORADO BASIN						
BROWNFIELD	365	236	132	(49)	(216)	(291)
COUNTY-OTHER	109	110	89	109	89	67
MANUFACTURING	3	0	0	0	0	0
MINING	(230)	(388)	(405)	(287)	(172)	(91)
LIVESTOCK	161	121	92	59	25	2
IRRIGATION	16,399	(40,392)	(41,117)	(41,271)	(41,283)	(41,258)
YOAKUM COUNTY - COLORADO BASIN						
DENVER CITY	3,890	3,734	3,593	3,425	3,247	3,077
PLAINS	700	652	609	560	506	453
COUNTY-OTHER	136	112	89	63	31	1
MINING	(536)	(570)	(383)	(193)	(19)	123
STEAM ELECTRIC POWER	90	90	90	90	90	90
LIVESTOCK	100	95	90	85	80	78
IRRIGATION	(32,558)	(78,546)	(78,546)	(78,546)	(78,546)	(78,546)

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Appendix G. TWDB DB22 Report #9 - Source Water Balance

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Region O Source Water Balance (Availability - WUG Supply)

GROUNDWATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
DOCKUM AQUIFER	BAILEY	BRAZOS	FRESH	833	833	833	833	833	833
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	0	0	0	0	0	0
DOCKUM AQUIFER	COCHRAN	BRAZOS	FRESH	104	104	104	104	104	104
DOCKUM AQUIFER	COCHRAN	COLORADO	FRESH	868	868	868	868	868	868
DOCKUM AQUIFER	CROSBY	BRAZOS	FRESH	172	172	172	172	172	172
DOCKUM AQUIFER	CROSBY	RED	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	DEAF SMITH	CANADIAN	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	DEAF SMITH	RED	FRESH	977	977	977	977	977	977
DOCKUM AQUIFER	DICKENS	BRAZOS	FRESH	43	43	43	43	43	43
DOCKUM AQUIFER	DICKENS	RED	FRESH	51	51	51	51	51	51
DOCKUM AQUIFER	FLOYD	BRAZOS	FRESH	2,976	2,976	2,976	2,976	2,976	2,976
DOCKUM AQUIFER	FLOYD	RED	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	GAINES	COLORADO	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	GARZA	BRAZOS	BRACKISH	495	495	495	495	495	495
DOCKUM AQUIFER	HALE	BRAZOS	FRESH	1,092	1,092	1,092	1,092	1,092	1,092
DOCKUM AQUIFER	HALE	RED	FRESH	29	29	29	29	29	29
DOCKUM AQUIFER	HOCKLEY	BRAZOS	FRESH	862	862	862	862	862	862
DOCKUM AQUIFER	HOCKLEY	COLORADO	FRESH	167	167	167	167	167	167
DOCKUM AQUIFER	LAMB	BRAZOS	FRESH	923	923	923	923	923	923
DOCKUM AQUIFER	LUBBOCK	BRAZOS	FRESH	1,086	1,086	1,086	1,086	1,086	1,086
DOCKUM AQUIFER	LYNN	BRAZOS	FRESH	791	791	791	791	791	791
DOCKUM AQUIFER	LYNN	COLORADO	FRESH	121	121	121	121	121	121
DOCKUM AQUIFER	MOTLEY	RED	FRESH	0	0	0	0	0	0
DOCKUM AQUIFER	PARMER	BRAZOS	FRESH	2,252	2,252	2,252	2,252	1,492	1,391
DOCKUM AQUIFER	PARMER	RED	FRESH	1,973	1,973	1,973	1,973	1,973	1,973
DOCKUM AQUIFER	SWISHER	BRAZOS	FRESH	25	25	25	25	25	25
DOCKUM AQUIFER	SWISHER	RED	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER	DICKENS	BRAZOS	FRESH	56	56	56	56	56	56
OGALLALA AQUIFER	DICKENS	RED	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER	MOTLEY	RED	FRESH	38	38	38	38	38	38
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	BAILEY	BRAZOS	FRESH	16,650	16,821	17,068	17,353	17,676	18,556
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	BRISCOE	RED	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	CASTRO	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	CASTRO	RED	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	COCHRAN	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	COCHRAN	COLORADO	FRESH	25,116	7,068	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	CROSBY	BRAZOS	FRESH	7,906	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	CROSBY	RED	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.

Region O Source Water Balance (Availability - WUG Supply)

GROUNDWATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY*	2020	2030	2040	2050	2060	2070
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	DAWSON	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	DAWSON	COLORADO	FRESH	12,362	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	DEAF SMITH	RED	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	FLOYD	BRAZOS	FRESH	72,769	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	FLOYD	RED	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	GAINES	COLORADO	FRESH	1	1	1	1	1	1
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	GARZA	BRAZOS	FRESH	2,241	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	GARZA	COLORADO	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	HALE	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	HALE	RED	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	HOCKLEY	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	HOCKLEY	COLORADO	FRESH	31,581	11,153	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	LAMB	BRAZOS	FRESH	16,454	16,625	16,872	17,157	17,480	18,610
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	LUBBOCK	BRAZOS	FRESH	1	1	1	1	1	1
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	LYNN	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	LYNN	COLORADO	FRESH	921	197	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	PARMER	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	PARMER	RED	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	SWISHER	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	SWISHER	RED	FRESH	0	0	0	0	540	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	TERRY	BRAZOS	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	TERRY	COLORADO	FRESH	0	0	0	0	0	0
OGALLALA AQUIFER & EDWARDS-TRINITY-HIGH PLAINS AQUIFER	YOAKUM	COLORADO	FRESH	0	0	0	0	0	0
OTHER AQUIFER	BRISCOE	RED	FRESH	873	873	873	873	873	873
OTHER AQUIFER	CROSBY	BRAZOS	BRACKISH	538	538	538	538	538	538
OTHER AQUIFER	DICKENS	BRAZOS	BRACKISH	114	114	114	114	114	114
OTHER AQUIFER	DICKENS	RED	BRACKISH	152	151	150	149	148	147
OTHER AQUIFER	FLOYD	RED	FRESH	515	515	515	515	515	515
OTHER AQUIFER	GARZA	BRAZOS	FRESH	570	570	570	570	570	570
OTHER AQUIFER	MOTLEY	RED	BRACKISH	684	684	683	683	682	682
SEYMOUR AQUIFER	BRISCOE	RED	BRACKISH	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.

Region O Source Water Balance (Availability - WUG Supply)

GROUNDWATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY*	2020	2030	2040	2050	2060	2070
SEYMOUR AQUIFER	MOTLEY	RED	FRESH	3,999	5,835	3,999	3,986	3,128	3,117
			GROUNDWATER TOTAL SOURCE WATER BALANCE	209,381	77,080	57,318	57,874	57,440	58,797

REUSE SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY*	2020	2030	2040	2050	2060	2070
DIRECT REUSE	BAILEY	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	CASTRO	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	COCHRAN	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	COCHRAN	COLORADO	FRESH	0	0	0	0	0	0
DIRECT REUSE	CROSBY	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	DEAF SMITH	RED	FRESH	0	0	0	0	0	0
DIRECT REUSE	FLOYD	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	HALE	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	HOCKLEY	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	HOCKLEY	COLORADO	FRESH	0	0	0	0	0	0
DIRECT REUSE	LAMB	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	LUBBOCK	BRAZOS	FRESH	3,483	12,611	15,064	18,995	20,496	21,750
DIRECT REUSE	LYNN	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	PARMER	BRAZOS	FRESH	0	0	0	0	0	0
DIRECT REUSE	PARMER	RED	FRESH	0	0	0	0	0	0
			REUSE TOTAL SOURCE WATER BALANCE	3,483	12,611	15,064	18,995	20,496	21,750

SURFACE WATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY*	2020	2030	2040	2050	2060	2070
ALAN HENRY LAKE/RESERVOIR	RESERVOIR	BRAZOS	FRESH	12,600	12,320	12,020	11,700	11,380	10,720
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
BRAZOS RUN-OF-RIVER	CROSBY	BRAZOS	FRESH	0	0	0	0	0	0
MACKENZIE LAKE/RESERVOIR	RESERVOIR	RED	FRESH	3,962	3,962	3,962	3,962	3,962	3,962
RED RUN-OF-RIVER	BRISCOE	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	FLOYD	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	MOTLEY	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	PARMER	RED	FRESH	0	0	0	0	0	0
WHITE RIVER LAKE/RESERVOIR	RESERVOIR	BRAZOS	FRESH	3,650	3,650	3,650	3,650	3,650	3,650
			SURFACE WATER TOTAL SOURCE WATER BALANCE	20,212	19,932	19,632	19,312	18,992	18,332

REGION O TOTAL SOURCE WATER BALANCE	233,076	109,623	92,014	96,181	96,928	98,879

*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.

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Appendix H. TWDB DB22 Report #10a – WUG Data Comparison to 2016 RWP

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Region O Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
BAILEY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	280	411	46.8%	265	411	55.1%
PROJECTED DEMAND TOTAL	277	277	0.0%	411	411	0.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	146	0	-100.0%
BAILEY COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	36,926	72,810	97.2%	12,715	9,946	-21.8%
PROJECTED DEMAND TOTAL	119,268	88,108	-26.1%	105,752	55,616	-47.4%
WATER SUPPLY NEEDS TOTAL	82,342	15,298	-81.4%	93,037	45,670	-50.9%
BAILEY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,286	3,077	139.3%	753	3,077	308.6%
PROJECTED DEMAND TOTAL	2,335	2,428	4.0%	3,204	3,958	23.5%
WATER SUPPLY NEEDS TOTAL	1,049	0	-100.0%	2,451	881	-64.1%
BAILEY COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	133	0	-100.0%	64	0	-100.0%
PROJECTED DEMAND TOTAL	316	0	-100.0%	388	0	-100.0%
WATER SUPPLY NEEDS TOTAL	183	0	-100.0%	324	0	-100.0%
BAILEY COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,125	3,056	171.6%	1,200	3,056	154.7%
PROJECTED DEMAND TOTAL	1,174	1,173	-0.1%	1,787	1,787	0.0%
WATER SUPPLY NEEDS TOTAL	49	0	-100.0%	587	0	-100.0%
BRISCOE COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	295	219	-25.8%	295	219	-25.8%
PROJECTED DEMAND TOTAL	297	159	-46.5%	288	154	-46.5%
WATER SUPPLY NEEDS TOTAL	2	0	-100.0%	0	0	0.0%
BRISCOE COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	33,335	33,668	1.0%	10,993	11,097	0.9%
PROJECTED DEMAND TOTAL	37,260	26,417	-29.1%	31,052	15,231	-51.0%
WATER SUPPLY NEEDS TOTAL	3,925	0	-100.0%	20,059	4,134	-79.4%
BRISCOE COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	273	353	29.3%	273	353	29.3%
PROJECTED DEMAND TOTAL	302	286	-5.3%	348	352	1.1%
WATER SUPPLY NEEDS TOTAL	29	0	-100.0%	75	0	-100.0%
BRISCOE COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	71	446	528.2%	71	446	528.2%
PROJECTED DEMAND TOTAL	126	234	85.7%	119	221	85.7%
WATER SUPPLY NEEDS TOTAL	55	0	-100.0%	48	0	-100.0%
CASTRO COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	420	460	9.5%	520	460	-11.5%
PROJECTED DEMAND TOTAL	411	368	-10.5%	496	444	-10.5%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
CASTRO COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	125,052	254,821	103.8%	33,519	15,033	-55.2%
PROJECTED DEMAND TOTAL	387,976	379,863	-2.1%	320,029	222,898	-30.4%

*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 2016 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 Needs totals.

Region O Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
WATER SUPPLY NEEDS TOTAL	262,924	125,042	-52.4%	286,510	207,865	-27.4%
CASTRO COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	3,656	11,339	210.1%	2,429	11,339	366.8%
PROJECTED DEMAND TOTAL	5,848	6,721	14.9%	7,851	10,261	30.7%
WATER SUPPLY NEEDS TOTAL	2,897	0	-100.0%	5,606	0	-100.0%
CASTRO COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	962	95	-90.1%	1,059	95	-91.0%
PROJECTED DEMAND TOTAL	980	61	-93.8%	1,319	66	-95.0%
WATER SUPPLY NEEDS TOTAL	85	0	-100.0%	260	0	-100.0%
CASTRO COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,244	5,034	304.7%	1,203	5,034	318.5%
PROJECTED DEMAND TOTAL	1,276	1,400	9.7%	1,557	1,712	10.0%
WATER SUPPLY NEEDS TOTAL	43	0	-100.0%	354	0	-100.0%
COCHRAN COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	485	383	-21.0%	560	383	-31.6%
PROJECTED DEMAND TOTAL	500	306	-38.8%	583	376	-35.5%
WATER SUPPLY NEEDS TOTAL	16	0	-100.0%	23	0	-100.0%
COCHRAN COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	35,366	74,660	111.1%	21,693	40,689	87.6%
PROJECTED DEMAND TOTAL	102,229	99,449	-2.7%	84,214	62,972	-25.2%
WATER SUPPLY NEEDS TOTAL	66,863	42,778	-36.0%	62,521	28,190	-54.9%
COCHRAN COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	149	674	352.3%	242	674	178.5%
PROJECTED DEMAND TOTAL	536	102	-81.0%	684	118	-82.7%
WATER SUPPLY NEEDS TOTAL	387	0	-100.0%	442	0	-100.0%
COCHRAN COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	152	312	105.3%	80	312	290.0%
PROJECTED DEMAND TOTAL	154	154	0.0%	81	81	0.0%
WATER SUPPLY NEEDS TOTAL	6	0	-100.0%	4	0	-100.0%
COCHRAN COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	350	911	160.3%	350	911	160.3%
PROJECTED DEMAND TOTAL	473	595	25.8%	469	596	27.1%
WATER SUPPLY NEEDS TOTAL	123	0	-100.0%	119	0	-100.0%
CROSBY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	238	188	-21.0%	248	188	-24.2%
PROJECTED DEMAND TOTAL	155	150	-3.2%	192	185	-3.6%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
CROSBY COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	110,280	167,160	51.6%	89,800	40,033	-55.4%
PROJECTED DEMAND TOTAL	117,362	107,583	-8.3%	95,864	67,695	-29.4%
WATER SUPPLY NEEDS TOTAL	7,082	576	-91.9%	6,064	27,662	356.2%
CROSBY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	155	211	36.1%	155	211	36.1%
PROJECTED DEMAND TOTAL	262	171	-34.7%	294	209	-28.9%

*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 2016 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 Needs totals.

Region O Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
WATER SUPPLY NEEDS TOTAL	107	0	-100.0%	139	0	-100.0%
CROSBY COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	6	3	-50.0%	6	3	-50.0%
PROJECTED DEMAND TOTAL	3	2	-33.3%	3	3	0.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
CROSBY COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	650	1,183	82.0%	360	1,183	228.6%
PROJECTED DEMAND TOTAL	994	994	0.0%	568	568	0.0%
WATER SUPPLY NEEDS TOTAL	348	368	5.7%	210	210	0.0%
CROSBY COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	952	1,519	59.6%	1,093	1,519	39.0%
PROJECTED DEMAND TOTAL	838	843	0.6%	1,058	1,065	0.7%
WATER SUPPLY NEEDS TOTAL	0	78	100.0%	40	146	265.0%
DAWSON COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	633	750	18.5%	582	750	28.9%
PROJECTED DEMAND TOTAL	588	606	3.1%	721	739	2.5%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	149	0	-100.0%
DAWSON COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	108,203	158,435	46.4%	76,137	67,872	-10.9%
PROJECTED DEMAND TOTAL	106,630	106,312	-0.3%	80,286	79,443	-1.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	4,149	11,847	185.5%
DAWSON COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	149	201	34.9%	159	201	26.4%
PROJECTED DEMAND TOTAL	139	53	-61.9%	159	65	-59.1%
WATER SUPPLY NEEDS TOTAL	2	0	-100.0%	2	0	-100.0%
DAWSON COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	129	0	-100.0%	168	0	-100.0%
PROJECTED DEMAND TOTAL	129	0	-100.0%	175	0	-100.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	7	0	-100.0%
DAWSON COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	779	266	-65.9%	0	266	100.0%
PROJECTED DEMAND TOTAL	954	1,812	89.9%	255	1,812	610.6%
WATER SUPPLY NEEDS TOTAL	175	1,546	783.4%	255	1,546	506.3%
DAWSON COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2,039	2,315	13.5%	1,213	2,433	100.6%
PROJECTED DEMAND TOTAL	2,293	2,258	-1.5%	2,445	2,409	-1.5%
WATER SUPPLY NEEDS TOTAL	264	0	-100.0%	1,232	0	-100.0%
DEAF SMITH COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	603	988	63.8%	941	988	5.0%
PROJECTED DEMAND TOTAL	541	590	9.1%	904	988	9.3%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
DEAF SMITH COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	109,276	192,430	76.1%	36,547	31,800	-13.0%
PROJECTED DEMAND TOTAL	193,410	210,016	8.6%	164,985	118,219	-28.3%

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Region O Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
WATER SUPPLY NEEDS TOTAL	84,134	17,586	-79.1%	128,438	86,419	-32.7%
DEAF SMITH COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	8,080	12,089	49.6%	15,673	12,089	-22.9%
PROJECTED DEMAND TOTAL	12,555	11,170	-11.0%	16,471	15,604	-5.3%
WATER SUPPLY NEEDS TOTAL	4,475	112	-97.5%	798	3,515	340.5%
DEAF SMITH COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,600	4	-99.8%	1,800	4	-99.8%
PROJECTED DEMAND TOTAL	3,834	1,002	-73.9%	4,438	1,107	-75.1%
WATER SUPPLY NEEDS TOTAL	2,234	998	-55.3%	2,638	1,103	-58.2%
DEAF SMITH COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	4,000	6,759	69.0%	6,756	6,759	0.0%
PROJECTED DEMAND TOTAL	3,953	3,857	-2.4%	6,907	6,739	-2.4%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	151	0	-100.0%
DICKENS COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	294	181	-38.4%	277	181	-34.7%
PROJECTED DEMAND TOTAL	153	145	-5.2%	142	132	-7.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
DICKENS COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	9,608	10,376	8.0%	9,233	10,376	12.4%
PROJECTED DEMAND TOTAL	9,363	9,039	-3.5%	8,060	9,039	12.1%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
DICKENS COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	305	487	59.7%	305	487	59.7%
PROJECTED DEMAND TOTAL	375	387	3.2%	422	475	12.6%
WATER SUPPLY NEEDS TOTAL	70	0	-100.0%	117	0	-100.0%
DICKENS COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	12	29	141.7%	12	29	141.7%
PROJECTED DEMAND TOTAL	12	12	0.0%	12	12	0.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
DICKENS COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	178	235	32.0%	170	240	41.2%
PROJECTED DEMAND TOTAL	178	191	7.3%	170	187	10.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
FLOYD COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	292	295	1.0%	253	295	16.6%
PROJECTED DEMAND TOTAL	200	192	-4.0%	224	291	29.9%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
FLOYD COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	122,428	109,193	-10.8%	92,461	53,048	-42.6%
PROJECTED DEMAND TOTAL	147,725	128,837	-12.8%	120,941	76,235	-37.0%
WATER SUPPLY NEEDS TOTAL	26,565	41,938	57.9%	29,390	23,187	-21.1%
FLOYD COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	798	1,639	105.4%	948	1,639	72.9%
PROJECTED DEMAND TOTAL	738	1,168	58.3%	942	1,268	34.6%

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Region O Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	23	0	-100.0%
FLOYD COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	486	492	1.2%	485	492	1.4%
PROJECTED DEMAND TOTAL	486	486	0.0%	485	485	0.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
FLOYD COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	978	2,495	155.1%	898	2,495	177.8%
PROJECTED DEMAND TOTAL	840	849	1.1%	958	854	-10.9%
WATER SUPPLY NEEDS TOTAL	35	0	-100.0%	67	0	-100.0%
GAINES COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,150	1,750	52.2%	2,020	1,750	-13.4%
PROJECTED DEMAND TOTAL	1,403	1,400	-0.2%	3,633	3,630	-0.1%
WATER SUPPLY NEEDS TOTAL	253	0	-100.0%	1,613	1,880	16.6%
GAINES COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	231,255	264,961	14.6%	25,401	125,301	393.3%
PROJECTED DEMAND TOTAL	379,779	362,482	-4.6%	292,238	282,438	-3.4%
WATER SUPPLY NEEDS TOTAL	148,524	97,521	-34.3%	266,837	157,137	-41.1%
GAINES COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	240	203	-15.4%	158	203	28.5%
PROJECTED DEMAND TOTAL	238	123	-48.3%	304	137	-54.9%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	146	0	-100.0%
GAINES COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,968	544	-72.4%	494	544	10.1%
PROJECTED DEMAND TOTAL	2,278	1,512	-33.6%	2,874	1,587	-44.8%
WATER SUPPLY NEEDS TOTAL	310	968	212.3%	2,380	1,043	-56.2%
GAINES COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,627	7,729	375.0%	313	7,729	2369.3%
PROJECTED DEMAND TOTAL	1,829	1,829	0.0%	776	776	0.0%
WATER SUPPLY NEEDS TOTAL	202	0	-100.0%	463	0	-100.0%
GAINES COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2,220	2,766	24.6%	2,470	2,766	12.0%
PROJECTED DEMAND TOTAL	2,767	2,771	0.1%	4,177	4,181	0.1%
WATER SUPPLY NEEDS TOTAL	548	551	0.5%	1,707	1,878	10.0%
GARZA COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	195	171	-12.3%	154	171	11.0%
PROJECTED DEMAND TOTAL	135	135	0.0%	133	133	0.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
GARZA COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	11,675	15,028	28.7%	8,775	11,827	34.8%
PROJECTED DEMAND TOTAL	11,621	10,353	-10.9%	8,655	10,353	19.6%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
GARZA COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	68	184	170.6%	68	184	170.6%
PROJECTED DEMAND TOTAL	299	148	-50.5%	346	181	-47.7%

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Region O Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
WATER SUPPLY NEEDS TOTAL	231	0	-100.0%	278	0	-100.0%
GARZA COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2	2	0.0%	2	2	0.0%
PROJECTED DEMAND TOTAL	2	2	0.0%	2	2	0.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
GARZA COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	395	544	37.7%	164	544	231.7%
PROJECTED DEMAND TOTAL	395	395	0.0%	164	164	0.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
GARZA COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,098	964	-12.2%	1,271	964	-24.2%
PROJECTED DEMAND TOTAL	792	792	0.0%	965	964	-0.1%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
HALE COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,190	1,289	8.3%	1,200	1,289	7.4%
PROJECTED DEMAND TOTAL	1,171	1,031	-12.0%	1,173	1,058	-9.8%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
HALE COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	131,321	209,308	59.4%	108,113	21,151	-80.4%
PROJECTED DEMAND TOTAL	369,812	310,542	-16.0%	313,161	227,568	-27.3%
WATER SUPPLY NEEDS TOTAL	238,491	101,234	-57.6%	205,048	206,417	0.7%
HALE COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,107	3,715	235.6%	1,016	3,715	265.6%
PROJECTED DEMAND TOTAL	2,045	2,752	34.6%	2,821	4,098	45.3%
WATER SUPPLY NEEDS TOTAL	938	0	-100.0%	1,805	383	-78.8%
HALE COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,603	1,416	-11.7%	3,600	1,416	-60.7%
PROJECTED DEMAND TOTAL	2,830	4,383	54.9%	3,510	5,076	44.6%
WATER SUPPLY NEEDS TOTAL	1,227	2,967	141.8%	0	3,660	100.0%
HALE COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	14	215	1435.7%	0	215	100.0%
PROJECTED DEMAND TOTAL	1,168	1,168	0.0%	662	662	0.0%
WATER SUPPLY NEEDS TOTAL	1,154	953	-17.4%	662	447	-32.5%
HALE COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	6,744	11,362	68.5%	5,842	11,136	90.6%
PROJECTED DEMAND TOTAL	5,520	5,725	3.7%	5,687	5,876	3.3%
WATER SUPPLY NEEDS TOTAL	80	0	-100.0%	51	0	-100.0%
HALE COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	26	31	19.2%	139	31	-77.7%
PROJECTED DEMAND TOTAL	60	31	-48.3%	139	31	-77.7%
WATER SUPPLY NEEDS TOTAL	34	0	-100.0%	0	0	0.0%
HOCKLEY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,048	1,152	9.9%	1,052	1,152	9.5%
PROJECTED DEMAND TOTAL	922	921	-0.1%	1,013	1,012	-0.1%

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Region O Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
HOCKLEY COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	83,565	138,733	66.0%	52,686	46,493	-11.8%
PROJECTED DEMAND TOTAL	131,207	131,866	0.5%	107,813	73,589	-31.7%
WATER SUPPLY NEEDS TOTAL	47,642	0	-100.0%	55,127	27,096	-50.8%
HOCKLEY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	468	408	-12.8%	625	408	-34.7%
PROJECTED DEMAND TOTAL	238	133	-44.1%	304	157	-48.4%
WATER SUPPLY NEEDS TOTAL	35	0	-100.0%	45	0	-100.0%
HOCKLEY COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,185	700	-40.9%	1,200	700	-41.7%
PROJECTED DEMAND TOTAL	1,185	576	-51.4%	1,203	691	-42.6%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	3	0	-100.0%
HOCKLEY COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,707	1,547	-9.4%	0	1,547	100.0%
PROJECTED DEMAND TOTAL	18	18	0.0%	15	15	0.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	15	0	-100.0%
HOCKLEY COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	3,357	6,909	105.8%	2,349	6,536	178.2%
PROJECTED DEMAND TOTAL	3,019	3,018	0.0%	3,383	3,385	0.1%
WATER SUPPLY NEEDS TOTAL	18	0	-100.0%	1,111	0	-100.0%
LAMB COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	450	575	27.8%	600	575	-4.2%
PROJECTED DEMAND TOTAL	435	401	-7.8%	596	492	-17.4%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
LAMB COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	126,104	184,075	46.0%	28,179	7,414	-73.7%
PROJECTED DEMAND TOTAL	325,356	259,451	-20.3%	268,045	194,185	-27.6%
WATER SUPPLY NEEDS TOTAL	199,252	75,376	-62.2%	239,866	186,771	-22.1%
LAMB COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2,080	5,225	151.2%	788	5,225	563.1%
PROJECTED DEMAND TOTAL	2,969	3,940	32.7%	3,427	6,271	83.0%
WATER SUPPLY NEEDS TOTAL	889	0	-100.0%	2,639	1,046	-60.4%
LAMB COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	336	1,000	197.6%	635	1,000	57.5%
PROJECTED DEMAND TOTAL	616	807	31.0%	781	940	20.4%
WATER SUPPLY NEEDS TOTAL	280	0	-100.0%	146	0	-100.0%
LAMB COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	16	108	575.0%	0	108	100.0%
PROJECTED DEMAND TOTAL	586	586	0.0%	333	333	0.0%
WATER SUPPLY NEEDS TOTAL	570	478	-16.1%	333	225	-32.4%
LAMB COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2,128	5,073	138.4%	1,928	5,073	163.1%
PROJECTED DEMAND TOTAL	1,966	1,996	1.5%	1,860	1,961	5.4%

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	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	24	0	-100.0%
LAMB COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	11,436	15,666	37.0%	37,407	15,666	-58.1%
PROJECTED DEMAND TOTAL	17,663	13,450	-23.9%	40,391	13,450	-66.7%
WATER SUPPLY NEEDS TOTAL	6,227	0	-100.0%	2,984	0	-100.0%
LUBBOCK COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	4,656	6,340	36.2%	6,906	6,340	-8.2%
PROJECTED DEMAND TOTAL	4,647	3,797	-18.3%	6,847	6,339	-7.4%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
LUBBOCK COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	114,222	147,334	29.0%	53,637	80,356	49.8%
PROJECTED DEMAND TOTAL	169,242	144,866	-14.4%	127,582	114,260	-10.4%
WATER SUPPLY NEEDS TOTAL	55,020	0	-100.0%	73,945	33,904	-54.1%
LUBBOCK COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	800	1,290	61.3%	1,050	1,290	22.9%
PROJECTED DEMAND TOTAL	780	1,088	39.5%	1,021	1,287	26.1%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
LUBBOCK COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,929	335	-82.6%	3,005	335	-88.9%
PROJECTED DEMAND TOTAL	2,161	856	-60.4%	3,148	1,011	-67.9%
WATER SUPPLY NEEDS TOTAL	232	521	124.6%	143	676	372.7%
LUBBOCK COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	93	982	955.9%	0	982	100.0%
PROJECTED DEMAND TOTAL	6,354	6,354	0.0%	4,314	4,314	0.0%
WATER SUPPLY NEEDS TOTAL	6,261	5,372	-14.2%	4,314	3,332	-22.8%
LUBBOCK COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	38,356	49,824	29.9%	27,138	42,574	56.9%
PROJECTED DEMAND TOTAL	48,610	49,776	2.4%	72,004	72,709	1.0%
WATER SUPPLY NEEDS TOTAL	10,565	3,716	-64.8%	45,022	32,736	-27.3%
LUBBOCK COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	15,682	10,098	-35.6%	8,961	7,858	-12.3%
PROJECTED DEMAND TOTAL	4,540	5,694	25.4%	9,906	5,694	-42.5%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	945	0	-100.0%
LYNN COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	316	389	23.1%	255	389	52.5%
PROJECTED DEMAND TOTAL	311	311	0.0%	319	319	0.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	69	0	-100.0%
LYNN COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	84,592	110,493	30.6%	64,587	70,447	9.1%
PROJECTED DEMAND TOTAL	84,566	88,921	5.1%	64,515	88,921	37.8%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	18,474	100.0%
LYNN COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	159	167	5.0%	159	167	5.0%
PROJECTED DEMAND TOTAL	141	65	-53.9%	165	79	-52.1%

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	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
WATER SUPPLY NEEDS TOTAL	1	0	-100.0%	6	0	-100.0%
LYNN COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	483	542	12.2%	483	542	12.2%
PROJECTED DEMAND TOTAL	1,166	1,166	0.0%	660	660	0.0%
WATER SUPPLY NEEDS TOTAL	683	635	-7.0%	177	165	-6.8%
LYNN COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	647	1,057	63.4%	382	915	139.5%
PROJECTED DEMAND TOTAL	583	582	-0.2%	616	615	-0.2%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	234	0	-100.0%
MOTLEY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	110	122	10.9%	105	122	16.2%
PROJECTED DEMAND TOTAL	109	98	-10.1%	103	91	-11.7%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
MOTLEY COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	9,701	12,107	24.8%	9,706	12,106	24.7%
PROJECTED DEMAND TOTAL	9,439	9,426	-0.1%	8,123	9,426	16.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
MOTLEY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	320	375	17.2%	320	375	17.2%
PROJECTED DEMAND TOTAL	481	276	-42.6%	529	340	-35.7%
WATER SUPPLY NEEDS TOTAL	161	0	-100.0%	209	0	-100.0%
MOTLEY COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	6	0	-100.0%	6	0	-100.0%
PROJECTED DEMAND TOTAL	6	0	-100.0%	6	0	-100.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
MOTLEY COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	104	244	134.6%	104	244	134.6%
PROJECTED DEMAND TOTAL	240	240	0.0%	161	161	0.0%
WATER SUPPLY NEEDS TOTAL	136	0	-100.0%	57	0	-100.0%
MOTLEY COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	219	780	256.2%	219	782	257.1%
PROJECTED DEMAND TOTAL	213	230	8.0%	207	226	9.2%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
PARMER COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	625	946	51.4%	810	946	16.8%
PROJECTED DEMAND TOTAL	631	661	4.8%	902	945	4.8%
WATER SUPPLY NEEDS TOTAL	12	0	-100.0%	92	0	-100.0%
PARMER COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	57,086	138,394	142.4%	14,451	16,915	17.1%
PROJECTED DEMAND TOTAL	329,806	239,225	-27.5%	312,736	177,802	-43.1%
WATER SUPPLY NEEDS TOTAL	272,720	122,909	-54.9%	298,285	160,887	-46.1%
PARMER COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	5,125	11,329	121.1%	5,475	11,329	106.9%
PROJECTED DEMAND TOTAL	5,634	7,339	30.3%	7,593	11,276	48.5%

*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 2016 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 Needs totals.

Region O Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
WATER SUPPLY NEEDS TOTAL	582	0	-100.0%	2,149	0	-100.0%
PARMER COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,560	1,866	19.6%	1,560	1,866	19.6%
PROJECTED DEMAND TOTAL	2,233	1,666	-25.4%	2,973	1,841	-38.1%
WATER SUPPLY NEEDS TOTAL	673	0	-100.0%	1,413	0	-100.0%
PARMER COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,556	3,592	130.8%	1,855	3,592	93.6%
PROJECTED DEMAND TOTAL	1,598	1,567	-1.9%	2,286	2,243	-1.9%
WATER SUPPLY NEEDS TOTAL	45	0	-100.0%	431	0	-100.0%
SWISHER COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	220	447	103.2%	230	447	94.3%
PROJECTED DEMAND TOTAL	214	357	66.8%	226	377	66.8%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
SWISHER COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	99,462	122,218	22.9%	45,034	16,040	-64.4%
PROJECTED DEMAND TOTAL	196,895	135,396	-31.2%	198,581	86,540	-56.4%
WATER SUPPLY NEEDS TOTAL	97,433	13,178	-86.5%	153,547	70,500	-54.1%
SWISHER COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2,370	6,089	156.9%	3,020	5,767	91.0%
PROJECTED DEMAND TOTAL	2,362	2,728	15.5%	3,015	3,469	15.1%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
SWISHER COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,077	2,280	111.7%	968	2,274	134.9%
PROJECTED DEMAND TOTAL	1,104	964	-12.7%	1,174	1,028	-12.4%
WATER SUPPLY NEEDS TOTAL	172	0	-100.0%	235	0	-100.0%
TERRY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	339	556	64.0%	389	556	42.9%
PROJECTED DEMAND TOTAL	320	445	39.1%	383	487	27.2%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
TERRY COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	144,022	188,833	31.1%	3,381	83,584	2372.2%
PROJECTED DEMAND TOTAL	143,461	172,785	20.4%	110,848	125,527	13.2%
WATER SUPPLY NEEDS TOTAL	0	351	100.0%	107,467	41,943	-61.0%
TERRY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	315	590	87.3%	16	590	3587.5%
PROJECTED DEMAND TOTAL	270	420	55.6%	395	586	48.4%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	379	0	-100.0%
TERRY COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2	17	750.0%	0	17	100.0%
PROJECTED DEMAND TOTAL	2	14	600.0%	2	17	750.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	2	0	-100.0%
TERRY COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	355	140	-60.6%	0	140	100.0%
PROJECTED DEMAND TOTAL	355	355	0.0%	206	206	0.0%

*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 2016 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 Needs totals.

Region O Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
WATER SUPPLY NEEDS TOTAL	0	230	100.0%	206	91	-55.8%
TERRY COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,897	1,969	3.8%	981	1,702	73.5%
PROJECTED DEMAND TOTAL	1,888	1,604	-15.0%	2,285	1,993	-12.8%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	1,304	291	-77.7%
YOAKUM COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	270	399	47.8%	405	399	-1.5%
PROJECTED DEMAND TOTAL	267	263	-1.5%	403	398	-1.2%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
YOAKUM COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	55,427	129,135	133.0%	5,480	39,135	614.1%
PROJECTED DEMAND TOTAL	146,083	161,693	10.7%	114,838	117,681	2.5%
WATER SUPPLY NEEDS TOTAL	90,656	32,558	-64.1%	109,358	78,546	-28.2%
YOAKUM COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	0	191	100.0%	0	191	100.0%
PROJECTED DEMAND TOTAL	281	91	-67.6%	322	113	-64.9%
WATER SUPPLY NEEDS TOTAL	281	0	-100.0%	322	0	-100.0%
YOAKUM COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	914	764	-16.4%	0	764	100.0%
PROJECTED DEMAND TOTAL	1,300	1,300	0.0%	641	641	0.0%
WATER SUPPLY NEEDS TOTAL	386	536	38.9%	641	0	-100.0%
YOAKUM COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	902	6,451	615.2%	1,350	6,451	377.9%
PROJECTED DEMAND TOTAL	1,855	1,861	0.3%	2,912	2,921	0.3%
WATER SUPPLY NEEDS TOTAL	953	0	-100.0%	1,562	0	-100.0%
YOAKUM COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2,232	2,000	-10.4%	676	2,000	195.9%
PROJECTED DEMAND TOTAL	3,718	1,910	-48.6%	8,540	1,910	-77.6%
WATER SUPPLY NEEDS TOTAL	1,486	0	-100.0%	7,864	0	-100.0%
REGION O						
EXISTING WUG SUPPLY TOTAL	2,000,640	2,976,690	48.8%	976,717	1,042,480	6.7%
PROJECTED DEMAND TOTAL	3,710,638	3,367,953	-9.2%	3,210,784	2,452,931	-23.6%
WATER SUPPLY NEEDS TOTAL	1,731,832	706,374	-59.2%	2,240,096	1,471,903	-34.3%

*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 2016 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 Needs totals.

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Appendix I. TWDB DB22 Report #10b – Source Data Comparison to 2016 RWP

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Region O Source Data Comparison to 2016 Regional Water Plan (RWP)

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
BAILEY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	41,563	98,512	137.0%	15,443	35,648	130.8%
REUSE AVAILABILITY TOTAL (acre-feet per year)	825	825	0.0%	825	825	0.0%
BRISCOE COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	34,751	35,335	1.7%	12,406	12,764	2.9%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	80	96	20.0%	80	96	20.0%
CASTRO COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	127,304	267,718	110.3%	114,768	27,930	-75.7%
REUSE AVAILABILITY TOTAL (acre-feet per year)	4,031	4,031	0.0%	4,031	4,031	0.0%
COCHRAN COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	36,472	102,734	181.7%	22,895	43,647	90.6%
REUSE AVAILABILITY TOTAL (acre-feet per year)	294	294	0.0%	294	294	0.0%
CROSBY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	145,791	179,181	22.9%	145,791	44,148	-69.7%
REUSE AVAILABILITY TOTAL (acre-feet per year)	583	583	0.0%	583	583	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	10	0	-100.0%	10	0	-100.0%
DAWSON COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	199,242	172,852	-13.2%	77,569	69,927	-9.9%
DEAF SMITH COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	122,952	210,737	71.4%	59,107	50,007	-15.4%
REUSE AVAILABILITY TOTAL (acre-feet per year)	2,810	2,810	0.0%	2,810	2,810	0.0%
DICKENS COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	24,049	11,500	-52.2%	23,195	11,500	-50.4%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	130	0	-100.0%	130	0	-100.0%
FLOYD COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	164,266	189,677	15.5%	132,633	60,763	-54.2%
REUSE AVAILABILITY TOTAL (acre-feet per year)	449	449	0.0%	449	449	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	10	18	80.0%	10	18	80.0%
GAINES COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	286,312	277,954	-2.9%	34,378	138,294	302.3%
GARZA COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	20,954	19,208	-8.3%	18,833	13,766	-26.9%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	30	0	-100.0%	30	0	-100.0%
HALE COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	134,877	221,232	64.0%	115,203	33,075	-71.3%
REUSE AVAILABILITY TOTAL (acre-feet per year)	5,477	5,477	0.0%	5,477	5,477	0.0%
HOCKLEY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	93,049	178,488	91.8%	64,265	54,667	-14.9%
REUSE AVAILABILITY TOTAL (acre-feet per year)	1,521	1,521	0.0%	1,521	1,521	0.0%
LAMB COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	137,468	224,400	63.2%	70,998	47,739	-32.8%
REUSE AVAILABILITY TOTAL (acre-feet per year)	7,199	7,199	0.0%	7,199	7,199	0.0%
LUBBOCK COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	120,749	152,142	26.0%	86,132	91,884	6.7%
REUSE AVAILABILITY TOTAL (acre-feet per year)	22,728	22,523	-0.9%	30,759	31,830	3.5%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	20	0	-100.0%	20	0	-100.0%
LYNN COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	103,995	113,519	9.2%	82,501	72,552	-12.1%

Region O Source Data Comparison to 2016 Regional Water Plan (RWP)

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
REUSE AVAILABILITY TOTAL (acre-feet per year)	346	346	0.0%	346	346	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	30	0	-100.0%	30	0	-100.0%
MOTLEY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	23,572	18,345	-22.2%	22,733	17,462	-23.2%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	10	4	-60.0%	10	4	-60.0%
PARMER COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	63,067	157,465	149.7%	35,142	35,125	0.0%
REUSE AVAILABILITY TOTAL (acre-feet per year)	2,887	2,887	0.0%	2,887	2,887	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	10	0	-100.0%	10	0	-100.0%
RESERVOIR COUNTY						
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	25,120	28,780	14.6%	23,240	26,900	15.7%
SWISHER COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	108,103	130,859	21.1%	52,961	24,359	-54.0%
TERRY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	197,204	190,768	-3.3%	5,096	85,519	1578.2%
YOAKUM COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	61,638	138,940	125.4%	9,347	48,940	423.6%
REGION O						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	2,247,378	3,091,566	37.6%	1,201,396	1,019,716	-15.1%
REUSE AVAILABILITY TOTAL (acre-feet per year)	49,150	48,945	-0.4%	57,181	58,252	1.9%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	25,450	28,898	13.5%	23,570	27,018	14.6%

Appendix J. WAM input and output files

Electronic submittal of files

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Appendix K. Region G Hydrologic Variance Information

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Memorandum

Date:	Friday, February 23, 2018
Project:	2021 Brazos G Regional Water Plan
To:	Jeff Walker, Executive Administrator, Texas Water Development Board
CC:	Brazos G RWPG, Thomas Barnett, Stephen Hamlin
From:	David D. Dunn, P.E.
Subject:	Hydrologic Variance Request for Surface Water Availability Analyses in Brazos G

The Brazos G Regional Water Planning Group (Brazos G) met on February 7, 2018 and discussed the process to determine the amount of surface water available from existing water rights and future water management strategies. During this meeting, Brazos G discussed specific deviations from the standard Texas Water Development Board (TWDB) guidance that will be employed to develop the 2021 Brazos G Regional Water Plan. As you know, the guidance provided by the TWDB in the base scope of work for the Fifth Cycle of Regional Water Planning requires the use of the Run 3 (full authorization) version of the Brazos River Basin and Brazos-San Jacinto Coastal Basin Water Availability Model (Brazos WAM) maintained by the Texas Commission on Environmental Quality (TCEQ). This model is used by the TCEQ for evaluating legal water available to applications for new or amended water rights, and as such, includes some aspects that limit its usefulness for water planning.

Brazos G requests that the TWDB allow specific variations from the base TCEQ Brazos WAM for analyses that determine surface water available to existing rights. These variations will allow a more accurate assessment of supplies available to existing water rights, and will provide consistency with the analyses used to develop the 2006, 2011 and 2016 Brazos G Plans. The resulting WAM containing these necessary modifications to the TCEQ Brazos WAM will be referred to as the "Brazos G WAM."

1. Utilize naturalized flow and evaporation data developed by the Brazos River Authority (BRA) to extend the period of record through 2015.

   The TCEQ Brazos WAM includes a period of record of 1940 – 1997. This period of record does not include the severe drought experienced recently, which in some areas of Texas has replaced the 1950's drought as the "drought of record." The BRA, in support of the development of its Water Management Plan for its recently-granted System Operations Permit, has extended the naturalized flow and evaporation datasets through 2015 in order to analyze the impact of the new potential drought of record on the agency's water supplies. The hydrology has been updated throughout the Brazos Basin. Although developed in response to TCEQ requirements for the BRA's Management Plan, the TCEQ does not consider these extended flows to be the "official" dataset for analyzing water right appropriations because the flow naturalization process did not include adjust gaged records for water rights with authorized annual diversions less than 1,000 acre-feet, reservoirs with storage less than 5,000 acre-feet, or wastewater effluent discharges less than 1 million gallons per day.. The resulting naturalized flows are somewhat more conservative (smaller) than those that would have been developed with a full flow naturalization process because diversions and water added to storage are added back into the gage flows during the flow naturalization process. The smaller return flows would

make an even smaller difference. Brazos G believes that this is a relatively small limitation in comparison to the opportunity to utilize an extended period of record that encompasses the existing and potentially new "droughts of record" in the Brazos Basin.
<u>Benefit:</u> Improved estimation of flows available to existing water rights considering the likelihood that a new drought of record exists in many parts of the Brazos Basin.

2. Separate individual BRA contractual diversions from cumulative contractual diversions.

   The TCEQ Brazos WAM formerly assumed all diversions from storage occur lakeside and did not take into account the multiple BRA contracts located throughout the basin. The more recent TCEQ Brazos WAM now accumulates the BRA's contracts within various reaches throughout the river basin. Those cumulative contractual diversions will need to be broken out to individual contract holders in the input data set to that water available to specific WUGs and WWPs can be determined.

   <u>Benefits</u>: Improved estimates of water available to WUGs and WWPs that receive supplies from BRA.

3. Include estimated current and future return flows. (utilized in the 2006, 2011 and 2016 Brazos G Plans)

   The Brazos G WAM will include a certain level of current and future return flows (wastewater treatment plant effluent) discharged by entities located throughout the basin that are permitted to discharge in excess of 0.9 million gallons per day (MGD). These return flows are based on historical discharges and projected future discharges assuming an aggressive plan for future reuse of each entity's effluent. For determining a conservatively low estimate of return flows available to existing water rights, it was assumed that 25% of existing levels of discharge would be directly reused and not continued to be discharged, and 50% of any increases in wastewater plan flows would be reused. These return flow amounts were reviewed and acknowledged by each entity during the development of the 2006 Plan and were used during the development of the 2006, 2011 and 2016 Plans following approval by the TWDB. These return flow amounts will be revisited for the 2021 Plan and will be adjusted for any changes including new discharges, new reuse permits and requests by entities to revise their estimated discharges.

   <u>Benefits</u>: Improved estimates of water available to existing water rights; improved estimates of streamflows throughout the Brazos Basin; provide an estimate of wastewater flows potentially available for direct reuse throughout the Brazos Basin.

4. Update reservoir operating rules to work correctly under recent drought conditions.

   The reservoir operating rules in the TCEQ Brazos G WAM were developed to allow the BRA's system of reservoirs to optimize water supply through the drought of the 1950's. However, these operating rules do not allow the system to operate optimally during the more recent drought. The BRA has developed an alternative set of rules that allow the reservoir system to operate optimally through both the 1950's and more recent drought, and the Brazos G WAM will incorporate these rules into the model.

5. Include existing subordination agreements in the Brazos G WAM. (utilized in the 2006, 2011 and 2016 Brazos G Plans)

   Several agreements exist between parties in the Brazos River Basin whereby one party agrees to not exercise a priority call on the other party's upstream junior water right during times of low flow. This increases water available to the junior water right and decreases water available to the downstream senior water right when insufficient flows exist to satisfy both water rights. Some subordination agreements are included by TCEQ in the TCEQ Brazos WAM, but only those that are identified specifically in the language of the water rights involved. Many others are not included in the language of any water right and therefore are not included in the TCEQ Brazos WAM. The Brazos G WAM will be modified to include additional subordination agreements between entities in the Brazos Basin that are not included in the TCEQ Brazos WAM. Specific agreements currently identified to be added to the Brazos G WAM include:

   - Possum Kingdom Reservoir water rights are subordinated to Lake Alan Henry;
   - Possum Kingdom Reservoir water rights are subordinated to the City of Stamford's California Creek pump-back operation into Lake Stamford;
   - Lake Waco is subordinated to the City of Clifton's 1996 priority date water right;
   - Possum Kingdom Reservoir water rights are subordinated to rights held by the West Central Texas Municipal Water District in Hubbard Creek Reservoir; and
   - Possum Kingdom Reservoir water rights are subordinated to rights held by the City of Abilene to divert flows from the Clear Fork of the Brazos River into Lake Fort Phantom Hill.

   Some of these may already be incorporated into the TCEQ Brazos WAM. Other subordination agreements will also be incorporated when identified during the planning process.

   Benefits: Provides a more realistic determination of water available to existing water rights; improved estimates of streamflows throughout the Brazos Basin.

6. Utilize safe yield analyses for reservoirs upstream of Possum Kingdom Reservoir and for Lake Palo Pinto. (utilized in the 2011 and 2016 Brazos G Plans)

   Supplies available from reservoirs will use either a firm or safe yield depending on the location of the reservoir and the preference of the reservoir owner. In the upper Brazos Basin (upstream of Possum Kingdom Reservoir), both 1-year and 2-year safe yields are used by reservoir owners as their preferred basis of supply. These same approaches will be used, as requested by individual reservoir owners to best reflect the operation of their facilities. In addition, the Palo Pinto County Municipal Water District No. 1 has decided to operate on a percent storage reserve basis for Lake Palo Pinto, which is approximately equivalent to a 0.5-year safe yield. The same safe and firm yield assumptions employed in the 2016 Plan will be used in the 2021 Plan, unless a change is specifically requested by a reservoir owner. For reservoirs in which a 0.5-, 1-, or 2-year safe yield is used as the basis for supply, Brazos G will also determine and report the firm yield, as required by TWDB guidance.

   Benefits: Provides a more realistic method for determining water supplies in west Texas because it matches that area's preferred approach for managing reservoir water supplies.

7. Utilize the Brazos Mini-WAM to determine supplies in the Clear Fork portion of the Brazos Basin.

   During the Phase I studies leading into the 2011 planning cycle, Brazos G developed a subset of the Brazos WAM that extended the period of record through June 2008 for a portion of the upper Brazos Basin (16 primary control points) including the Clear Fork of the Brazos River. This model is referred to as the "Brazos Mini-WAM." This model was used to determine water available to rights in the applicable portion of the Brazos Basin for the 2011 and 2016 Brazos G Plans. Hydrology for this model has now been updated through 2015 to incorporate the potential new drought of record. Naturalized streamflows for this model were developed using all water rights in the subwatershed and therefore are somewhat more precise than those developed by the BRA for the entire Brazos Basin. Brazos G requests that Brazos G Mini-WAM be used to determine surface water supplies for its applicable portion of the upper Brazos Basin, if it is determined that it provides greater than a 10-percent difference in supply (yield or run-of-river) than results from using the hydrology updated by the BRA.

   Benefit: The Brazos G Mini-WAM may provide a better estimate of water available to water rights in the applicable part of the Brazos Basin; provide water supply estimates consistent with recent permitting and management decisions made by the City of Abilene.

8. 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 actually be permitted by the TCEQ. However, TCEQ takes into account 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. Brazos G requests that the Brazos G WAM be utilized to evaluate water management strategies instead of the base TCEQ Run 3 WAM.

   Benefits: This will provide a consistent basis of evaluation between existing supplies and new water management strategies.

Brazos G 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. Note that we have coordinated with the technical consultants for Region O and Region H, and they have indicated they intend to utilize the same approaches as outlined above.

Please direct any questions to the Brazos G technical consultant, David Dunn of HDR at david.dunn@hdrinc.com or (512) 912-5136.

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

April 17, 2018

Mr. Wayne Wilson
Region G Chair
c/o Wilson Cattle Company
7026 East OSR
Bryan, TX 77808

RE: Brazos G Regional Water Planning Group (RWPG) request for approval to modify surface water availability hydrologic assumptions for development of the 2021 Brazos G Regional Water Plan (RWP)

Dear Mr. Wilson:

The Texas Water Development Board (TWDB) has reviewed the request submitted by Mr. David Dunn on behalf of the Brazos G RWPG dated February 23, 2018 for approval of alternative water supply assumptions to be used in determining surface water availability. This letter confirms that the TWDB approves the following requests:

1. Utilize naturalized flow and evaporation data developed by the Brazos River Authority (BRA), which extends the hydrologic record through 2015.
2. Separate BRA individual contractual diversions from cumulative contractual diversions.
3. Include a conservative estimate of current and future return flows.
4. Incorporate updated reservoir system operating rules to more accurately reflect recent conditions.
5. Include existing subordination agreements in the Brazos G Water Availability Model (WAM).
6. Utilize 0.5, 1, or 2-year safe yields for reservoirs upstream of Possum Kingdom Reservoir and for Lake Palo Pinto (to be clearly specified, by reservoir, in the 2021 Brazos G RWP).
7. Utilize the Brazos Mini-WAM to determine supplies in the Clear Fork sub-basin of the Brazos basin.

Region G also requested to use the same water supply assumptions for strategy evaluations as used for existing supply. While the use of these modified conditions may be reasonable for planning purposes, WAM RUN 3 would be utilized by the Texas Commission on Environmental Quality for analyzing permit applications. It is acceptable to use modified conditions for water management strategy supply evaluations only if the yield produced is more conservative for surface water appropriations than WAM RUN 3. However, TWDB is of the understanding that the modified conditions will result in greater yields than WAM RUN 3. Therefore, strategy evaluations involving new surface water appropriations must be based on WAM RUN 3. Accounting for subordination agreements and use of future return flows are acceptable modifications for strategy evaluations as outlined in Exhibit C, Section 5.2.1.

Although the TWDB approves the use of safe yields for developing estimates of current water supplies, firm yield for each reservoir must still be reported to TWDB in the online planning database and plan documents.

While the TWDB authorizes these modifications to evaluate existing water supplies for development of the 2021 Brazos G 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 contract Exhibit C, *Second Amended General Guidelines for Fifth Cycle of Regional Water Plan Development.*

If you have any questions, please do not hesitate to contact Tom Barnett, project manager for Region G, at 512-463-4209 or via email at thomas.barnett@twdb.texas.gov.

Sincerely,

Jeff Walker
Executive Administrator

c w/o enc: Mr. Stephen Hamlin, Brazos River Authority
Mr. David Dunn, HDR, Inc.
Ms. Paula Jo Lemonds, HDR, Inc.
Ms. Simone Kiel, Freese & Nichols, Inc
Mr. Tom Barnett, TWDB

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Appendix L. Region O Hydrologic Variance Information

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LLANO ESTACADO REGIONAL WATER PLANNING GROUP

1323 58th Street
Lubbock, TX 79412
(806) 762-8721
Fax (806) 765-9544
www.llanoplan.org
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March 28, 2018

Region O Project Manager
Texas Water Development Board
PO Box 13231
Austin, Texas 78711

Re: Procedures for determining surface water availability and water supplies for the 2021 Llano Estacado Regional Water Plan (RegionO)

The Llano Estacado Regional Water Planning Group (Region O) met on January 23, 2018 and discussed the process to determine the amount of surface water available from existing water rights and future water management strategies. During this meeting, Region O discussed specific deviations from the standard Texas Water Development Board (TWDB) guidance that will be employed to develop the 2021 Llano Estacado Regional Water Plan.

As you know, the guidance provided by the TWDB in the base scope of work for the Fifth 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.

Region O 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. Region O 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, Region O 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 Region O Water User Groups (WUGs), specifically Lake Meredith.

3. Colorado WAM. Region O 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 Region O Water User Groups (WUGs) to promote inter-regional consistency.

4. Red River WAM. Region O 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. Lake Alan Henry Analysis. Region O requests permission to conduct analyses using a stand-alone WAM developed specifically for Lake Alan Henry. In response to the ongoing drought in the mid-2000s, the City of Lubbock requested that HDR perform a yield analysis of Lake Alan Henry (LAH) that extended through 2006 in order to better account for the impacts of that drought cycle. Additionally, a recent (2005) hydrographic survey of LAH by the TWDB indicates that the capacity of LAH has been reduced from its permitted capacity of 115,937 to 94,808 acre-feet (acft). This is due to sedimentation in the reservoir pool and inaccuracies in the determination of the storage capacity during initial construction. Both the drought extending through 2006 and the reduced storage capacity could substantially reduce the computed yield of the reservoir.

   The model developed for Lubbock uses WAM naturalized flows through 1997 and then extends the period of record through 2006 using relationships consistent with the WAM methodology. The benefit to using this subset of the Brazos WAM is that it will provide a better estimate of the yield of Lake Alan Henry.

6. 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 actually be permitted by the TCEQ. However, TCEQ takes into account 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. Region O 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.

Region O 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 Region O technical consultant, Paula Jo Lemonds of HDR at paula.lemonds@hdrinc.com or (512) 912-5127.

Sincerely,

Aubrey Spear, Chairman
Llano Estacado Regional Water Planning Group – Region O

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Texas Water Development Board

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May 18, 2018

Mr. Aubrey Spear
Region O Chair
c/o City of Lubbock
P.O. Box 2000
Lubbock, TX 79457

RE: Region O Regional Water Planning Group (RWPG) request for approval to modify surface water availability hydrologic assumptions for development of the 2021 Llano Estacado (Region O) Regional Water Plan (RWP)

Dear Mr. ~~Spear:~~ Aubrey

The Texas Water Development Board (TWDB) has reviewed the request submitted by the Region O RWPG dated March 28, 2018 for approval of alternative water supply assumptions to be used in determining surface water availability. This letter confirms that the TWDB approves the following requests:

1. Utilize the hydrologic variances approved for use by the Brazos G RWPG to conduct analyses for the Brazos River Basin.
2. Utilize yield values approved for use by the Region A RWPG for the Canadian River Basin.
3. Utilize yield values approved for use by the Region F RWPG for the Colorado River Basin.
4. Utilize yield values approved for use by the Region A RWPG for the Red River Basin.
5. Utilize a stand-alone Water Availability Model (WAM) for Lake Alan Henry that was developed for the City of Lubbock.

Region O also requested to use the same water supply assumptions for strategy evaluations as used for existing supply. While the use of these modified conditions may be reasonable for planning purposes, WAM RUN 3 would be utilized by the Texas Commission on Environmental Quality for analyzing permit applications. It is acceptable to use modified conditions for water management strategy supply evaluations only if the yield produced is more conservative for surface water appropriations than WAM RUN 3. However, the TWDB is of the understanding that the modified conditions could result in greater or lesser yields than WAM RUN 3 on a case-by-case basis. Therefore, strategy evaluations involving new surface water appropriations must be based on WAM RUN 3 when modified conditions would be less conservative. Accounting for subordination agreements and use of future return flows are acceptable modifications for strategy evaluations as outlined in Exhibit C, Section 5.2.1.

While the TWDB authorizes these modifications to evaluate existing water supplies for development of the 2021 Brazos G 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 contract Exhibit C, *Second Amended General Guidelines for Fifth Cycle of Regional Water Plan Development.*

If you have any questions, please do not hesitate to contact Tom Barnett, project manager for Region O, at 512-463-4209 or via email at thomas.barnett@twdb.texas.gov.

Sincerely,

Jeff Walker
Executive Administrator

c w/o enc: Ms. Kelly Davila, South Plains Association of Governments
Ms. Paula Jo Lemonds, HDR, Inc.
Mr. David Dunn, HDR, Inc.
Ms. Simone Kiel, Freese & Nichols, Inc
Mr. Tom Barnett, TWDB

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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
Birds					
Bald eagle	*Haliaeetus leucocephalus*	Found primarily near rivers and large lakes	--	--	Resident
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries, and along sandy beaches.	--	--	Resident
Lesser prairie chicken	*Tympanuchus pallidicinctus*	Arid grasslands, generally interspersed with shrubs	--	--	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Western burrowing owl	*Athene cunicularia hypugaea*	Open grassland, especially prairie, plains, and savanna	--	--	Resident
White-faced Ibis	*Plegadis chihi*	Prefers freshwater marshes, sloughs, and irrigated rice fields. Currently confined to rookeries in near-coastal areas.	--	T	Possible migrant
Mammals					
American badger	*Taxidea taxus*	Occupies a variety of habitats. Commonly occupy range inhabited by ground squirrels or prairie dogs.	--	--	Resident
Big brown bat	*Eptesicus fuscus*	Any wooded areas or woodlands except south Texas. Riparian areas in west Texas.	--	--	Resident

[1] TPWD. 2020. Annotated County Lists of Rare Species – Bailey County. Revised August 25, 2020.

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
Big free-tailed bat	*Nyctinomops macrotis*	Habitat data is sparse but seems to prefer to roost in crevices and cracks in high canyon walls or buildings.	--	--	Resident
Black-tailed prairie dog	*Cynomys ludovicianus*	Dry, flat, short grassland with low, sparse vegetation.	--	--	Resident
Eastern red bat	*Lasiurus borealis*	Found in a variety of habitats in Texas. Usually associated with wooded areas.	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, and etc.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodland in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Long-tailed weasel	*Mustela frenata*	Brushlands, fence rows, upland woods and bottomland hardwoods, forest edges and rocky desert scrub.	--	--	Resident
Mexican free-tailed bat	*Tadarida braziliensis*	Found in all habitats, forest to desert.	--	--	Resident
Mountain lion	*Puma concolor*	Rugged mountains and riparian zones.	--	--	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
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	Dry, sandy areas are preferred, but also found in grassy parks, open pine forests, scattered brush and rocky mesas.	--	--	Resident
Townsend's big-eared bat	*Corynorhinus townsendii*	May inhabit old buildings. Frequents caves and mines.	--	--	Resident
Reptiles					
Texas horned lizard	*Phrynosoma cornutum*	Open, arid, and semi-arid regions with sparse vegetation	--	T	Resident
Western box turtle	*Terrapene ornata*	Prairie grasslands, pasture, fields, sandhills and open woodland.	--	--	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
Western hognose snake	*Heterodon nasicus*	Areas with sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, semiagricultural areas and irrigation ditches.	--	--	Resident
Western rattlesnake	*Crotalus viridis*	Grassland, both desert and prairie. 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
Texas barberry	*Berberis swaseyi*	Shallow calcareous stony clay of uplands grasslands/shrublands over limestone or openly wooded canyons	--	--	Resident

Notes:
Acronyms: SGCN = species of greatest conservation need; USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department;
Statuses: T = State Threatened; -- = SGCN or Rare

D.2 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					
Bald eagle	*Haliaeetus leucocephalus*	Found primarily near rivers and large lakes	--	--	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
Lesser prairie-chicken	*Tympanuchus pallidicinctus*	Arid grasslands, generally interspersed with shrubs.	--	-	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Western burrowing owl	*Athene cunicularia hypugaea*	Open grassland, especially prairie, plains, and savanna	--	--	Resident
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
Mammals					
American badger	*Taxidea taxus*	Generalist. Prefers areas with soft soils that sustain ground squirrels for food.	--	--	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
Eastern red bat	*Lasiurus borealis*	Found in a variety of habitats in Texas. Usually associated with wooded areas. Found in towns, especially during migration.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident

[2] TPWD. 2020. Annotated County Lists of Rare Species – Gaines County. Revised August 25, 2020.

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
Kit fox	*Vulpes macrotis*	Open desert grassland; avoids rugged, rocky terrain and wooded areas.	--	--	Resident
Long-tailed weasel	*Mustela frenata*	Brushlands, fence rows, upland woods and bottomland hardwoods, forest edges & rocky desert scrub.	--	--	Resident
Mexican free-tailed bat	*Tadarida brasiliensis*	Found in all habitats, forest to desert.	--	--	Resident
Mountain lion	*Puma concolor*	Generalist, most commonly found in rugged mountains and riparian zones	--	--	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
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	Found in grassland habitats.	--	--	Resident
Western hog-nosed skunk	*Conepatus leuconotus*	Habitats include woodlands, grasslands and deserts to 7,200 feet.	--	--	Resident
Western spotted skunk	*Spilogale gracilis*	Habitat description is not available at this time.	--	--	Resident
Reptiles					
Dunes sagebrush lizard	*Sceloporus arenicolus*	Confined to active sand dunes near Monahans; dwarf shin-oak sandhills with sagebrush and yucca.	--	--	Resident
Massasauga	*Sistrurus tergeminus*	Quite common in gently rolling prairie occasionally broken by creek valley or rocky hillside.	--	--	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 hognose snake	*Heterodon nasicus*	Areas with sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semiagricultural areas and margins of irrigation ditches.	--	--	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
Western rattlesnake	*Crotalus viridis*	Grassland, both desert and prairie. 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 cinegas, playa lakes and other desert wetlands.	--	--	Resident
Cory's ephedra	*Ephedra coryi*	Dune areas and dry grasslands in the 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: T = State Threatened; -- = SGCN or Rare

D.3 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					
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 the edge of marsh.	PT	T	Resident

[3] TPWD. 2020. Annotated County Lists of Rare Species – Garza County. Revised August 25, 2020.

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
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries, and along sandy beaches.	--	--	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Western burrowing owl	*Athene cunicularia hypugaea*	Open grassland, especially prairie, plains, and savanna	--	--	Resident
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
Fishes					
Chub shiner	*Notropis potteri*	Large, turbid rivers and smaller tributaries. Found in flowing water with silt or sand substrate. Tolerant of high salinities.	--	--	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.	LE	E	Resident
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.	LE	E	Resident
Insects					
American bumblebee	*Bombus pensylvanicus*	Found in open farmland and fields.	--	--	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
Mammals					
American badger	*Taxidea taxus*	eneralist. Prefers areas with soft soils that sustain ground squirrels for food.	--	--	Resident
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. Found in towns, especially during migration.	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, and etc.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Long-tailed weasel	*Mustela frenata*	Includes burshlands, fence rows, upland woods and bottomland hardwoods, forest edges & rocky desert scrub. Usually close to water.	--	--	Resident
Mexican free-tailed bat	*Tadarida brasiliensis*	Found in all habitats, forest to desert.	--	--	Resident
Mountain lion	*Puma concolor*	Rugged mountains and riparian zones	--	--	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
Palo Duro mouse	*Peromyscus truei Comanche*	Rocky, juniper-mesquite covered slopes of steep-walled canyons. Juniper woodlands in canyon country in the Panhandle.	--	T	Resident
Plains spotted skunk	*Spilogale putorius interrupta*	Prefers wooded, brushy areas and tallgrass prairie	--	--	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
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	Found in grassland habitats.	--	--	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 hog-nosed skunk	*Conepatus leuconotus*	Woodlands, grasslands, and deserts up to 7,200 feet. Most common in rugged, rocky canyon country.	--	--	Resident
Western spotted skunk	*Spilogale gracilis*	Mixed woodlands, open areas and farmland	--	--	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
Western hognose snake	*Heterodon nasicus*	Areas with sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semiagricultural areas and margins of irrigation ditches.	--	--	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
Western rattlesnake	*Crotalus viridis*	Grassland, both desert and prairie. Shrub desert rocky hillsides, edges of arid and semi-arid river breaks	--	--	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 = Proposed Threatened; T = State Threatened; LE = Federally Endangered; E = State Endangered; -- = SGCN or Rare

D.4 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, Kent, Lubbock, and Lynn Counties, Texas [4]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	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 edge of marsh.	PT	T	Possible migrant

[4] TPWD. 2020. Annotated County Lists of Rare Species – Garza, Lubbock, and Lynn Counties. Revised August 25, 2020.

Table D.4. Endangered, Threatened, Candidate and SGCN Listed for Garza, Kent, Lubbock, and Lynn Counties, Texas [4]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Common black-hawk	*Buteogallus anthracinus*	Cottonwood-lined rivers and streams. Formerly bred in south Texas.	--	T	Possible migrant
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries and along sandy beaches.	--	--	Possible migrant
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Western burrowing owl	*Athene cunicularia hypugaea*	Open grassland, especially prairie, plains, and savanna	--	--	Resident
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					
Chub shiner	*Notropis potteri*	Large, turbid rivers and smaller tributaries. Found in flowing water with silt or sand substrate. Tolerant of high salinities.	--	--	Resident
Red River pupfish	*Cyprinodon rubrofluviatilis*	Headwater streams of xeric grasslands. River edges, channels, backwaters, over sand bottoms. Euryhaline and eurythermal.	--	--	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.	LE	--	Resident

Table D.4. Endangered, Threatened, Candidate and SGCN Listed for Garza, Kent, Lubbock, and Lynn Counties, Texas [4]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
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.	LE	--	Resident
Insects					
American bumblebee	*Bombus pensylvanicus*	Habitat description is not available at this time.	--	--	Resident
No common name	*Eupseudomorpha brillians*	Habitat description is not available at this time.	--	--	Resident
Mammals					
American badger	*Taxidea taxus*	Generalist. Prefers areas with soft soils that sustain ground squirrels for food.	--	--	Resident
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. Found in towns, especially during migration.	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, and 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.4. Endangered, Threatened, Candidate and SGCN Listed for Garza, Kent, Lubbock, and Lynn Counties, Texas [4]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Long-tailed weasel	*Mustela frenata*	Includes burshlands, fence rows, upland woods and bottomland hardwoods, forest edges & rocky desert scrub. Usually close to water.	--	--	Resident
Mexican free-tailed bat	*Tadarida brasiliensis*	Found in all habitats, forest to desert.	--	--	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
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, plateau areas of open grassland. Desert grassland and desert-scrub.	--	--	Resident
Swift fox	*Vulpes velox*	Restricted to current and historic shortgrass prairie	--	--	Resident
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	Found in grassland habitats.	--	--	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 hog-nosed skunk	*Conepatus leuconotus*	Woodlands, grasslands, and deserts up to 7,200 feet. Most common in rugged, rocky canyon country.	--	--	Resident
Western spotted skunk	*Spilogale gracilis*	Habitat description is not available at this time.	--	--	Resident

Table D.4. Endangered, Threatened, Candidate and SGCN Listed for Garza, Kent, Lubbock, and Lynn Counties, Texas [4]

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. 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
Massasauga	*Sistrurus tergeminus*	Quite common in gently rolling prairie occasionally broken by creek valley or rocky hillside.	--	--	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 hognose snake	*Heterodon nasicus*	Areas with sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semiagricultural areas and margins of irrigation ditches.	--	--	Resident
Western rattlesnake	*Crotalus viridis*	Grassland, both desert and prairie. Shrub desert rocky hillsides, edges of arid and semi-arid river breaks	--	--	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

Table D.4. Endangered, Threatened, Candidate and SGCN Listed for Garza, Kent, Lubbock, and Lynn Counties, Texas [4]

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 = Proposed Threatened; T = State Threatened; LE = Federally Endangered; -- = SGCN or Rare

D.5 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 [5]

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
Black Rail	*Laterallus jamaicensis*	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps. Nests in or along edge of marsh.	PT	T	Possible migrant
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries and along sandy beaches.	--	--	Possible migrant
Mountain Plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Western Burrowing Owl	*Athene cunicularia hypugaea*	Open grassland, especially prairie, plains, and savanna	--	--	Resident

[5] TPWD. 2020. Annotated County Lists of Rare Species – Hale County. Revised August 25, 2020.

Table D.5. Endangered, Threatened, Candidate and SGCN Listed for Hale County, Texas [5]

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
Insects					
American bumblebee	*Bombus pensylvanicus*	Habitat description is not available at this time.	--	--	Resident
Mammals					
American badger	*Taxidea taxus*	Generalist. Prefers areas with soft soils that sustain ground squirrels for food.	--	--	Resident
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. Found in towns, especially during migration.	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Catholic. Prefers wooded, brushy areas and tallgrass prairies.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Long-tailed weasel	*Mustela frenata*	Includes burshlands, fence rows, upland woods and bottomland hardwoods, forest edges & rocky desert scrub. Usually close to water.	--	--	Resident
Mexican free-tailed bat	*Tadarida brasiliensis*	Found in all habitats, forest to desert.	--	--	Resident
Mountain lion	*Puma concolor*	Rugged mountains and riparian zones	--	--	Resident
Plains spotted skunk	*Spilogale putorius interrupta*	Prefers wooded, brushy areas and tallgrass prairie	--	--	Resident

Table D.5. Endangered, Threatened, Candidate and SGCN Listed for Hale County, Texas [5]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Prairie vole	*Microtus ochrogaster taylori*	Upland herbaceous fields, grasslands, old agricultural lands and thickets. Places where there is suitable cover for runways.	--	--	Resident
Swift fox	*Vulpes velox*	Restricted to current and historic shortgrass prairie	--	--	Resident
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	Found in grassland habitats.	--	--	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
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
Western hognose snake	*Heterodon nasicus*	Areas with sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semiagricultural areas and margins of irrigation ditches.	--	--	Resident

Notes:
Acronyms: SGCN = species of greatest conservation need; USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department;
Statuses: PT = Proposed Threatened; T = State Threatened; -- = SGCN or Rare

D.6 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
- 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 Aquifer Storage and Recovery
- South Lubbock Well Field

Table D.6. Endangered, Threatened, Candidate and SGCN Listed for Lubbock County, Texas [6]

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
Black rail	*Laterallus jamaicensis*	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps. Nests in or along edge of marsh.	PT	T	Possible migrant
Common black-hawk	*Buteogallus anthracinus*	Cottonwood-lined rivers and streams. Formerly bred in south Texas.	--	T	Possible migrant
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries and along sandy beaches.	--	--	Possible migrant
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Western burrowing owl	*Athene cunicularia hypugaea*	Open grassland, especially prairie, plains, and savanna	--	--	Resident
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
Insects					
American bumblebee	*Bombus pensylvanicus*	Habitat description is not available at this time.	--	--	Resident
No common name	*Eupseudomorpha brillians*	Habitat description is not available at this time.	--	--	Resident
Mammals					

[6] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Lubbock County. Revised April 18, 2019.

Table D.6. Endangered, Threatened, Candidate and SGCN Listed for Lubbock County, Texas [6]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
American badger	*Taxidea taxus*	Generalist. Prefers areas with soft soils that sustain ground squirrels for food.	--	--	Resident
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. Found in towns, especially during migration.	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, and etc.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Long-tailed weasel	*Mustela frenata*	Includes burshlands, fence rows, upland woods and bottomland hardwoods, forest edges & rocky desert scrub. Usually close to water.	--	--	Resident
Mexican free-tailed bat	*Tadarida brasiliensis*	Found in all habitats, forest to desert.	--	--	Resident
Mountain lion	*Puma concolor*	Rugged mountains and riparian zones	--	--	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

Table D.6. Endangered, Threatened, Candidate and SGCN Listed for Lubbock County, Texas [6]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
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
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	Found in grassland habitats.	--	--	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 hog-nosed skunk	*Conepatus leuconotus*	Woodlands, grasslands, and deserts up to 7,200 feet. Most common in rugged, rocky canyon country.	--	--	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
Massasauga	*Sistrurus tergeminus*	Quite common in gently rolling prairie occasionally broken by creek valley or rocky hillside.	--	--	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 hognose snake	*Heterodon nasicus*	Areas with sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semiagricultural areas and margins of irrigation ditches.	--	--	Resident

Table D.6. Endangered, Threatened, Candidate and SGCN Listed for Lubbock County, Texas [6]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Western rattlesnake	*Crotalus viridis*	Grassland, both desert and prairie. Shrub desert rocky hillsides, edges of arid and semi-arid river breaks	--	--	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 = Proposed Threatened; T = State Threatened; -- = SGCN or Rare

D.7 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[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 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 edge of marsh.	PT	T	Possible migrant
Common black-hawk	*Buteogallus anthracinus*	Cottonwood-lined rivers and streams. Formerly bred in south Texas.	--	T	Possible migrant

[7] TPWD. 2020. Annotated County Lists of Rare Species – Lubbock and Lynn Counties. Revised August 25, 2020.

Table D.7. Endangered, Threatened, Candidate and SGCN Listed for Lubbock and Lynn Counties, Texas[7]

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
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Western burrowing owl	*Athene cunicularia hypugaea*	Open grassland, especially prairie, plains, and savanna	--	--	Resident
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*	Habitat description not provided. Possibly playa lakes.	--	--	Resident
Insects					
American bumblebee	*Bombus pensylvanicus*	Habitat description is not available at this time.	--	--	Resident
No common name	*Eupseudomorpha brillians*	Habitat description is not available at this time.	--	--	Resident
Mammals					
American badger	*Taxidea taxus*	Generalist. Prefers areas with soft soils that sustain ground squirrels for food.	--	--	Resident
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. Found in towns, especially during migration.	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, and etc.	--	--	Resident

Table D.7. Endangered, Threatened, Candidate and SGCN Listed for Lubbock and Lynn Counties, Texas[7]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Long-tailed weasel	*Mustela frenata*	Includes brushlands, fence rows, upland woods and bottomland hardwoods, forest edges & rocky desert scrub. Usually close to water.	--	--	Resident
Mexican free-tailed bat	*Tadarida brasiliensis*	Found in all habitats, forest to desert.	--	--	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 on the eastern edge of the Llano Estacado.	--	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, plateau areas of open grassland. Desert grassland and desert-scrub.	--	--	Resident
Swift fox	*Vulpes velox*	Restricted to current and historic shortgrass prairie	--	--	Resident
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	Found in grassland habitats.	--	--	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 hog-nosed skunk	*Conepatus leuconotus*	Woodlands, grasslands, and deserts up to 7,200 feet. Most common in rugged, rocky canyon country.	--	--	Resident
Western spotted skunk	*Spilogale gracilis*	Rocky bluffs and brush-bordered canyon stream beds.	--	--	Resident

Table D.7. Endangered, Threatened, Candidate and SGCN Listed for Lubbock and Lynn Counties, Texas[7]

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. 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
Massasauga	*Sistrurus tergeminus*	Quite common in gently rolling prairie occasionally broken by creek valley or rocky hillside.	--	--	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 hognose snake	*Heterodon nasicus*	Areas with sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semiagricultural areas and margins of irrigation ditches.	--	--	Resident
Western rattlesnake	*Crotalus viridis*	Grassland, both desert and prairie. Shrub desert rocky hillsides, edges of arid and semi-arid river breaks	--	--	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 = Proposed Threatened; T = State Threatened; -- = SGCN or Rare

D.8 Roberts County

The follow species list (Table D.8) for only Roberts County, Texas, applies to the following groundwater management strategy, CRMWA to Aquifer Storage and Recovery, discussed in Chapter 5.

Table D.8. Endangered, Threatened, Candidate and SGCN Listed for Roberts 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					
Bald eagle	*Haliaeetus leucocephalus*	Found primarily near rivers and large lakes	--	--	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
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.	LE	E	Resident
Lesser prairie-chicken	*Tympanuchus pallidicinctus*	Arid grasslands, generally interspersed with shrubs.	--	--	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Western burrowing owl	*Athene cunicularia hypugaea*	Open grassland, especially prairie, plains, and savanna	--	--	Resident
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.	LE	E	Possible migrant
Fish					
Arkansas River shiner	*Notropis girardi*	Typically in turbid waters of broad shallow channels of main streams over mostly silt and shifting sand bottom.	LT	T	Resident
Peppered chub	*Macrhybopsis tetranema*	Large low gradient streams, usually over fine gravel or sand. Middle Canadian and Beaver River basins	--	--	Resident

[8] TPWD. 2020. Annotated County Lists of Rare Species – Roberts County. Revised August 25, 2020.

Table D.8. Endangered, Threatened, Candidate and SGCN Listed for Roberts County, Texas[8]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
Red River pupfish	*Cyprinodon ubrofluviatilis*	Headwater streams of xeric grasslands. River edges, channels, backwaters, over sand bottoms. Euryhaline and eurythermal.	--	T	Potential Resident
Mammals					
American badger	*Taxidea taxus*	Generalist. Prefers areas with soft soils that sustain ground squirrels for food.	--	--	Resident
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. Found in towns, especially during migration.	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, and etc.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Mexican free-tailed bat	*Tadarida brasiliensis*	Found in all habitats, forest to desert.	--	--	Resident
Mountain lion	*Puma concolor*	Rugged mountains and riparian zones	--	--	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

Table D.8. Endangered, Threatened, Candidate and SGCN Listed for Roberts County, Texas[8]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County
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
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	Found in grassland habitats.	--	--	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
Reptiles					
Massasauga	*Sistrurus tergeminus*	Quite common in gently rolling prairie occasionally broken by creek valley or rocky hillside.	--	--	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 hognose snake	*Heterodon nasicus*	Areas with sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semiagricultural areas and margins of irrigation ditches.	--	--	Resident
Western rattlesnake	*Crotalus viridis*	Grassland, both desert and prairie. Shrub desert rocky hillsides, edges of arid and semi-arid river breaks	--	--	Resident

Table D.8. Endangered, Threatened, Candidate and SGCN Listed for Roberts County, Texas[8]

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in County

Notes:
Acronyms: SGCN = species of greatest conservation need; USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department;
Statuses: T = State Threatened; LE = Federally Endangered; E = State Endangered; LT = Federally Threatened; -- = SGCN or Rare

D.9 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[9], Hutchison[10], Gray[11], Carson[12] and Potter[13] 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 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 edge of marsh.	PT	T	Possible migrant
Common black-hawk	*Buteogallus anthracinus*	Cottonwood-lined rivers and streams. Formerly bred in south Texas.	--	T	Possible migrant
Franklin's gull	*Leucophaeus pipixcan*	Nests in marshes and along inland lakes. Winters along coast in bays, estuaries and along sandy beaches.	--	--	Possible migrant

9 TPWD. 2020. Annotated County Lists of Rare Species – Roberts County. Revised August 25, 2020.
10 TPWD. 2020b. Annotated County Lists of Rare Species – Hutchison County. Revised August 25, 2020.
11 TPWD. 2020c. Annotated County Lists of Rare Species – Gray County. Revised August 25, 2020.
12 TPWD. 2020d. Annotated County Lists of Rare Species – Carson County. Revised August 25, 2020.
13 TPWD. 2020e. Annotated County Lists of Rare Species – Potter County. Revised August 25, 2020.

Table D.9. Endangered, Threatened, Candidate and SGCN Listed for Roberts[9], Hutchison[10], Gray[11], Carson[12] and Potter[13] Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
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.	LE	E	Resident
Lesser prairie-chicken	*Tympanuchus pallidicinctus*	Arid grasslands, generally interspersed with shrubs.	--	-	Resident
Mountain plover	*Charadrius montanus*	Nest on high plains or shortgrass prairie.	--	--	Resident
Western burrowing owl	*Athene cunicularia hypugaea*	Open grassland, especially prairie, plains, and savanna	--	--	Resident
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.	LE	E	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.	LT	T	Resident
Flathead chub	*Platygobio gracilis*	Found in strong currents over sandy bottoms and in pools.	--	--	Likely extirpated
Peppered chub	*Macrhybopsis tetranema*	Large low gradient streams, usually over fine gravel or sand. Middle Canadian and Beaver River basins	--	--	Resident
Red River pupfish	*Cyprinodon ubrofluviatilis*	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
Mammals					
American badger	*Taxidea taxus*	Lives in a variety of habitats, but most commonly found in open country such as prairies and plains.	--	--	Resident

Table D.9. Endangered, Threatened, Candidate and SGCN Listed for Roberts[9], Hutchison[10], Gray[11], Carson[12] and Potter[13] Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
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 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
Eastern red bat	*Lasiurus borealis*	Found in a variety of habitats in Texas. Usually associated with wooded areas. Found in towns, especially during migration.	--	--	Resident
Eastern spotted skunk	*Spilogale putorius*	Generalist, open fields, prairies, croplands, fencerows, woodlands, and etc.	--	--	Resident
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodlands in Trans-Pecos, forests and woods in east and central Texas.	--	--	Resident
Mexican free-tailed bat	*Tadarida brasiliensis*	Found in all habitats, forest to desert.	--	--	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
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

Table D.9. Endangered, Threatened, Candidate and SGCN Listed for Roberts[9], Hutchison[10], Gray[11], Carson[12] and Potter[13] Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
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
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	Found in grassland habitats.	--	--	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 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
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
Massasauga	*Sistrurus tergeminus*	Quite common in gently rolling prairie occasionally broken by creek valley or rocky hillside.	--	--	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 garter snake	*Thamnophis sirtalis annectens*	Wet or moist microhabitats are conducive to the species occurrence but it is not necessarily restricted to them.	--	--	Resident

Table D.9. Endangered, Threatened, Candidate and SGCN Listed for Roberts[9], Hutchison[10], Gray[11], Carson[12] and Potter[13] Counties, Texas

Common Name	Scientific Name	Summary of Habitat Preference	USFWS Status	TPWD Status	Potential Occurrence in Counties
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 hognose snake	*Heterodon nasicus*	Areas with sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semiagricultural areas and margins of irrigation ditches.	--	--	Resident
Western rattlesnake	*Crotalus viridis*	Grassland, both desert and prairie. Shrub desert rocky hillsides, edges of arid and semi-arid river breaks	--	--	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

Notes:
Acronyms: SGCN = species of greatest conservation need; USFWS = U.S. Fish & Wildlife Service; TPWD = Texas Parks and Wildlife Department;
Statuses: PT = Proposed Threatened; T = State Threatened: LE = Federally Endangered: LT = Federally Threatened; E = State Endangered; -- = SGCN or Rare

E

Water Management Strategy Evaluation – Agricultural Resources and Environmental Factors

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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
5.1	Jim Bertram Lake 7	Lubbock	Surface Water/Reuse	34	774	779	34	45	2	3	2	3	3	3
5.2	Lake Alan Henry Phase 2	Garza, Kent, Lubbock, Lynn[a]	Surface Water	5	0	0	5	42	2	3	3	3	3	3
5.3	North Fork Scalping Operation	Garza	Surface Water	37	650	655	37	42	2	3	2	3	3	3
5.4	Direct Potable Reuse to North Water Treatment Plant	Lubbock	Reuse	48	0	0	48	45	2	3	3	3	3	3
5.5	Direct Potable Reuse to South Water Treatment Plant	Lubbock	Reuse	56	0	0	56	45	2	3	3	3	3	3
5.6	North Fork Diversion at CR 7300	Lubbock	Reuse	103	0	5	103	45	2	3	2	3	3	3
5.7	North Fork Diversion to Lake Alan Henry Pump Station	Garza	Reuse	37	0	5	37	42	2	3	2	3	3	3
5.8	South Fork Discharge	Lubbock, Lynn	Reuse	111	0	0	111	48	2	3	3	3	3	3
5.9	Plainview Reuse	Hale	Reuse	28	0	0	28	29	2	3	3	3	3	3
---	Groundwater - General[b]	Multiple	Groundwater	2	0	0	2	Variable	3	3	3	3	3	3
5.11	Brackish Supplemental Water Supply for Bailey County Well Field	Bailey	Groundwater	45	0	0	45	27	3	3	3	3	3	3
5.12	Bailey County Well Field Capacity Maintenance	Bailey	Groundwater	170	0	0	170	27	3	3	3	3	3	3
5.13	CRMWA to Lubbock ASR	Lubbock	Groundwater	163	0	0	163	45	3	3	3	3	3	3
5.14	CRMWA to Plainview ASR	Hale	Groundwater	22	0	0	22	29	3	3	3	3	3	3
5.15	South Lubbock Well Field	Lubbock	Groundwater	43	0	0	0	45	3	3	3	3	3	3
5.16	New Transmission Line to Aqueduct for Roberts County Well Field	Roberts, Hutchison, Gray, Carson, Potter	Groundwater	850	0	0	850	48	3	3	3	3	3	3
5.17	Roberts County Well Field Capacity Maintenance	Roberts	Groundwater	38	0	0	38	37	3	3	3	3	3	3
5.18	Seminole Local Groundwater Development	Gaines	Groundwater	23	0	0	23	29	3	3	3	3	3	3
5.19	Seminole Brackish Groundwater Desalination	Gaines	Groundwater	34	0	0	34	29	3	3	3	3	3	3
5.22	Wolfforth Water Management Strategy	Lubbock	Groundwater	12	0	0	12	45	3	3	3	3	3	3
5.35	South Garza Water Supply	Lubbock	Groundwater	5	0	0	5	45	3	3	3	3	3	3
5.36.1	Expanded Development of Roberts County Well Field	Roberts	Groundwater	827	0	0	827	37	3	3	3	3	3	3
5.36.2	CRMWA ASR	Lubbock	Groundwater	54	0	0	54	45	3	3	3	3	3	3
5.37	Control of Naturally Occurring Salinity	Kent, King, Stonewall	---	50	0	0	50		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.

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TWDB Socioeconomic Impacts of Projected Water Shortages Report

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Socioeconomic Impacts of Projected Water Shortages for the Llano Estacado (Region O) Regional Water Planning Area

Prepared in Support of the 2021 Region O Regional Water Plan

Texas Water Development Board

Dr. John R. Ellis
Water Use, Projections, & Planning Division
Texas Water Development Board

November 2019

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Executive Summary

Evaluating the social and economic impacts of not meeting identified water needs is a required analysis in the regional water planning process. The Texas Water Development Board (TWDB) estimates these impacts for regional water planning groups (RWPGs) and summarizes the impacts in the state water plan. The analysis presented is for the Llano Estacado Regional Water Planning Group (Region O).

Based on projected water demands and existing water supplies, Region O identified water needs (potential shortages) that could occur within its region under a repeat of the drought of record for six water use categories (irrigation, livestock, manufacturing, mining, municipal and steam-electric power). The TWDB then estimated the annual socioeconomic impacts of those needs—if they are not met—for each water use category and as an aggregate for the region.

This analysis was performed using an economic impact modeling software package, IMPLAN (Impact for Planning Analysis), as well as other economic analysis techniques, and represents a snapshot of socioeconomic impacts that may occur during a single year repeat of the drought of record with the further caveat that no mitigation strategies are implemented. Decade specific impact estimates assume that growth occurs, and future shocks are imposed on an economy at 10-year intervals. The estimates presented are not cumulative (i.e., summing up expected impacts from today up to the decade noted), but are simply snapshots of the estimated annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated water supplies and demands for that same decade.

For regional economic impacts, income losses and job losses are estimated within each planning decade (2020 through 2070). The income losses represent an approximation of gross domestic product (GDP) that would be foregone if water needs are not met.

The analysis also provides estimates of financial transfer impacts, which include tax losses (state, local, and utility tax collections); water trucking costs; and utility revenue losses. In addition, social impacts are estimated, encompassing lost consumer surplus (a welfare economics measure of consumer wellbeing); as well as population and school enrollment losses.

IMPLAN data reported that Region O generated more than $24 billion in GDP (2018 dollars) and supported roughly 295,000 jobs in 2016. The Region O estimated total population was approximately 512,000 in 2016.

It is estimated that not meeting the identified water needs in Region O would result in an annually combined lost income impact of approximately $12.7 billion in 2020 and $13.6 billion in 2070 (Table ES-1). In 2020, the region would lose approximately 91,000 jobs, and by 2070 job losses would increase to approximately 116,000 if anticipated needs are not mitigated.

All impact estimates are in year 2018 dollars and were calculated using a variety of data sources and tools including the use of a region-specific IMPLAN model, data from TWDB annual water use estimates, the U.S. Census Bureau, Texas Agricultural Statistics Service, and the Texas Municipal League.

Table ES-1 Region O socioeconomic impact summary

Regional Economic Impacts	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$12,745	$15,091	$14,621	$14,075	$13,806	$13,596
Job losses	91,473	112,867	112,166	112,158	114,484	115,546
Financial Transfer Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Tax losses on production and imports ($ millions)*	$1,076	$1,221	$1,171	$1,109	$1,076	$1,051
Water trucking costs ($ millions)*	$-	$-	$-	$-	$-	$-
Utility revenue losses ($ millions)*	$15	$34	$55	$79	$108	$133
Utility tax revenue losses ($ millions)*	$0	$1	$1	$2	$2	$3
Social Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Consumer surplus losses ($ millions)*	$1	$3	$8	$19	$49	$86
Population losses	16,794	20,722	20,594	20,592	21,019	21,214
School enrollment losses	3,212	3,964	3,939	3,939	4,020	4,058

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

1 Introduction

Water shortages during a repeat of the drought of record would likely curtail or eliminate certain economic activity in businesses and industries that rely heavily on water. Insufficient water supplies could not only have an immediate and real impact on the regional economy in the short term, but they could also adversely and chronically affect economic development in Texas. From a social perspective, water supply reliability is critical as well. Shortages could disrupt activity in homes, schools and government, and could adversely affect public health and safety. For these reasons, it is important to evaluate and understand how water supply shortages during drought could impact communities throughout the state.

As part of the regional water planning process, RWPGs must evaluate the social and economic impacts of not meeting water needs (31 Texas Administrative Code §357.33 (c)). Due to the complexity of the analysis and limited resources of the planning groups, the TWDB has historically performed this analysis for the RWPGs upon their request. Staff of the TWDB's Water Use, Projections, & Planning Division designed and conducted this analysis in support of Region O, and those efforts for this region as well as the other 15 regions allow consistency and a degree of comparability in the approach.

This document summarizes the results of the analysis and discusses the methodology used to generate the results. Section 1 provides a snapshot of the region's economy and summarizes the identified water needs in each water use category, which were calculated based on the RWPG's water supply and demand established during the regional water planning process. Section 2 defines each of ten impact assessment measures used in this analysis. Section 3 describes the methodology for the impact assessment and the approaches and assumptions specific to each water use category (i.e., irrigation, livestock, manufacturing, mining, municipal, and steam-electric power). Section 4 presents the impact estimates for each water use category with results summarized for the region as a whole. Appendix A presents a further breakdown of the socioeconomic impacts by county.

1.1 Regional Economic Summary

The Region O Regional Water Planning Area generated more than $24 billion in gross domestic product (2018 dollars) and supported roughly 295,000 jobs in 2016, according to the IMPLAN dataset utilized in this socioeconomic analysis. This activity accounted for 1.4 percent of the state's total gross domestic product of 1.73 trillion dollars for the year based on IMPLAN. Table 1-1 lists all economic sectors ranked by the total value-added to the economy in Region O. The agricultural sector (including cattle ranching and irrigated farming) generated more than 9 percent of the region's total value-added. The top employers in the region were in the public administration, retail trade, health care, and agriculture sectors. Region O's estimated total population was roughly 512,000 in 2016, approximately 2 percent of the state's total.

This represents a snapshot of the regional economy as a whole, and it is important to note that not all economic sectors were included in the TWDB socioeconomic impact analysis. Data considerations prompted use of only the more water-intensive sectors within the economy because damage estimates could only be calculated for those economic sectors which had both reliable income and water use estimates.

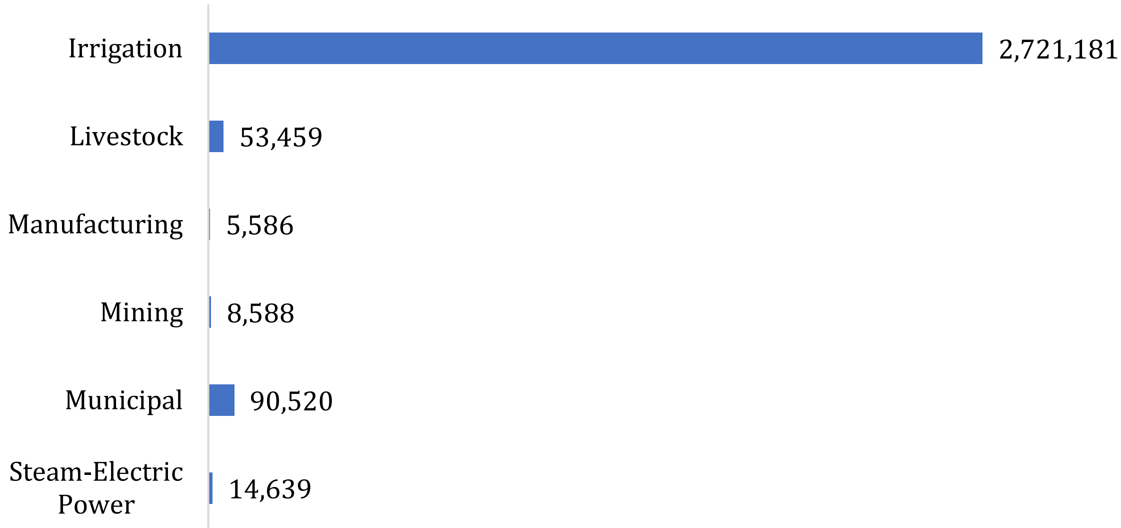
Table 1-1 Region O regional economy by economic sector*

Economic sector	Value-added ($ millions)	Tax ($ millions)	Jobs
Public Administration	$3,474.2	$(9.8)	45,065
Agriculture, Forestry, Fishing and Hunting	$2,252.8	$75.5	27,250
Real Estate and Rental and Leasing	$2,147.6	$339.0	9,838
Wholesale Trade	$1,740.5	$320.7	10,913
Health Care and Social Assistance	$1,726.4	$25.4	27,290
Retail Trade	$1,696.9	$402.2	29,490
Manufacturing	$1,505.6	$64.6	11,631
Mining, Quarrying, and Oil and Gas Extraction	$1,332.1	$318.4	10,766
Information	$1,268.7	$378.3	4,510
Construction	$1,125.9	$18.5	16,701
Finance and Insurance	$1,124.7	$75.7	15,253
Transportation and Warehousing	$876.4	$27.1	11,438
Accommodation and Food Services	$864.3	$143.1	23,935
Utilities	$850.1	$147.5	1,971
Other Services (except Public Administration)	$802.7	$92.6	16,955
Professional, Scientific, and Technical Services	$757.7	$26.7	12,052
Administrative and Support and Waste Management and Remediation Services	$468.6	$15.9	11,353
Management of Companies and Enterprises	$145.5	$5.6	1,972
Arts, Entertainment, and Recreation	$101.9	$24.5	3,796
Educational Services	$84.6	$5.6	3,312
Grand Total	$24,347.2	$2,496.9	295,489

*Source: 2016 IMPLAN for 536 sectors aggregated by 2-digit NAICS (North American Industry Classification System)

Figure 1-1 illustrates Region O's breakdown of the 2016 water use estimates by TWDB water use category. The vast majority (94 percent) of water use in 2016 occurred in irrigated agriculture. In fact, close to 35 percent of the state's irrigation water use occurred within Region O.

Figure 1-1 Region O 2016 water use estimates by water use category (in acre-feet)



Source: TWDB Annual Water Use Estimates (all values in acre-feet)

1.2 Identified Regional Water Needs (Potential Shortages)

As part of the regional water planning process, the TWDB adopted water demand projections for water user groups (WUG) in Region O with input from the planning group. WUG-level demand projections were established for utilities that provide more than 100 acre-feet of annual water supply, combined rural areas (designated as county-other), and county-wide water demand projections for five non-municipal categories (irrigation, livestock, manufacturing, mining and steam-electric power). The RWPG then compared demands to the existing water supplies of each WUG to determine potential shortages, or needs, by decade.

Table 1-2 summarizes the region's identified water needs in the event of a repeat of the drought of record. Demand management, such as conservation, or the development of new infrastructure to increase supplies, are water management strategies that may be recommended by the planning group to address those needs. This analysis assumes that no strategies are implemented, and that the identified needs correspond to future water shortages. Note that projected water needs generally increase over time, primarily due to anticipated population growth, economic growth, or declining supplies. To provide a general sense of proportion, total projected needs as an overall percentage of total demand by water use category are also presented in aggregate in Table 1-2. Projected needs for individual water user groups within the aggregate can vary greatly and may reach 100% for a given WUG and water use category. A detailed summary of water needs by WUG and county appears in Chapter 4 of the 2021 Region O Regional Water Plan.

Table 1-2 Regional water needs summary by water use category*

Water Use Category		2020	2030	2040	2050	2060	2070
Irrigation	water needs (acre-feet per year)	692,132	1,421,093	1,428,558	1,423,943	1,423,741	1,422,508
	% of the category's total water demand	22%	45%	53%	58%	62%	64%
Livestock	water needs (acre-feet per year)	112	122	844	2,041	3,794	5,825
	% of the category's total water demand	0%	0%	2%	4%	7%	10%
Manufacturing	water needs (acre-feet per year)	5,454	6,482	6,482	6,482	6,482	6,482
	% of the category's total water demand	50%	53%	53%	53%	53%	53%
Mining	water needs (acre-feet per year)	10,118	10,503	9,517	8,145	6,908	6,016
	% of the category's total water demand	60%	58%	58%	57%	56%	55%
Municipal**	water needs (acre-feet per year)	4,345	9,345	15,418	21,861	30,062	36,931
	% of the category's total water demand	5%	9%	14%	19%	24%	28%
Steam-electric power	water needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	0%	0%	0%	0%	0%	0%
Total water needs (acre-feet per year)		**712,161**	**1,447,545**	**1,460,819**	**1,462,472**	**1,470,987**	**1,477,762**

*Entries denoted by a dash (-) indicate no identified water need for a given water use category.
** Municipal category consists of residential and non-residential (commercial and institutional) subcategories.

2 Impact Assessment Measures

A required component of the regional and state water plans is to estimate the potential economic and social impacts of potential water shortages during a repeat of the drought of record. Consistent with previous water plans, ten impact measures were estimated and are described in Table 2-1.

Table 2-1 Socioeconomic impact analysis measures

Regional economic impacts	Description
Income losses - value-added	The value of output less the value of intermediate consumption; it is a measure of the contribution to gross domestic product (GDP) made by an individual producer, industry, sector, or group of sectors within a year. Value-added measures used in this report have been adjusted to include the direct, indirect, and induced monetary impacts on the region.
Income losses - electrical power purchase costs	Proxy for income loss in the form of additional costs of power as a result of impacts of water shortages.
Job losses	Number of part-time and full-time jobs lost due to the shortage. These values have been adjusted to include the direct, indirect, and induced employment impacts on the region.
Financial transfer impacts	**Description**
Tax losses on production and imports	Sales and excise taxes not collected due to the shortage, in addition to customs duties, property taxes, motor vehicle licenses, severance taxes, other taxes, and special assessments less subsidies. These values have been adjusted to include the direct, indirect and induced tax impacts on the region.
Water trucking costs	Estimated cost of shipping potable water.
Utility revenue losses	Foregone utility income due to not selling as much water.
Utility tax revenue losses	Foregone miscellaneous gross receipts tax collections.
Social impacts	**Description**
Consumer surplus losses	A welfare measure of the lost value to consumers accompanying restricted water use.
Population losses	Population losses accompanying job losses.
School enrollment losses	School enrollment losses (K-12) accompanying job losses.

2.1 Regional Economic Impacts

The two key measures used to assess regional economic impacts are income losses and job losses. The income losses presented consist of the sum of value-added losses and the additional purchase costs of electrical power.

Income Losses - Value-added Losses

Value-added is the value of total output less the value of the intermediate inputs also used in the production of the final product. Value-added is similar to GDP, a familiar measure of the productivity of an economy. The loss of value-added due to water shortages is estimated by input-output analysis using the IMPLAN software package, and includes the direct, indirect, and induced monetary impacts on the region. The indirect and induced effects are measures of reduced income as well as reduced employee spending for those input sectors which provide resources to the water shortage impacted production sectors.

Income Losses - Electric Power Purchase Costs

The electrical power grid and market within the state is a complex interconnected system. The industry response to water shortages, and the resulting impact on the region, are not easily modeled using traditional input/output impact analysis and the IMPLAN model. Adverse impacts on the region will occur and are represented in this analysis by estimated additional costs associated with power purchases from other generating plants within the region or state. Consequently, the analysis employs additional power purchase costs as a proxy for the value-added impacts for the steam-electric power water use category, and these are included as a portion of the overall income impact for completeness.

For the purpose of this analysis, it is assumed that power companies with insufficient water will be forced to purchase power on the electrical market at a projected higher rate of 5.60 cents per kilowatt hour. This rate is based upon the average day-ahead market purchase price of electricity in Texas that occurred during the recent drought period in 2011. This price is assumed to be comparable to those prices which would prevail in the event of another drought of record.

Job Losses

The number of jobs lost due to the economic impact is estimated using IMPLAN output associated with each TWDB water use category. Because of the difficulty in predicting outcomes and a lack of relevant data, job loss estimates are not calculated for the steam-electric power category.

2.2 Financial Transfer Impacts

Several impact measures evaluated in this analysis are presented to provide additional detail concerning potential impacts on a portion of the economy or government. These financial transfer impact measures include lost tax collections (on production and imports), trucking costs for imported water, declines in utility revenues, and declines in utility tax revenue collected by the state. These measures are not solely adverse, with some having both positive and negative impacts. For example, cities and residents would suffer if forced to pay large costs for trucking in potable water. Trucking firms, conversely, would benefit from the transaction. Additional detail for each of these measures follows.

Tax Losses on Production and Imports

Reduced production of goods and services accompanying water shortages adversely impacts the collection of taxes by state and local government. The regional IMPLAN model is used to estimate reduced tax collections associated with the reduced output in the economy. Impact estimates for this measure include the direct, indirect, and induced impacts for the affected sectors.

Water Trucking Costs

In instances where water shortages for a municipal water user group are estimated by RWPGs to exceed 80 percent of water demands, it is assumed that water would need to be trucked in to support basic consumption and sanitation needs. For water shortages of 80 percent or greater, a fixed, maximum of $35,000[1] per acre-foot of water applied as an economic cost. This water trucking cost was utilized for both the residential and non-residential portions of municipal water needs.

Utility Revenue Losses

Lost utility income is calculated as the price of water service multiplied by the quantity of water not sold during a drought shortage. Such estimates are obtained from utility-specific pricing data provided by the Texas Municipal League, where available, for both water and wastewater. These water rates are applied to the potential water shortage to estimate forgone utility revenue as water providers sold less water during the drought due to restricted supplies.

Utility Tax Losses

Foregone utility tax losses include estimates of forgone miscellaneous gross receipts taxes. Reduced water sales reduce the amount of utility tax that would be collected by the State of Texas for water and wastewater service sales.

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[1] Based on staff survey of water hauling firms and historical data concerning transport costs for potable water in the recent drought in California for this estimate. There are many factors and variables that would determine actual water trucking costs including distance to, cost of water, and length of that drought.

2.3 Social Impacts

Consumer Surplus Losses for Municipal Water Users

Consumer surplus loss is a measure of impact to the wellbeing of municipal water users when their water use is restricted. Consumer surplus is the difference between how much a consumer is willing and able to pay for a commodity (i.e., water) and how much they actually have to pay. The difference is a benefit to the consumer's wellbeing since they do not have to pay as much for the commodity as they would be willing to pay. Consumer surplus may also be viewed as an estimate of how much consumers would be willing to pay to keep the original quantity of water which they used prior to the drought. Lost consumer surplus estimates within this analysis only apply to the residential portion of municipal demand, with estimates being made for reduced outdoor and indoor residential use. Lost consumer surplus estimates varied widely by location and degree of water shortage.

Population and School Enrollment Losses

Population loss due to water shortages, as well as the associated decline in school enrollment, are based upon the job loss estimates discussed in Section 2.1. A simplified ratio of job and net population losses are calculated for the state as a whole based on a recent study of how job layoffs impact the labor market population.[2] For every 100 jobs lost, 18 people were assumed to move out of the area. School enrollment losses are estimated as a proportion of the population lost based upon public school enrollment data from the Texas Education Agency concerning the age K-12 population within the state (approximately 19%).

[2] Foote, Andrew, Grosz, Michel, Stevens, Ann. "Locate Your Nearest Exit: Mass Layoffs and Local Labor Market Response." University of California, Davis. April 2015, http://paa2015.princeton.edu/papers/150194. The study utilized Bureau of Labor Statistics data regarding layoffs between 1996 and 2013, as well as Internal Revenue Service data regarding migration, to model the change in the population as the result of a job layoff event. The study found that layoffs impact both out-migration and in-migration into a region, and that a majority of those who did move following a layoff moved to another labor market rather than an adjacent county.

3 Socioeconomic Impact Assessment Methodology

This portion of the report provides a summary of the methodology used to estimate the potential economic impacts of future water shortages. The general approach employed in the analysis was to obtain estimates for income and job losses on the smallest geographic level that the available data would support, tie those values to their accompanying historic water use estimate, and thereby determine a maximum impact per acre-foot of shortage for each of the socioeconomic measures. The calculations of economic impacts are based on the overall composition of the economy divided into many underlying economic sectors. Sectors in this analysis refer to one or more of the 536 specific production sectors of the economy designated within IMPLAN, the economic impact modeling software used for this assessment. Economic impacts within this report are estimated for approximately 330 of these sectors, with the focus on the more water-intensive production sectors. The economic impacts for a single water use category consist of an aggregation of impacts to multiple, related IMPLAN economic sectors.

3.1 Analysis Context

The context of this socioeconomic impact analysis involves situations where there are physical shortages of groundwater or surface water due to a recurrence of drought of record conditions. Anticipated shortages for specific water users may be nonexistent in earlier decades of the planning horizon, yet population growth or greater industrial, agricultural or other sector demands in later decades may result in greater overall demand, exceeding the existing supplies. Estimated socioeconomic impacts measure what would happen if water user groups experience water shortages for a period of one year. Actual socioeconomic impacts would likely become larger as drought of record conditions persist for periods greater than a single year.

3.2 IMPLAN Model and Data

Input-Output analysis using the IMPLAN software package was the primary means of estimating the value-added, jobs, and tax related impact measures. This analysis employed regional level models to determine key economic impacts. IMPLAN is an economic impact model, originally developed by the U.S. Forestry Service in the 1970's to model economic activity at varying geographic levels. The model is currently maintained by the Minnesota IMPLAN Group (MIG Inc.) which collects and sells county and state specific data and software. The year 2016 version of IMPLAN, employing data for all 254 Texas counties, was used to provide estimates of value-added, jobs, and taxes on production for the economic sectors associated with the water user groups examined in the study. IMPLAN uses 536 sector-specific Industry Codes, and those that rely on water as a primary input were assigned to their appropriate planning water user categories (irrigation, livestock, manufacturing, mining, and municipal). Estimates of value-added for a water use category were obtained by summing value-added estimates across the relevant IMPLAN sectors associated with that water use category. These calculations were also performed for job losses as well as tax losses on production and imports.

The adjusted value-added estimates used as an income measure in this analysis, as well as the job and tax estimates from IMPLAN, include three components:

- ***Direct effects*** representing the initial change in the industry analyzed;
- ***Indirect effects*** that are changes in inter-industry transactions as supplying industries respond to reduced demands from the directly affected industries; and,
- ***Induced effects*** that reflect changes in local spending that result from reduced household income among employees in the directly and indirectly affected industry sectors.

Input-output models such as IMPLAN only capture backward linkages and do not include forward linkages in the economy.

3.3 Elasticity of Economic Impacts

The economic impact of a water need is based on the size of the water need relative to the total water demand for each water user group. Smaller water shortages, for example, less than 5 percent, are generally anticipated to result in no initial negative economic impact because water users are assumed to have a certain amount of flexibility in dealing with small shortages. As a water shortage intensifies, however, such flexibility lessens and results in actual and increasing economic losses, eventually reaching a representative maximum impact estimate per unit volume of water. To account for these characteristics, an elasticity adjustment function is used to estimate impacts for the income, tax and job loss measures. Figure 3-1 illustrates this general relationship for the adjustment functions. Negative impacts are assumed to begin accruing when the shortage reaches the lower bound 'b1' (5 percent in Figure 3-1), with impacts then increasing linearly up to the 100 percent impact level (per unit volume) once the upper bound reaches the 'b2' level shortage (40 percent in Figure 3-1).

To illustrate this, if the total annual value-added for manufacturing in the region was $2 million and the reported annual volume of water used in that industry is 10,000 acre-feet, the estimated economic measure of the water shortage would be $200 per acre-foot. The economic impact of the shortage would then be estimated using this value-added amount as the maximum impact estimate ($200 per acre-foot) applied to the anticipated shortage volume and then adjusted by the elasticity function. Using the sample elasticity function shown in Figure 3-1, an approximately 22 percent shortage in the livestock category would indicate an economic impact estimate of 50% of the original $200 per acre-foot impact value (i.e., $100 per acre-foot).

Such adjustments are not required in estimating consumer surplus, utility revenue losses, or utility tax losses. Estimates of lost consumer surplus rely on utility-specific demand curves with the lost consumer surplus estimate calculated based on the relative percentage of the utility's water shortage. Estimated changes in population and school enrollment are indirectly related to the elasticity of job losses.

Assumed values for the lower and upper bounds 'b1' and 'b2' vary by water use category and are presented in Table 3-1.

Figure 3-1 Example economic impact elasticity function (as applied to a single water user's shortage)

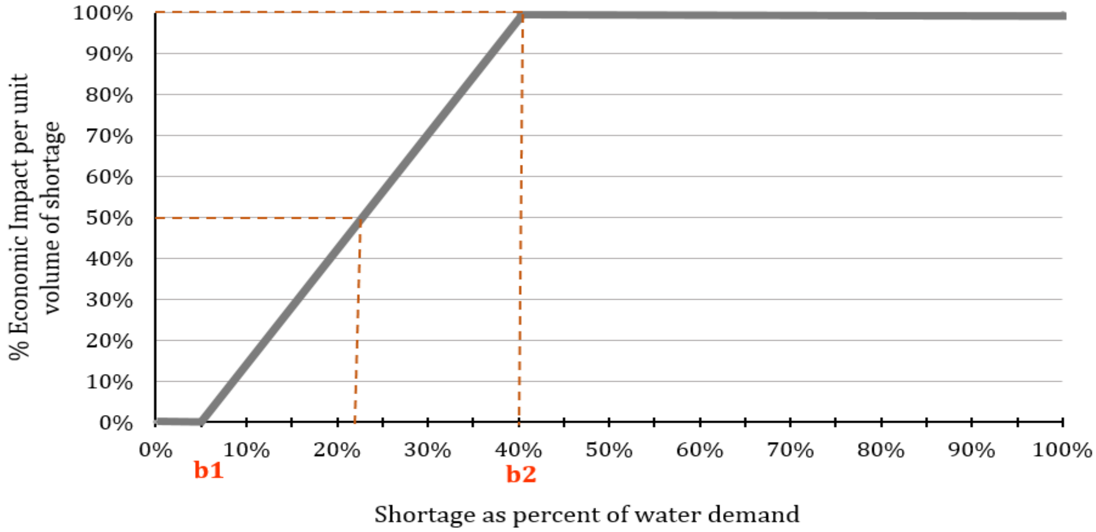

Table 3-1 Economic impact elasticity function lower and upper bounds

Water use category	Lower bound (b1)	Upper bound (b2)
Irrigation	5%	40%
Livestock	5%	10%
Manufacturing	5%	40%
Mining	5%	40%
Municipal (non-residential water intensive subcategory)	5%	40%
Steam-electric power	N/A	N/A

3.4 Analysis Assumptions and Limitations

The modeling of complex systems requires making many assumptions and acknowledging the model's uncertainty and limitations. This is particularly true when attempting to estimate a wide range of socioeconomic impacts over a large geographic area and into future decades. Some of the key assumptions and limitations of this methodology include:

1. The foundation for estimating the socioeconomic impacts of water shortages resulting from a drought are the water needs (potential shortages) that were identified by RWPGs as part of the

regional water planning process. These needs have some uncertainty associated with them but serve as a reasonable basis for evaluating the potential impacts of a drought of record event.

2. All estimated socioeconomic impacts are snapshots for years in which water needs were identified (i.e., 2020, 2030, 2040, 2050, 2060, and 2070). The estimates are independent and distinct "what if" scenarios for each particular year, and water shortages are assumed to be temporary events resulting from a single year recurrence of drought of record conditions. The evaluation assumed that no recommended water management strategies are implemented. In other words, growth occurs and future shocks are imposed on an economy at 10-year intervals, and the resulting impacts are estimated. Note that the estimates presented are not cumulative (i.e., summing up expected impacts from today up to the decade noted), but are simply snapshots of the estimated annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated water supplies and demands for that same decade.

3. Input-output models such as IMPLAN rely on a static profile of the structure of the economy as it appears today. This presumes that the relative contributions of all sectors of the economy would remain the same, regardless of changes in technology, availability of limited resources, and other structural changes to the economy that may occur in the future. Changes in water use efficiency will undoubtedly take place in the future as supplies become more stressed. Use of the static IMPLAN structure was a significant assumption and simplification considering the 50-year time period examined in this analysis. To presume an alternative future economic makeup, however, would entail positing many other major assumptions that would very likely generate as much or more error.

4. This is not a form of cost-benefit analysis. That approach to evaluating the economic feasibility of a specific policy or project employs discounting future benefits and costs to their present value dollars using some assumed discount rate. The methodology employed in this effort to estimate the economic impacts of future water shortages did not use any discounting methods to weigh future costs differently through time.

5. All monetary values originally based upon year 2016 IMPLAN and other sources are reported in constant year 2018 dollars to be consistent with the water management strategy requirements in the State Water Plan.

6. IMPLAN based loss estimates (income-value-added, jobs, and taxes on production and imports) are calculated only for those IMPLAN sectors for which the TWDB's Water Use Survey (WUS) data was available and deemed reliable. Every effort is made in the annual WUS effort to capture all relevant firms who are significant water users. Lack of response to the WUS, or omission of relevant firms, impacts the loss estimates.

7. Impacts are annual estimates. The socioeconomic analysis does not reflect the full extent of impacts that might occur as a result of persistent water shortages occurring over an extended duration. The drought of record in most regions of Texas lasted several years.

8. Value-added estimates are the primary estimate of the economic impacts within this report. One may be tempted to add consumer surplus impacts to obtain an estimate of total adverse economic impacts to the region, but the consumer surplus measure represents the change to the wellbeing of households (and other water users), not an actual change in the flow of dollars through the economy. The two measures (value-added and consumer surplus) are both valid impacts but ideally should not be summed.

9. The value-added, jobs, and taxes on production and import impacts include the direct, indirect and induced effects to capture backward linkages in the economy described in Section 2.1. Population and school enrollment losses also indirectly include such effects as they are based on the associated losses in employment. The remaining measures (consumer surplus, utility revenue, utility taxes, additional electrical power purchase costs, and potable water trucking costs), however, do not include any induced or indirect effects.

10. The majority of impacts estimated in this analysis may be more conservative (i.e., smaller) than those that might actually occur under drought of record conditions due to not including impacts in the forward linkages in the economy. Input-output models such as IMPLAN only capture backward linkages on suppliers (including households that supply labor to directly affected industries). While this is a common limitation in this type of economic modeling effort, it is important to note that forward linkages on the industries that use the outputs of the directly affected industries can also be very important. A good example is impacts on livestock operators. Livestock producers tend to suffer substantially during droughts, not because there is not enough water for their stock, but because reductions in available pasture and higher prices for purchased hay have significant economic effects on their operations. Food processors could be in a similar situation if they cannot get the grains or other inputs that they need. These effects are not captured in IMPLAN, resulting in conservative impact estimates.

11. The model does not reflect dynamic economic responses to water shortages as they might occur, nor does the model reflect economic impacts associated with a recovery from a drought of record including:
    a. The likely significant economic rebound to some industries immediately following a drought, such as landscaping;
    b. The cost and time to rebuild liquidated livestock herds (a major capital investment in that industry);
    c. Direct impacts on recreational sectors (i.e., stranded docks and reduced tourism); or,
    d. Impacts of negative publicity on Texas’ ability to attract population and business in the event that it was not able to provide adequate water supplies for the existing economy.

12. Estimates for job losses and the associated population and school enrollment changes may exceed what would actually occur. In practice, firms may be hesitant to lay off employees, even in difficult economic times. Estimates of population and school enrollment changes are based on regional evaluations and therefore do not necessarily reflect what might occur on a statewide basis.

13. **The results must be interpreted carefully. It is the general and relative magnitudes of impacts as well as the changes of these impacts over time that should be the focus rather than the absolute numbers.** Analyses of this type are much better at predicting relative percent differences brought about by a shock to a complex system (i.e., a water shortage) than the precise size of an impact. To illustrate, assuming that the estimated economic impacts of a drought of record on the manufacturing and mining water user categories are $2 and $1 million, respectively, one should be more confident that the economic impacts on manufacturing are twice as large as those on mining and that these impacts will likely be in the millions of dollars. But one should have less confidence that the actual total economic impact experienced would be $3 million.

14. The methodology does not capture “spillover” effects between regions – or the secondary impacts that occur outside of the region where the water shortage is projected to occur.

15. The methodology that the TWDB has developed for estimating the economic impacts of unmet water needs, and the assumptions and models used in the analysis, are specifically designed to estimate potential economic effects at the regional and county levels. Although it may be tempting to add the regional impacts together in an effort to produce a statewide result, the TWDB cautions against that approach for a number of reasons. The IMPLAN modeling (and corresponding economic multipliers) are all derived from regional models – a statewide model of Texas would produce somewhat different multipliers. As noted in point 14 within this section, the regional modeling used by TWDB does not capture spillover losses that could result in other regions from unmet needs in the region analyzed, or potential spillover gains if decreased production in one region leads to increases in production elsewhere. The assumed drought of record may also not occur in every region of Texas at the same time, or to the same degree.

4 Analysis Results

This section presents estimates of potential economic impacts that could reasonably be expected in the event of water shortages associated with a drought of record and if no recommended water management strategies were implemented. Projected economic impacts for the six water use categories (irrigation, livestock, manufacturing, mining, municipal, and steam-electric power) are reported by decade.

4.1 Impacts for Irrigation Water Shortages

Eighteen of the 21 counties in the region are projected to experience water shortages in the irrigated agriculture water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 4-1. Note that tax collection impacts were not estimated for this water use category. IMPLAN data indicates a negative tax impact (i.e., increased tax collections) for the associated production sectors, primarily due to past subsidies from the federal government. However, it was not considered realistic to report increasing tax revenues during a drought of record.

Table 4-1 Impacts of water shortages on irrigation in Region O

Impact measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$255	$668	$661	$665	$673	$678
Job losses	3,192	8,315	8,229	8,279	8,373	8,429

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.2 Impacts for Livestock Water Shortages

Four of the 21 counties in the region are projected to experience water shortages in the livestock water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 4-2.

Table 4-2 Impacts of water shortages on livestock in Region O

Impact measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$-	$-	$10	$71	$139	$218
Jobs losses	-	-	115	807	1,557	2,434
Tax losses on production and imports ($ millions)*	$-	$-	$1	$4	$8	$12

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.3 Impacts of Manufacturing Water Shortages

Manufacturing water shortages in the region are projected to occur in four of the 21 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 4-3.

Table 4-3 Impacts of water shortages on manufacturing in Region O

Impacts measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$7,318	$8,961	$8,961	$8,961	$8,961	$8,961
Job losses	64,475	78,747	78,747	78,747	78,747	78,747
Tax losses on production and Imports ($ millions)*	$528	$642	$642	$642	$642	$642

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.4 Impacts of Mining Water Shortages

Mining water shortages in the region are projected to occur in eight of the 21 counties in the region for one or more decades within the planning horizon. Estimated impacts to this water use type appear in Table 4-4.

Table 4-4 Impacts of water shortages on mining in Region O

Impacts measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$5,162	$5,402	$4,829	$4,074	$3,504	$3,092
Job losses	23,612	24,673	22,102	18,663	15,970	13,918
Tax losses on production and Imports ($ millions)*	$547	$573	$512	$432	$372	$331

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.5 Impacts for Municipal Water Shortages

Four of the 21 counties in the region are projected to experience water shortages in the municipal water use category for one or more decades within the planning horizon.

Impact estimates were made for two sub-categories within municipal water use: residential and non-residential. Non-residential municipal water use includes commercial and institutional users, which are further divided into non-water-intensive and water-intensive subsectors including car wash, laundry, hospitality, health care, recreation, and education. Lost consumer surplus estimates were made only for needs in the residential portion of municipal water use. Available IMPLAN and TWDB Water Use Survey data for the non-residential, water-intensive portion of municipal demand allowed these sectors to be included in income, jobs, and tax loss impact estimate.

Trucking cost estimates, calculated for shortages exceeding 80 percent, assumed a fixed, maximum cost of $35,000 per acre-foot to transport water for municipal use. The estimated impacts to this water use category appear in Table 4-5.

Table 4-5 Impacts of water shortages on municipal water users in Region O

Impacts measure	2020	2030	2040	2050	2060	2070
Income losses[1] ($ millions)*	$10	$61	$160	$305	$530	$647
Job losses[1]	194	1,131	2,972	5,662	9,837	12,018
Tax losses on production and imports[1] ($ millions)*	$1	$6	$16	$31	$54	$66
Trucking costs ($ millions)*	$-	$-	$-	$-	$-	$-
Utility revenue losses ($ millions)*	$15	$34	$55	$79	$108	$133
Utility tax revenue losses ($ millions)*	$0	$1	$1	$2	$2	$3

[1] Estimates apply to the water-intensive portion of non-residential municipal water use.
* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.6 Impacts of Steam-Electric Water Shortages

None of the 21 counties in the region are projected to experience water shortages in the steam-electric water use category. Estimated impacts to this water use category appear in Table 4-6.

Note that estimated economic impacts to steam-electric water users:

- Are reflected as an income loss proxy in the form of estimated additional purchasing costs for power from the electrical grid to replace power that could not be generated due to a shortage;
- Do not include estimates of impacts on jobs. Because of the unique conditions of power generators during drought conditions and lack of relevant data, it was assumed that the industry would retain, perhaps relocating or repurposing, their existing staff in order to manage their ongoing operations through a severe drought.
- Do not presume a decline in tax collections. Associated tax collections, in fact, would likely increase under drought conditions since, historically, the demand for electricity increases during times of drought, thereby increasing taxes collected on the additional sales of power.

Table 4-6 Impacts of water shortages on steam-electric power in Region O

Impacts measure	2020	2030	2040	2050	2060	2070
Income Losses ($ millions)*	$-	$-	$-	$-	$-	$-

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.7 Regional Social Impacts

Projected changes in population, based upon several factors (household size, population, and job loss estimates), as well as the accompanying change in school enrollment, were also estimated and are summarized in Table 4-7.

Table 4-7 Region-wide social impacts of water shortages in Region O

Impacts measure	2020	2030	2040	2050	2060	2070
Consumer surplus losses ($ millions)*	$1	$3	$8	$19	$49	$86
Population losses	16,794	20,722	20,594	20,592	21,019	21,214
School enrollment losses	3,212	3,964	3,939	3,939	4,020	4,058

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

Appendix A - County Level Summary of Estimated Economic Impacts for Region O

County level summary of estimated economic impacts of not meeting identified water needs by water use category and decade (in 2018 dollars, rounded). Values are presented only for counties with projected economic impacts for at least one decade.
(* Entries denoted by a dash (-) indicate no estimated economic impact)

		Income losses (Million $)*						Job losses					
County	Water Use Category	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
BAILEY	IRRIGATION	$2.05	$17.30	$17.30	$17.30	$17.30	$17.30	26	219	219	219	219	219
BAILEY	LIVESTOCK	-	-	-	$5.44	$19.95	$31.27	-	-	-	59	215	337
BAILEY Total		**$2.05**	**$17.30**	**$17.30**	**$22.74**	**$37.25**	**$48.57**	**26**	**219**	**219**	**278**	**434**	**556**
BRISCOE	IRRIGATION	-	$0.82	$1.15	$1.39	$1.57	$1.70	-	10	13	16	18	20
BRISCOE Total		**-**	**$0.82**	**$1.15**	**$1.39**	**$1.57**	**$1.70**	**-**	**10**	**13**	**16**	**18**	**20**
CASTRO	IRRIGATION	$35.82	$74.66	$74.66	$74.66	$74.66	$74.66	486	1,013	1,013	1,013	1,013	1,013
CASTRO Total		**$35.82**	**$74.66**	**$74.66**	**$74.66**	**$74.66**	**$74.66**	**486**	**1,013**	**1,013**	**1,013**	**1,013**	**1,013**
COCHRAN	IRRIGATION	$26.92	$29.79	$25.18	$22.25	$19.59	$17.74	328	363	307	271	239	216
COCHRAN Total		**$26.92**	**$29.79**	**$25.18**	**$22.25**	**$19.59**	**$17.74**	**328**	**363**	**307**	**271**	**239**	**216**
CROSBY	IRRIGATION	-	-	$14.06	$18.66	$22.03	$23.75	-	-	160	212	251	270
CROSBY	MINING	$168.92	$166.73	$147.56	$128.39	$111.62	$96.25	714	705	624	543	472	407
CROSBY	MUNICIPAL	$0.54	$0.69	$0.83	$1.06	$1.36	$1.69	10	13	15	20	25	31
CROSBY Total		**$169.46**	**$167.42**	**$162.45**	**$148.11**	**$135.01**	**$121.68**	**724**	**718**	**799**	**775**	**748**	**709**
DAWSON	IRRIGATION	-	-	$1.34	$1.75	$2.03	$2.22	-	-	16	21	24	26
DAWSON	MINING	$1,459.95	$1,459.95	$1,459.95	$1,459.95	$1,459.95	$1,459.95	5,628	5,628	5,628	5,628	5,628	5,628
DAWSON Total		**$1,459.95**	**$1,459.95**	**$1,461.29**	**$1,461.70**	**$1,461.97**	**$1,462.17**	**5,628**	**5,628**	**5,644**	**5,649**	**5,652**	**5,654**
DEAF SMITH	IRRIGATION	$0.49	$25.16	$25.16	$25.16	$25.15	$25.14	7	340	340	340	339	339
DEAF SMITH	LIVESTOCK	-	-	$10.08	$65.63	$100.66	$137.57	-	-	115	749	1,148	1,569
DEAF SMITH	MANUFACTURING	$331.41	$366.27	$366.27	$366.27	$366.27	$366.27	5,091	5,627	5,627	5,627	5,627	5,627
DEAF SMITH Total		**$331.90**	**$391.44**	**$401.52**	**$457.07**	**$492.09**	**$528.98**	**5,098**	**5,967**	**6,082**	**6,715**	**7,115**	**7,536**
FLOYD	IRRIGATION	$28.83	$29.90	$13.56	$12.21	$13.69	$14.70	335	348	158	142	159	171
FLOYD Total		**$28.83**	**$29.90**	**$13.56**	**$12.21**	**$13.69**	**$14.70**	**335**	**348**	**158**	**142**	**159**	**171**
GAINES	IRRIGATION	$34.51	$81.06	$81.06	$81.06	$81.06	$81.06	428	1,005	1,005	1,005	1,005	1,005
GAINES	MANUFACTURING	$385.91	$415.81	$415.81	$415.81	$415.81	$415.81	2,758	2,972	2,972	2,972	2,972	2,972
GAINES	MUNICIPAL	$3.99	$7.63	$13.81	$21.39	$26.83	$32.06	74	142	256	397	498	595
GAINES Total		**$424.42**	**$504.50**	**$510.68**	**$518.26**	**$523.70**	**$528.93**	**3,261**	**4,119**	**4,234**	**4,375**	**4,476**	**4,573**

County	Water Use Category	Income losses (Million $)* 2020	2030	2040	2050	2060	2070	Job losses 2020	2030	2040	2050	2060	2070
HALE	IRRIGATION	$41.48	$107.27	$107.27	$107.27	$107.27	$107.27	502	1,299	1,299	1,299	1,299	1,299
HALE	LIVESTOCK	-	-	-	-	-	$12.01	-	-	-	-	-	131
HALE	MANUFACTURING	$6,029.45	$7,437.75	$7,437.75	$7,437.75	$7,437.75	$7,437.75	51,977	64,117	64,117	64,117	64,117	64,117
HALE	MINING	$749.07	$736.50	$634.31	$527.42	$433.09	$351.35	3,267	3,213	2,767	2,301	1,889	1,533
HALE Total		**$6,820.01**	**$8,281.51**	**$8,179.33**	**$8,072.43**	**$7,978.11**	**$7,908.37**	**55,746**	**68,628**	**68,182**	**67,716**	**67,305**	**67,079**
HOCKLEY	IRRIGATION	-	$24.61	$16.91	$15.30	$16.85	$17.80	-	285	196	177	195	206
HOCKLEY Total		**-**	**$24.61**	**$16.91**	**$15.30**	**$16.85**	**$17.80**	**-**	**285**	**196**	**177**	**195**	**206**
LAMB	IRRIGATION	$30.27	$109.14	$109.14	$109.14	$109.14	$109.14	364	1,313	1,313	1,313	1,313	1,313
LAMB	LIVESTOCK	-	-	-	-	$17.97	$36.80	-	-	-	-	194	397
LAMB	MINING	$387.67	$382.00	$328.47	$273.32	$224.66	$182.48	1,673	1,649	1,418	1,180	970	788
LAMB Total		**$417.94**	**$491.13**	**$437.61**	**$382.46**	**$351.76**	**$328.42**	**2,037**	**2,962**	**2,731**	**2,493**	**2,477**	**2,498**
LUBBOCK	IRRIGATION	-	$12.74	$14.24	$15.41	$16.36	$17.08	-	146	163	176	187	195
LUBBOCK	MANUFACTURING	$570.98	$740.85	$740.85	$740.85	$740.85	$740.85	4,648	6,031	6,031	6,031	6,031	6,031
LUBBOCK	MINING	$1,417.62	$1,436.36	$1,301.25	$1,140.01	$997.77	$879.28	8,088	8,195	7,424	6,504	5,693	5,017
LUBBOCK	MUNICIPAL	$5.91	$52.55	$145.36	$282.34	$501.16	$612.79	110	976	2,700	5,245	9,309	11,383
LUBBOCK Total		**$1,994.51**	**$2,242.50**	**$2,201.70**	**$2,178.62**	**$2,256.14**	**$2,250.00**	**12,846**	**15,348**	**16,319**	**17,957**	**21,221**	**22,626**
LYNN	IRRIGATION	-	-	$0.02	$1.61	$3.53	$5.12	-	-	0	19	41	59
LYNN	MINING	$221.75	$274.13	$250.73	$178.45	$107.01	$32.93	1,418	1,753	1,604	1,141	684	211
LYNN Total		**$221.75**	**$274.13**	**$250.76**	**$180.05**	**$110.53**	**$38.05**	**1,418**	**1,753**	**1,604**	**1,160**	**725**	**270**
PARMER	IRRIGATION	$45.07	$59.31	$59.31	$59.31	$59.03	$59.00	597	786	786	786	782	781
PARMER Total		**$45.07**	**$59.31**	**$59.31**	**$59.31**	**$59.03**	**$59.00**	**597**	**786**	**786**	**786**	**782**	**781**
SWISHER	IRRIGATION	$0.74	$29.25	$29.25	$29.25	$29.48	$29.12	9	356	356	356	359	354
SWISHER Total		**$0.74**	**$29.25**	**$29.25**	**$29.25**	**$29.48**	**$29.12**	**9**	**356**	**356**	**356**	**359**	**354**
TERRY	IRRIGATION	-	$17.94	$22.11	$24.33	$25.64	$26.45	-	225	277	305	322	332
TERRY	MINING	$227.17	$383.23	$400.02	$283.47	$169.89	$89.88	848	1,430	1,493	1,058	634	335
TERRY	MUNICIPAL	-	-	-	-	$0.21	$0.43	-	-	-	-	4	8
TERRY Total		**$227.17**	**$401.18**	**$422.13**	**$307.81**	**$195.73**	**$116.76**	**848**	**1,655**	**1,770**	**1,363**	**960**	**675**
YOAKUM	IRRIGATION	$8.77	$48.91	$48.91	$48.91	$48.91	$48.91	109	608	608	608	608	608
YOAKUM	MINING	$529.42	$563.00	$306.87	$82.61	-	-	1,976	2,101	1,145	308	-	-
YOAKUM Total		**$538.18**	**$611.90**	**$355.77**	**$131.52**	**$48.91**	**$48.91**	**2,085**	**2,709**	**1,753**	**916**	**608**	**608**
REGION O Total		**$12,744.72**	**$15,091.29**	**$14,620.55**	**$14,075.14**	**$13,806.06**	**$13,595.55**	**91,473**	**112,867**	**112,166**	**112,158**	**114,484**	**115,546**

G

Water User Group Information Verification Survey

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Appendix G: Water User Group Information Verification Survey

SPAG
South Plains Association Of Governments

HDR

Water User Group (WUG) Information Verification Survey

Date:	Tuesday, September 03, 2019
Project:	2021 Llano Estacado Regional Water Plan
To:	Water Utility Manager
From:	HDR, Inc. on behalf of the Llano Estacado 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 (Region O) is in the process of developing water management strategies, conservation, and drought recommendations for use in the 2021 Llano Estacado Regional Water Plan (2021 Plan).

This is a follow-up survey to the previous one sent in September 2017. 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 20, 2019.

If no feedback is received by you for your utility, then we will use the information currently available, based primarily on the 2016 Plan. 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 2021 Llano Estacado Regional Water Plan. Region O, 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 Region O 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 20, 2019.

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? ____

H

Region O Model Drought Contingency Plan for a Small Retail Public Water Supplier Sole Source Local Groundwater

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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:

<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 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

Target: Achieve a 75 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:

- *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 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

__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

__Target__: Achieve a 75 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:

- *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.

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.

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 one-half 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.

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Implementation Status of Projects Identified in 2016 Plan

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Planning Region	WMS or WMS Project Name	Database Online Decade	Related Sponsor Entity and/or Benefitting WUGs	Implementation Survey Record Type	Database ID	Has Sponsor taken affirmative vote or actions?* (TWC 16.053(h)(10))	If yes, in what year did this occur?	If yes, by what date is the action on schedule for implementation?	At what level of implementation is the project currently?*	If not implemented, why?* (When "If other, please describe" is selected, please add the descriptive text to that field)	What impediments presented to implementation?* (When "If other, please describe" is selected, please add the descriptive text to that field)
O	BRISCOE COUNTY - SILVERTON LOCAL GROUNDWATER DEVELOPMENT	2020	PROJECT SPONSOR(S): SILVERTON	RECOMMENDED WMS PROJECT	2330	No	-	-			
O	COCHRAN COUNTY - MORTON WATER LOSS REDUCTION PHASE 1	2020	PROJECT SPONSOR(S): MORTON	RECOMMENDED WMS PROJECT	2558	No	-	-			
O	CROSBY COUNTY - LORENZO WATER LOSS REDUCTION PHASE 1	2020	PROJECT SPONSOR(S): LORENZO	RECOMMENDED WMS PROJECT	2560	No	-	-			
O	CROSBY COUNTY - WHITE RIVER MWD LOCAL GROUNDWATER DEVELOPMENT	2020	PROJECT SPONSOR(S): WHITE RIVER MWD	RECOMMENDED WMS PROJECT	2561	Yes	2019	2022	Feasibility study ongoing		
O	FLOYD COUNTY - LOCKNEY LOCAL GROUNDWATER DEVELOPMENT	2020	PROJECT SPONSOR(S): LOCKNEY	RECOMMENDED WMS PROJECT	2299	Yes	2020	2021	Sponsor has taken official action to initiate project		
O	GAINES COUNTY - SEMINOLE GROUNDWATER DESALINATION	2020	PROJECT SPONSOR(S): SEMINOLE	RECOMMENDED WMS PROJECT	2567	Yes	2015	2015	Currently operating		
O	GAINES COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT PHASE 1	2020	PROJECT SPONSOR(S): COUNTY-OTHER (GAINES)	RECOMMENDED WMS PROJECT	2564	No	-	-	Not implemented		
O	GARZA COUNTY - INFRASTRUCTURE TO SERVE AREAS SURROUNDING LAKE ALAN HENRY	2020	PROJECT SPONSOR(S): COUNTY-OTHER (GARZA)	RECOMMENDED WMS PROJECT	2143	No	-	-			
O	HALE COUNTY - ABERNATHY GROUNDWATER DESALINATION	2020	PROJECT SPONSOR(S): ABERNATHY	RECOMMENDED WMS PROJECT	2568	Yes	2016	2016	Feasibility study ongoing		
O	HOCKLEY COUNTY - SUNDOWN WATER LOSS REDUCTION PHASE 1	2020	PROJECT SPONSOR(S): SUNDOWN	RECOMMENDED WMS PROJECT	2571		-	-			
O	HOCKLEY COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT	2020	PROJECT SPONSOR(S): COUNTY-OTHER (HOCKLEY)	RECOMMENDED WMS PROJECT	2300		-	-			
O	LAMB COUNTY - AMHERST LOCAL GROUNDWATER DEVELOPMENT	2020	PROJECT SPONSOR(S): AMHERST	RECOMMENDED WMS PROJECT	2573		-	-			
O	LUBBOCK COUNTY - LUBBOCK BAILEY COUNTY WELL FIELD INITIAL CAPACITY MAINTENANCE	2020	PROJECT SPONSOR(S): LUBBOCK	RECOMMENDED WMS PROJECT	2163	Yes	2018	2022	Sponsor has taken official action to initiate project		
O	LUBBOCK COUNTY - LUBBOCK BRACKISH WELL FIELD AT THE SOUTH WATER TREATMENT PLANT	2020	PROJECT SPONSOR(S): LUBBOCK	RECOMMENDED WMS PROJECT	2169	Yes	2016	2016	Feasibility study ongoing	Test well produced saline water.	Low production, saline test well.
O	LUBBOCK COUNTY - LUBBOCK JIM BERTRAM LAKE 7	2020	PROJECT SPONSOR(S): LUBBOCK	RECOMMENDED WMS PROJECT	2171	Yes	2005	-	Permit application submitted/pending		
O	LUBBOCK COUNTY - LUBBOCK LAKE ALAN HENRY PHASE 2	2020	PROJECT SPONSOR(S): LUBBOCK	RECOMMENDED WMS PROJECT	2170	Yes	-	-	Feasibility study ongoing		
O	LUBBOCK COUNTY - LUBBOCK NORTH FORK SCALPING OPERATION	2020	PROJECT SPONSOR(S): LUBBOCK	RECOMMENDED WMS PROJECT	2173	Yes	2017	-	Feasibility study ongoing		
O	LUBBOCK COUNTY - SHALLOWATER WATER LOSS REDUCTION PHASE 1	2020	PROJECT SPONSOR(S): SHALLOWATER	RECOMMENDED WMS PROJECT	2248		-	-			
O	LYNN COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT	2020	PROJECT SPONSOR(S): COUNTY-OTHER (LYNN)	RECOMMENDED WMS PROJECT	2581		-	-			
O	PARMER COUNTY - FARWELL DIRECT POTABLE REUSE	2020	PROJECT SPONSOR(S): FARWELL	RECOMMENDED WMS PROJECT	2219		-	-			
O	SWISHER COUNTY - TULIA LOCAL GROUNDWATER DEVELOPMENT	2020	PROJECT SPONSOR(S): TULIA	RECOMMENDED WMS PROJECT	2333		-	-			
O	YOAKUM COUNTY - DENVER CITY LOCAL GROUNDWATER DEVELOPMENT	2020	PROJECT SPONSOR(S): DENVER CITY	RECOMMENDED WMS PROJECT	2295		-	-			
O	YOAKUM COUNTY - PLAINS LOCAL GROUNDWATER DEVELOPMENT	2020	PROJECT SPONSOR(S): PLAINS	RECOMMENDED WMS PROJECT	2302		-	-			
O	BAILEY COUNTY - MULESHOE LOCAL GROUNDWATER DEVELOPMENT PHASE 1	2030	PROJECT SPONSOR(S): MULESHOE	RECOMMENDED WMS PROJECT	2301		-	-			
O	GAINES COUNTY - SEMINOLE LOCAL GROUNDWATER DEVELOPMENT	2030	PROJECT SPONSOR(S): SEMINOLE	RECOMMENDED WMS PROJECT	2566		-	-			
O	LUBBOCK COUNTY - IDALOU LOCAL GROUNDWATER DEVELOPMENT	2030	PROJECT SPONSOR(S): IDALOU	RECOMMENDED WMS PROJECT	2298		-	-			
O	LUBBOCK COUNTY - LUBBOCK BAILEY COUNTY WELL FIELD FUTURE CAPACITY MAINTENANCE	2030	PROJECT SPONSOR(S): LUBBOCK	RECOMMENDED WMS PROJECT	2652	Yes	-	-	Sponsor has taken official action to initiate project		
O	LUBBOCK COUNTY - LUBBOCK CRMWA AQUIFER STORAGE AND RECOVERY	2030	PROJECT SPONSOR(S): LUBBOCK	RECOMMENDED WMS PROJECT	2165	Yes	2015	-	Sponsor has taken official action to initiate project		
O	LUBBOCK COUNTY - LUBBOCK SOUTH LUBBOCK WELL FIELD	2030	PROJECT SPONSOR(S): LUBBOCK	RECOMMENDED WMS PROJECT	2168	No	-	-			
O	LUBBOCK COUNTY - SHALLOWATER LOCAL GROUNDWATER DEVELOPMENT	2030	PROJECT SPONSOR(S): SHALLOWATER	RECOMMENDED WMS PROJECT	2329		-	-			
O	LUBBOCK COUNTY - WOLFFORTH LOCAL GROUNDWATER DEVELOPMENT	2030	PROJECT SPONSOR(S): WOLFFORTH	RECOMMENDED WMS PROJECT	2334	Yes	2018	-	Sponsor has taken official action to initiate project		
O	LUBBOCK COUNTY - WOLFFORTH POTABLE REUSE	2030	PROJECT SPONSOR(S): WOLFFORTH	RECOMMENDED WMS PROJECT	2220		-	-			
O	BAILEY COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT	2040	PROJECT SPONSOR(S): COUNTY-OTHER (BAILEY)	RECOMMENDED WMS PROJECT	2552		-	-			
O	CASTRO COUNTY - DIMMITT LOCAL GROUNDWATER DEVELOPMENT	2040	PROJECT SPONSOR(S): DIMMITT	RECOMMENDED WMS PROJECT	2296		-	-			
O	CASTRO COUNTY - HART LOCAL GROUNDWATER DEVELOPMENT	2040	PROJECT SPONSOR(S): HART	RECOMMENDED WMS PROJECT	2555		-	-			
O	COCHRAN COUNTY - MORTON WATER LOSS REDUCTION PHASE 2	2040	PROJECT SPONSOR(S): MORTON	RECOMMENDED WMS PROJECT	2644		-	-			
O	CROSBY COUNTY - LORENZO WATER LOSS REDUCTION PHASE 2	2040	PROJECT SPONSOR(S): LORENZO	RECOMMENDED WMS PROJECT	2645		-	-			
O	DAWSON COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT	2040	PROJECT SPONSOR(S): COUNTY-OTHER (DAWSON)	RECOMMENDED WMS PROJECT	2562		-	-			
O	GAINES COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT PHASE 2	2040	PROJECT SPONSOR(S): COUNTY-OTHER (GAINES)	RECOMMENDED WMS PROJECT	2649		-	-			
O	HOCKLEY COUNTY - SUNDOWN WATER LOSS REDUCTION PHASE 2	2040	PROJECT SPONSOR(S): SUNDOWN	RECOMMENDED WMS PROJECT	2646		-	-			
O	LUBBOCK COUNTY - SHALLOWATER WATER LOSS REDUCTION PHASE 2	2040	PROJECT SPONSOR(S): SHALLOWATER	RECOMMENDED WMS PROJECT	2647		-	-			
O	PARMER COUNTY - BOVINA LOCAL GROUNDWATER DEVELOPMENT	2040	PROJECT SPONSOR(S): BOVINA	RECOMMENDED WMS PROJECT	2331		-	-			
O	GAINES COUNTY - SEAGRAVES LOCAL GROUNDWATER DEVELOPMENT	2050	PROJECT SPONSOR(S): SEAGRAVES	RECOMMENDED WMS PROJECT	2565		-	-			
O	PARMER COUNTY - FARWELL LOCAL GROUNDWATER DEVELOPMENT	2050	PROJECT SPONSOR(S): FARWELL	RECOMMENDED WMS PROJECT	2584		-	-			
O	PARMER COUNTY - FRIONA LOCAL GROUNDWATER DEVELOPMENT	2050	PROJECT SPONSOR(S): FRIONA	RECOMMENDED WMS PROJECT	2297		-	-			
O	BAILEY COUNTY - MULESHOE LOCAL GROUNDWATER DEVELOPMENT PHASE 2	2060	PROJECT SPONSOR(S): MULESHOE	RECOMMENDED WMS PROJECT	2648		-	-			
O	GAINES COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT PHASE 3	2060	PROJECT SPONSOR(S): COUNTY-OTHER (GAINES)	RECOMMENDED WMS PROJECT	2650		-	-			
O	PARMER COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT	2060	PROJECT SPONSOR(S): COUNTY-OTHER (PARMER)	RECOMMENDED WMS PROJECT	2583		-	-			
O	HOCKLEY COUNTY - SUNDOWN LOCAL GROUNDWATER DEVELOPMENT	2070	PROJECT SPONSOR(S): SUNDOWN	RECOMMENDED WMS PROJECT	2332		-	-			

Planning Region	WMS or WMS Project Name	Current water supply project yield (ac-ft/yr)	Funds expended to date ($)	Project Cost ($)	Year the project is online?*	Is this a phased project?*	(Phased) Ultimate volume (ac-ft/yr)	(Phased) Ultimate project cost ($)	Year project reaches maximum capacity?*	What is the project funding source(s)?*	Funding Mechanism if Other?	Included in 2021 plan?*	Does the project or WMS involve reallocation of flood control?*	Does the project or WMS provide any measurable flood risk reduction?*	Optional Comments
O	BRISCOE COUNTY - SILVERTON LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-		-	-	-	-	-	No	No	No	-
O	COCHRAN COUNTY - MORTON WATER LOSS REDUCTION PHASE 1	-	$ -	$ -	-		-	-	-	-	-	No	No	No	-
O	CROSBY COUNTY - LORENZO WATER LOSS REDUCTION PHASE 1	-	$ -	$ -	-		-	-	-	-	-	No	No	No	-
O	CROSBY COUNTY - WHITE RIVER MWD LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-		-	-	-	-	-	Yes	No	No	WRMWD has begun plans to expand its wellfield to serve its member cities.
O	FLOYD COUNTY - LOCKNEY LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-		-	-	-	-	-	No	No	No	WMS Project included in 2021 Plan
O	GAINES COUNTY - SEMINOLE GROUNDWATER DESALINATION	1,700	$ -	$ -	2016	Yes	-	-	-	-	-	Yes	No	No	Brackish test well completed in 2015. Seminole now supplied in part by brackish groundwater.
O	GAINES COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT PHASE 1	-	$ -	$ -	-		-	-	-	-	-	Yes	No	No	-
O	GARZA COUNTY - INFRASTRUCTURE TO SERVE AREAS SURROUNDING LAKE ALAN HENRY	-	$ -	$ -	-		-	-	-	-	-	Yes	No	No	Project discussions ongoing
O	HALE COUNTY - ABERNATHY GROUNDWATER DESALINATION	-	$ -	$ -	-		-	-	-	-	-	No	No	No	Abernathy drilled Dockum Aquifer test well in 2016.
O	HOCKLEY COUNTY - SUNDOWN WATER LOSS REDUCTION PHASE 1	-	$ -	$ -	-		-	-	-	-	-	No	No	No	-
O	HOCKLEY COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-		-	-	-	-	-	No	No	No	-
O	LAMB COUNTY - AMHERST LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-		-	-	-	-	-	No	No	No	-
O	LUBBOCK COUNTY - LUBBOCK BAILEY COUNTY WELL FIELD INITIAL CAPACITY MAINTENANCE	-	$ -	$ -	-	No	-	-	-	-	-	Yes	No	No	The City has completed modeling to evaluate well field performance.
O	LUBBOCK COUNTY - LUBBOCK BRACKISH WELL FIELD AT THE SOUTH WATER TREATMENT PLANT	-	$ -	$ -	-		-	-	-	-	-	Yes	No	No	The City completed a brackish groundwater test well at the SWTP in 2016.
O	LUBBOCK COUNTY - LUBBOCK JIM BERTRAM LAKE 7	-	$ -	$ -	-	No	-	-	-	-	-	Yes	No	No	Studies and resource agency coordination are ongoing.
O	LUBBOCK COUNTY - LUBBOCK LAKE ALAN HENRY PHASE 2	-	$ -	$ -	-	No	-	-	-	-	-	Yes	No	No	The City has continued studies of feasibility of LAH Phase 2 project.
O	LUBBOCK COUNTY - LUBBOCK NORTH FORK SCALPING OPERATION	-	$ -	$ -	-	No	-	-	-	-	-	Yes	No	No	Studies and resource agency coordination are ongoing.
O	LUBBOCK COUNTY - SHALLOWATER WATER LOSS REDUCTION PHASE 1	-	$ -	$ -	-		-	-	-	-	-	No	No	No	-
O	LYNN COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-		-	-	-	-	-	No	No	No	-
O	PARMER COUNTY - FARWELL DIRECT POTABLE REUSE	-	$ -	$ -	-		-	-	-	-	-	No	No	No	-
O	SWISHER COUNTY - TULIA LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-		-	-	-	-	-	No	No	No	-
O	YOAKUM COUNTY - DENVER CITY LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-		-	-	-	-	-	No	No	No	-
O	YOAKUM COUNTY - PLAINS LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-		-	-	-	-	-	No	No	No	-
O	BAILEY COUNTY - MULESHOE LOCAL GROUNDWATER DEVELOPMENT PHASE 1	-	$ -	$ -	-		-	-	-	-	-	Yes	No	No	-
O	GAINES COUNTY - SEMINOLE LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-		-	-	-	-	-	Yes	No	No	WMS Project included in 2021 Plan
O	LUBBOCK COUNTY - IDALOU LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-		-	-	-	-	-	No	No	No	-
O	LUBBOCK COUNTY - LUBBOCK BAILEY COUNTY WELL FIELD FUTURE CAPACITY MAINTENANCE	33,600	$ -	$ 94,704,000.00	2022	Yes	Maintenance of 33,600	$ 94,704,000.00	2070	-	-	Yes	No	No	The City has completed modeling to evaluate new wells.
O	LUBBOCK COUNTY - LUBBOCK CRMWA AQUIFER STORAGE AND RECOVERY	-	$ -	$ -	-	No	-	-	-	-	-	Yes	No	No	The City completed an ASR feasibility study in 2015.
O	LUBBOCK COUNTY - LUBBOCK SOUTH LUBBOCK WELL FIELD	-	$ -	$ -	-	No	-	-	-	-	-	Yes	No	No	The City has continued studies of feasibility of South Lubbock Well Field project.
O	LUBBOCK COUNTY - SHALLOWATER LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-	No	-	-	-	-	-	Yes	No	No	-
O	LUBBOCK COUNTY - WOLFFORTH LOCAL GROUNDWATER DEVELOPMENT	1,180	$ -	$ 13,961,000.00	2022	No	-	-	-	-	-	Yes	No	No	Wolfforth drilled Edwards-Trinity High Plains Aquifer test well in 2018.
O	LUBBOCK COUNTY - WOLFFORTH POTABLE REUSE	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	BAILEY COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	CASTRO COUNTY - DIMMITT LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	CASTRO COUNTY - HART LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	COCHRAN COUNTY - MORTON WATER LOSS REDUCTION PHASE 2	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	CROSBY COUNTY - LORENZO WATER LOSS REDUCTION PHASE 2	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	DAWSON COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	GAINES COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT PHASE 2	-	$ -	$ -	-	No	-	-	-	-	-	Yes	No	No	-
O	HOCKLEY COUNTY - SUNDOWN WATER LOSS REDUCTION PHASE 2	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	LUBBOCK COUNTY - SHALLOWATER WATER LOSS REDUCTION PHASE 2	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	PARMER COUNTY - BOVINA LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	GAINES COUNTY - SEAGRAVES LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	PARMER COUNTY - FARWELL LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	PARMER COUNTY - FRIONA LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	BAILEY COUNTY - MULESHOE LOCAL GROUNDWATER DEVELOPMENT PHASE 2	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	GAINES COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT PHASE 3	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	PARMER COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O	HOCKLEY COUNTY - SUNDOWN LOCAL GROUNDWATER DEVELOPMENT	-	$ -	$ -	-	No	-	-	-	-	-	No	No	No	-
O															

K

Infrastructure Financing Survey Package Cover Letter

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SPAG
South Plains Association Of Governments

HDR

Infrastructure Financing Survey

Date:	Friday, July 17, 2020
Project:	2021 Llano Estacado Regional Water Plan
To:	Water Utility Manager
From:	HDR, Inc. on behalf of the Llano Estacado Regional Water Planning Group and the South Plains Association of Governments (SPAG)
Subject:	Infrastructure Financing Survey

The Llano Estacado Regional Water Planning Group (Region O) is in the process of developing the 2021 Llano Estacado Regional Water Plan (2021 Plan).

As part of the state water planning process, regional water planning groups recommend water supply projects within each of their respective regions. Texas Water Code requires each regional water planning group to examine the financing needed to implement the water management strategies and projects recommended in their regional plan.

This Infrastructure Financing Survey is a tool to gather information regarding how you, as a project sponsor, anticipate financing the water supply projects recommended to meet your needs in the 2021 Llano Estacado Regional Water Plan, including whether you, as a sponsor, intend to use financial assistance programs offered by the State of Texas and administered by the Texas Water Development Board (TWDB). The TWDB has several funding programs for water projects that support the planning, design, and construction of water supply projects with several financing options, including low-interest loans and deferral of principal and interest.

Your cooperation and responses to these questions are crucial to assisting the state in providing ongoing funding opportunities to ensure that our communities and our citizens have adequate water supplies. Note that a response to this survey is required for any entity seeking SWIFT funding for state water plan projects.

Attached to this email you will find a list of recommended strategies for which your entity is identified as the project sponsor in the 2021 Llano Estacado Regional Water Plan, an estimated capital cost for each strategy, and instructions on completing the Infrastructure Financing Survey. *Note that the capital cost includes planning, engineering, and mitigation costs associated with the project.*

Please complete the survey, scan or take a photo of your survey, and send your response to Kelly Davila, Kdavila@spag.org, 806.762.8721, as soon as possible and no later than August 7, 2020.

For information regarding the regional water planning process, please visit the Region O webpage at www.llanoplan.org.

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Comments Received on Initially Prepared Plan and Response to Comments

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Appendix L: Response to Comments

The public hearing to receive comments on the Initially Prepared 2021 Llano Estacado Regional Water Plan (LERWP) was held May 14, 2020, providing sufficient time to accept public comments according to statute to meet the November 5, 2020, deadline for submission of the adopted Final 2021 LERWP. The Initially Prepared 2021 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 2021 LERWP with responses are included here as Appendix L.

Comments received are included in this appendix as noted below.

L1. TWDB
L2. City of Smyer
L3. City of New Deal
L4. J. Collier Adams
L5. Texas Parks and Wildlife Department (TPWD)
L6. Protect Water Rights Coalition

Responses to comments for the TWDB's comments are included in Appendix L. Additional responses to comments are included below.

Comment Responses

1. Texas Water Development Board (TWDB) responses are included as part of Appendix L1.

2. Alternative water management strategy (WMS) for City of Smyer was included in Section 5 of the 2021 LERWP.

3. Alternative WMS for City of New Deal was included in Section 5 of the 2021 LERWP.

4. The objection to the listing of, or reference to, any federally-endangered species under the Endangered Species Act is noted. The reference to any such species is included so that any necessary mitigation may be accounted for in the planning stages of a strategy or project.

5. In response to the Texas Parks and Wildlife Department (TPWD) comments, the March 30, 2020, updates to the lists of federal- and state-listed species and species of greatest conservation need (SGCN), have been reviewed and incorporated into Table 1.17 of the 2021 LERWP. In addition, the documentation of existing and historical springs and seeps included in the 2016 LERWP has been included in the 2021 LERWP.

6. In response to the Protect Water Rights Coalition's comments, the Llano Estacado Regional Water Planning Group (LERWPG) supports the groundwater management associated with desired future conditions (DFC) as discussed in Section 3.2.2 of the 2021 LERWP. In addition, surface water importation at a large scale was not considered a feasible water management strategy for several reasons, the most significant being that most of surface water in the vicinity of the Llano Estacado Region is fully appropriated with existing surface water rights.

7. In a Zoom meeting on July 29, 2020, with Regan Kneese and Phillip Laughlin of Palisade Pipeline and Aubrey Spear and Paula Jo Lemonds, Palisade Pipeline expressed interest in their use of reclaimed water sources within the Llano Estacado Region. Their specific cooperation with the City of Lubbock has been noted in Section 5.55.3 of the 2021 LERWP.

8. In a Zoom meeting on July 29, 2020, with Richard Belt of Xcel Energy and Aubrey Spear and Paula Jo Lemonds, Xcel Energy requested that the 2021 LERWP address the needs that the steam-electric industry, specifically Xcel Energy, has in Lamb County. Language has been included in Section 5.54.8 of the 2021 LERWP.

Appendix L1. TWDB Comments

a. Comment Letter Region O IPP
b. Comment Letter Attachment Region O IPP

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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

Mr. Aubrey Spear, Chair
c/o City of Lubbock
P.O. Box 2000
Lubbock, Texas 79457

Ms. Kelly Davila
South Plains Association of Governments
1323 58th Street
Lubbock, Texas 79412

Re: Texas Water Development Board Comments for the Llano Estacado (Region O) Regional Water Planning Group Initially Prepared Plan, Contract No. 1548301843

Dear Mr. Spear and Ms. Davila:

Texas Water Development Board (TWDB) staff have completed their review of the Initially Prepared Plan (IPP) submitted by March 3, 2020 on behalf of the Llano Estacado Regional Water Planning Group (RWPG). The attached comments follow this format:

- **Level 1:** Comments, questions, and data revisions that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements; and,

- **Level 2:** Comments and suggestions for consideration that may improve the readability and overall understanding of the regional water plan.

Please note that rule references are based on recent revisions to 31 Texas Administrative Code (TAC) Chapter 357, adopted by the TWDB Board on June 4, 2020. 31 TAC § 357.50(f) requires the RWPG to consider timely agency and public comment. Section 357.50(g) requires the final adopted plan include summaries of all timely written and oral comments received, along with a response explaining any resulting revisions or why changes are not warranted. Copies of TWDB's Level 1 and 2 written comments and the region's responses must be included in the final, adopted regional water plan (*Contract Exhibit C, Section 13.1.2)*.

Standard to all planning groups is the need to include certain content in the final regional water plans that was not yet available at the time that IPPs were prepared and submitted. In your final regional water plan, please be sure to also incorporate the following:

a) Completed results from the RWPG's infrastructure financing survey for sponsors of recommended projects with capital costs, including an electronic version of the survey spreadsheet *[31 TAC § 357.44]*;
b) Completed results from the implementation survey, including an electronic version of the survey spreadsheet *[31 TAC § 357.45(a)]*;
c) Documentation that comments received on the IPP were considered in the development of the final plan *[31 TAC § 357.50(f)]*; and
d) Evidence, such as a certification in the form of a cover letter, that the final, adopted regional water plan is complete and adopted by the RWPG *[31 TAC § 357.50(h)(1)]*.

Please ensure that the final plan includes updated State Water Planning Database (DB22) reports, and that the numerical values presented in the tables throughout the final, adopted regional water plan are consistent with the data provided in DB22. For the purpose of development of the 2022 State Water Plan, water management strategy and other data entered by the RWPG in DB22 shall take precedence over any conflicting data presented in the final regional water plan *[Contract Exhibit C, Sections 13.1.3 and 13.2.2]*.

Additionally, subsequent review of DB22 data is being performed. If issues arise during our ongoing data review, they will be communicated promptly to the planning group to resolve. Please anticipate the need to respond to additional comments regarding data integrity, including any source overallocations, prior to the adoption of the final regional water plans.

The provision of certain content in an electronic-only form is permissible as follows: Internet links are permissible as a method for including model conservation and drought contingency plans within the final regional water plan; hydrologic modeling files may be submitted as electronic appendices, however all other regional water plan appendices should also be incorporated in hard copy format within each plan *[31 TAC § 357.50(g)(2)(C), Contract Exhibit C, Section 13.1.2 and 13.2.1]*.

The following items must accompany, the submission of the final, adopted regional water plan:

1. The prioritized list of all recommended projects in the regional water plan, including an electronic version of the prioritization spreadsheet *[31 TAC § 357.46];* and,
2. All hydrologic modeling files and GIS files, including any remaining files that may not have been provided at the time of the submission of the IPP but that were used in developing the final plan *[31 TAC § 357.50(g)(2)(C), Contract Exhibit C, Section 13.1.2, and 13.2.1].*

The following general requirements that apply to recommended water management strategies must be adhered to in all final regional water plans including:

1. Regional water plans must not include any recommended strategies or project costs that are associated with simply maintaining existing water supplies or replacing existing infrastructure. Plans may include only infrastructure costs that are associated with volumetric increases of treated water supplies delivered to water

user groups or that result in more efficient use of existing supplies *[31 TAC § 357.10(39), § 357.34(e)(3)(A), Contract Exhibit C, Sections 5.5.2 and 5.5.3]*; and,

2. Regional water plans must not include the costs of any retail distribution lines or other infrastructure costs that are not directly associated with the development of additional supply volumes (e.g., via treatment) other than those line replacement costs related to projects that are for the primary purpose of achieving conservation savings via water loss reduction *[§ 357.34(e)(3)(A), Contract Exhibit C, Section 5.5.3]*.

Please provide the TWDB with information on how you intend to address all Level 1 comments well in advance of your adoption the regional water plan to ensure that the response is adequate for the Executive Administrator to recommend the plan to the TWDB Board for consideration in a timely and efficient manner. Your TWDB project manager will review and provide feedback to ensure all IPP comments and associated plan revisions have been addressed adequately. Failure to adequately address any Level 1 comment may result in the delay of the TWDB Board approval of your final regional water plan.

As a reminder, the deadline to submit the final, adopted regional water plan and associated material to the TWDB is **October 14, 2020**. Any remaining data revisions to DB22 must be communicated to Sabrina Anderson at Sabrina.Anderson@twdb.texas.gov by **September 14, 2020.**

If you have any questions regarding these comments or would like to discuss your approach to addressing any of these comments, please do not hesitate to contact Jean Devlin at (512) 475-1529 or Jean.Devlin@twdb.texas.gov. TWDB staff will be available to assist you in any way possible to ensure successful completion of your final regional water plan.

Sincerely,

Jessica Zuba
Deputy Executive Administrator
Water Supply and Infrastructure

Date: 6/15/2020

Attachment

c w/att.: Mr. Tim Pierce, South Plains Association of Governments
Ms. Paula Jo Lemonds, HDR

TWDB comments on the Initially Prepared 2021 Llano Estacado (Region O) Regional Water Plan.

Level 1: Comments, questions, and data revisions that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements.

1. Chapter 5 and the State Water Planning Database (DB22). The plan includes 15 recommended *groundwater wells & other* water management strategies (WMS) providing supply in 2020. **Strategy supply with an online decade of 2020 must be constructed and delivering water by January 5, 2023.** Please confirm that strategies shown as providing supply in 2020 are expected to be providing water by January 5, 2023. *[31 § TAC 357.10(21); Contract Exhibit C, Section 5.2]*

   A sentence was added to the beginning of Chapter 5 confirming that strategies shown are expected to be providing water by January 5, 2023.

2. Section 1.6, page 1-41. Please clarify that the wholesale water providers presented in Section 1.6 were designated as major water providers (MWP) for the region in the final, adopted regional water plan. Additionally, please correct the definition of MWPs presented on page 1-43 and page 2-19 (Section 2.11) to include that MWPs are of particular significance to the region's water supply as determined by the planning group. This may include public or private entities that provide water for any water use category. *[31 TAC § 357.30(4)]* -

   Section 2.11 was deleted because of redundancy with Section 1.6. Section 1.6 was revised and the definition of MWPs was corrected. The revision eliminated mention of the term "wholesale water providers."

3. Section 2.10, Table 2.11. Please revise the section, table heading, and table columns referring to "Wholesale Water Providers" to "Major Water Providers" in the final, adopted regional water plan. *[31 TAC § 357.31(b); 31 TAC § 357.31(f)]* –

   *Headings in Table 2.11 were r*evised to replace "Wholesale Water Providers" with "Major Water Providers."

4. Section 3.3, page 3-6. The plan does not appear to mention the Briscoe, Swisher, Hale County Priority Groundwater Management Area (PGMA). Please mention how this PGMA was considered in the final, adopted regional water plan. *[31 TAC § 357.22(a)(6)]* –

   Discussion of the PGMA was added to as Section 3.2.3, following discussion of GMAs.

5. Section 3.4, Table 3.2, pages 3-8 and 3-9. The MAG volumes presented for the Dockum Aquifer in Motley and Parmer Counties do not match the 2070 MAG volumes (92 ac-ft/yr for Motley County, and 4,589 ac-ft/yr for Parmer County.)

Please revise these to include the MAG volumes in the final, adopted regional water plan. *[31 TAC § 357.32(d)]* –

The MAG volumes for Motley and Parmer counties in 2070 were corrected.

6. Section 3.4, Table 3.2. The plan includes availability values for Hale County, Other Aquifer, however this source is not included in DB22. Please remove this source from Table 3.2 in the final, adopted regional water plan or submit a source request to add the source to DB22. *[Contract Exhibit C, Section 3.5.2]*

   The source was removed from Table 3.2.

7. Section 3.3. The plan does not appear to describe the methodology used to estimate the non-MAG groundwater availability for the Seymour Aquifer, Briscoe County; Dockum Aquifer, Dickens County; and Ogallala Aquifer, Dickens County. Please provide the methodology used to estimate the groundwater availability for these aquifer/county splits in the final, adopted regional water plan. *[Contract Exhibit C, Section 3.5.2]*

   The methodology used to estimate non-MAG groundwater availability was added to Section 3.3.

8. Section 3.3. If a model was used to determine the availability for the Seymour Aquifer, Briscoe County; Dockum Aquifer, Dickens County; and Ogallala Aquifer, Dickens County, please include the GAM model(s) input/output or other model files necessary to support replication of the results used in developing the availabilities and a summary including 1) the named/labeled version (including date) of each model used; 2) the name of the entity/firm that performed each model run; and, 3) the date of each model run with the final, adopted regional water plan. *[Contract Exhibit C, Section 3.5.4]*

   Run 16-031 (Shi, 2017) summary spreadsheet provided for Seymour Aquifer, Briscoe County as an electronic submittal. No model was used to determine the availability for the Dockum Aquifer, Dickens County; and Ogallala Aquifer, Dickens County.

9. Section 3.3. Please include in Chapter 3 the methodology for estimating Other Aquifer availability volumes in the final, adopted regional water plan. *[Contract Exhibit C, Section 3.5.2]*

   Methodology used to estimate Other Aquifer groundwater availability added to Section 3.3.

10. Chapter 3. The plan does not appear to include the evaluation results of existing supplies for MWPs. Please report existing supplies for MWPs by decade and category of use in the final, adopted regional water plan. *[31 TAC § 357.32(g)]*

    Section 3.8 was added to show supplies available to MWPs by decade and category of use.

11. Section 4.2 and Table 4.2. Please revise the section, table heading, and table columns referring to "Wholesale Water Providers" to "Major Water Providers" in the final, adopted regional water plan. Additionally, please present the needs for all MWPs by category of use in the final, adopted regional water plan. *[31 TAC § 357.33(b)]*

    Table 4.2 headings were revised from "Wholesale Water Providers" to "Major Water Providers." Table 4.3 was added to show the needs for all MWPs by category of use.

12. Chapter 4. While the results of the secondary needs analysis is presented in Appendix A for WUGs, please add a discussion of this needs analysis to Chapter 4 or reference the current location in the final, adopted regional water plan. *[31 TAC § 357.33(e)]*

    Discussion of the secondary needs analysis was added in Section 4.3.1.

13. Chapter 4. The plan does not appear to include a secondary needs analysis for MWPs. Please present the results of the secondary needs analysis by decade for MWPs in the final, adopted regional water plan. *[31 TAC § 357.33(e)]*

    Discussion of a secondary needs analysis for MWPs was added in Section 4.3.2.

14. Section 5.1.2, Table 5.2, page 5-5 and Section 5.2.4, Table 5.4, page 5-17. For the Jim Bertram and Post Reservoir evaluations, it is not clear what costs are associated with land for the conservation pool footprint and what costs are associated with mitigation. Please clearly present the separate costs for each strategy evaluation in the final, adopted regional water plan. *[Contract Exhibit C, Section 5.5]*

    Tables 5.2 and 5.4 were revised to clarify the separate costs.

15. Section 5.12. The evaluation for the Bailey County Well Field Capacity Maintenance for City of Lubbock water management strategy (WMS) notes that 10 replacement wells will be required every six years to maintain the production capacity and that some of the new wells are considered replacement of existing wells. Please ensure that capital costs do not include any costs for maintenance of, or upgrades to, or rehabilitation to existing equipment or for costs that do not directly increase the volumetric water supply in the final, adopted regional water plan. *[Contract Exhibit C, Section 5.5.3]*

    Table 5.14 (in current Section 5.14.2) was revised to eliminate capitals costs for maintenance/upgrades/rehabilitation to existing equipment and costs that do not directly increase the volumetric water supply.

16. Section 5.17. The evaluation for the Roberts County Well Field Capacity Maintenance WMS notes that 11 replacement wells will be required every 30 years to maintain the production capacity. Please ensure that capital costs do not include any costs for maintenance of, or upgrades to, or rehabilitation to existing equipment or for costs that do not directly increase the volumetric water supply in the final, adopted regional water plan. *[Contract Exhibit C, Section 5.5.3]*

Table 5-19 (in current Section 5.19.2) was revised to eliminate capitals costs for maintenance/upgrades/rehabilitation to existing equipment and costs that do not directly increase the volumetric water supply.

17. Chapter 5. It is not clear in the plan whether the following types of strategies were considered to meet needs: interbasin transfers of surface water; system optimization; and cancellation of water rights. Please provide information on how these strategies were considered to meet needs in the final, adopted regional water plan. *[TWC § 16.053(e)(5); 31 TAC § 357.34(c)]*

    A paragraph was added before Part A of Chapter 5 to clarify how interbasin transfers of surface water, system optimization, and cancellation of water rights were considered to meet needs.

18. Chapter 5. The plan appears to describe qualitative information on environmental issues rather than presenting quantitative impacts of environmental factors (environmental water needs, wildlife habitat, cultural resources, and effect of upstream development on bays, estuaries, and arms of the Gulf of Mexico). Please include a quantitative reporting of environmental factors for each WMS in the final, adopted regional water plan. *[31 TAC § 357.34(e)(3)(B)]*

    A new appendix, X2, was added to describe qualitative environmental factors for each WMS.

19. Chapter 5. The plan appears to include qualitative crop information in the WMS evaluations but a quantitative analysis for impacts to agricultural resources does not appear to have been included. Please include a quantitative impacts analysis for agricultural resources for each WMS in the final, adopted regional water plan. *[31 TAC § 357.34(e)(3)(C)]*

    A new appendix, X2, was added to analyze quantitative impacts for agricultural resources for each WMS.

20. Chapter 5. Please clarify whether the North Fork Diversion to Lake Alan Henry Pump Station (Section 5.7) and South Fork Discharge (Section 5.8) WMSs are subject to TCEQ's adopted environmental flow standards and if so, please clarify if or how the TCEQ's adopted environmental flow standards were considered and document this information in the final, adopted regional water plan. *[31 TAC § 357.34(e)(3)(B); 31 TAC § 358.3(22); 31 TAC § 358.3(23)]*

    Language added in the North Fork Diversion to Lake Alan Henry Pump Station WMS (current Section 5.9.1) and South Fork Discharge WMS (current Section 5.10.1), clarifying that these WMSs are not subject to TCEQ flow standards.

21. Chapter 5. The plan does not appear to discuss how the threats to agricultural or natural resources that were identified in Chapter 1 will be addressed or affected by the WMSs evaluated. Please include this information in the final, adopted regional water plan. *[31 TAC § 357.34(e)(5)]*

Language was added in Section 6.9 and 6.10 discussing how threats to agricultural and natural resources were addressed/affected by the WMSs.

22. Chapter 5. Please include documentation of why drought management was not selected as a recommended WMSs in the final, adopted regional water plan. *[31 TAC § 357.34(i)(1)]*

    A paragraph was added before Part A of Chapter 5 discussing why drought management was not selected as a recommended WMS.

23. Chapter 5. The plan does not appear to include the region's model water conservation plans pursuant to Texas Water Code § 11.1271. Please include the region's model conservation plan via hard copy or hyperlink in the final, adopted regional water plan. *[31 TAC § 357.34(j)]*

    Language was added in Chapter 5, Part C, Section 5.30.

24. Chapter 5. The plan does not appear to include management supply factors for MWPs. Include the management supply factors for MWPs by entity and decade in the final, adopted regional water plan. *[31 TAC § 357.35(g)(2)]*

    Part F, Management Supply Factor for Major Water Providers, was added to Chapter 5.

25. Chapter 5. Please include documentation of why seawater desalination was not selected as recommended WMSs in the final, adopted regional water plan. *[TWC § 16.053(e)(5)(j); Contract Exhibit C, Section 5.2; 31 § TAC 357.34(g)]*

    A paragraph was added before Part A of Chapter 5 discussing why seawater desalination was not selected as a recommended WMS.

26. Chapter 5. The plan does not appear to indicate how WMS yields took into account anticipated water losses. Please include this information in the final, adopted regional water plan. *[Contract Exhibit C, Section 5.2.3]*

    Language was added before Part A of Chapter 5 discussing how WMS yields took anticipated water losses into account.

27. Chapter 6. Please describe the impacts of the plan on threats to agriculture and natural resources in the final, adopted regional water plan. *[31 TAC § 357.40(b)(3)]*

    Language was added in Section 6.9 and 6.10 discussing how threats to agricultural and natural resources were addressed/affected by the WMSs.

28. Chapter 6. Please provide a description of the impacts of the regional water plan on navigation in the final, adopted regional water plan. *[31 TAC § 357.40(b)(6)]*

    Section 6.3 was added to Chapter 6 describing the impacts of the regional water plan on navigation.

29. Chapter 6. Please include a summary of unmet water needs identified in Chapter 6 of the final, adopted regional water plan. *[31 TAC § 357.40(c)]*

    Section 6.12, Summary of Unmet Water Needs, was added to Chapter 6.

30. Section 7.4, page 7-23. The plan discusses submitting emergency interconnects information in a confidential manner to the TWDB, however the final, adopted regional water plan must include at a minimum, the number of existing and potential interconnects including who is connected to who. Please include this information in the final, adopted regional water plan. *[31 TAC § 357.42(d)]*

    Table 7.6 was added in Section 7.4 summarizing existing and potential interconnects.

31. Section 7.5. Please include a specific evaluation of potential emergency responses to local drought conditions or loss of existing water supplies in the final, adopted regional water plan. The evaluation may be presented using Contract Exhibit C, Table B and must include at a minimum: municipal WUGs that have existing populations less than 7,500; municipal WUGs that rely on a sole source for its water supply; and all county-other WUGs. *[31 TAC § 357.42(g); 31 TAC § 357.42(g)(1); 31 TAC § 357.42(g)(2); 31 TAC § 357.42(g)(3)]*

    Section 7.5 updated to include a specific evaluation of potential emergency responses.

32. Section 7.5. Please confirm whether the entities to be evaluated for emergency responses to local drought conditions or loss of municipal supply were assumed to have 180 days or less of remaining supply. *[Contract Exhibit C, Section 7.4]*

    Language was added in Section 7.5 confirming that entities were assumed to have 180 days or less of remaining supply.

33. Section 7.8. The plan does not appear to state how the region addressed recommendations from the Drought Preparedness Council, provided to planning groups on August 1, 2019. Please include a discussion on how the planning group considered the Drought Preparedness Council recommendations in the final, adopted regional water plan. *[31 TAC § 357.42(h)]*

    Section 7.8.1, Texas Drought Preparedness Council and Drought Preparedness Plan, was added to Chapter 7, discussing how the planning group considered council recommendations.

34. Chapter 7. The plan does not appear to include a discussion of whether drought contingency measures have been recently implemented (for example, since adoption of the last regional water plan) in response to drought conditions. Please include this information in the final, adopted regional water plan. *[Contract Scope of Work, Task 7, subtask 3]*

    A paragraph was added in Section 7.2.2 discussing drought contingency measures.

35. Section 8.2, page 8-1. It is not clear from the plan whether the region is recommending Jim Bertram Lake 7 as a unique reservoir site. Jim Bertram Lake 7 was identified as a designated unique reservoir in the 2017 State Water Plan. Please clarify this information consistent with the designation in the final, adopted regional water plan. *[31 TAC § 357.43(c)] –*

    Section 8.2.2 added to clarify that Jim Bertram Lake 7 is designated as a unique reservoir site.

36. Chapter 11. Please provide a brief summary of how the 2016 Plan differs from the 2021 Plan with regards to recommended and alternative WMS *projects* in the final, adopted regional water plan. *[31 TAC § 357.45(c)(4)]*

    Table 11-6 was expanded to summarize WMS project differences from the 2016 to the 2021 plans.

37. The GIS files submitted did not appear to include the locations of every recommended and alternative WMS project. Please include the locations of every recommended and alternative WMS project listed in the final, adopted regional water plan with the final GIS data submitted. *[Contract Exhibit C, Section 13.1.2]*

    GIS files have been updated to include the information noted.

38. The WMS Project vector data was submitted across more than one shapefile/feature class for the same feature type. The vector data must be divided into point, line, and polygon feature types across a maximum of three shapefiles in a single folder or three feature classes in a single file geodatabase (one for each feature type). Please combine all feature classes in the 'RegionO_RWP_2021' GBD into a single feature class for each feature type in the final GIS data submitted. *[Contract Exhibit D, Section 2.4.5]*

    GIS files have been updated to include the information noted.

39. Appendix A. The plan includes some DB22 reports that appear blank due to the region not having relevant data for these reports. Please provide a cover page to the DB22 report appendix indicating the reason for these report contents being blank. Additionally, please clearly document at the beginning of the Executive Summary where the DB22 appendix may be found. *[Contract Exhibit C, Section 13.1.2]*

    Blank final DB22 reports include a cover page indicating the reason for these report contents being blank.

40. Please remove use of the TWDB logo from the final, adopted regional water plan. In accordance with TWDB's Logo and Seal Policy, use of the TWDB logo requires an approved licensing agreement.

    The TWDB logo was removed from the cover.

Level 2: Comments and suggestions for consideration that may improve the readability and overall understanding of the regional water plan.

1. Section 1.13, page 1-60. The last paragraph of page 1-60 states the water loss audit data in Table 1.19 is for 2017, however the Table 1.19 header appears to present 2018 data. Please consider reconciling this information in the final plan.

   The typo was corrected in the paragraph to say "2018" to match Table 1.19.

2. Section 2.1, page 2-1, 2nd paragraph. Please consider changing "and of Office of the State Demographer" to "and the Office of the State Demographer".

   The language was revised as suggested.

3. Section 2.11, page 2-19. Please consider including the MWP, Red River Authority in the same table as the region's other four MWPs, to reduce confusion for the reader in the final plan.

   Red River Authority was added to Table 2-10 in current section Section 2.10.

4. Chapter 3, page 3-1, please change "the region in underlain" to "the region is underlain." Please consider a thorough spelling, grammar, and syntax check of all sections prior to submitting the final plan.

   The typo was corrected.

5. Section 3.2, Table 3.1 does not include Mesquite GCD in Briscoe County. Please add Mesquite GCD to Table 3.1 and move Briscoe County from "None (full counties)" to "None (partial counties)".

   Mesquite GCD was added to Table 3.1 and Briscoe County was moved to "None (partial counties).

6. Section 3.2.2, page 3-6. Please consider including the desired future conditions (DFC) for Groundwater Management Area (GMA) 6, and the DFC for the Dockum Aquifer in GMA 2.

   DFCs for GMA 6 and DFC for Dockum in GMA 2 added in Section 3.2.2.

7. Section 3.3, page 3-6. The plan references TWC §35.109 instead of TWC §35.019. Please correct the reference to TWC §35.019.

   The reference was corrected.

8. Section 3.4, Table 3.2. The table as presented appears to assign MAG volumes to non-relevant aquifers and other aquifers, which do not have MAGs. Please consider presenting non-MAG availability separately in the final plan.

Table 3.2 was modified to show MAG availability and non-MAG availability.

9. Chapter 3. To assist with TWDB's review of surface water data, please consider describing the methodology used to derive the 2070 projected capacity-area rating curves for Lake Alan Henry.

   Language was added to Section 3.5.3 describing the methodology used to derive the 2070 projected capacity area rating curves for LAH.

10. Section 4.2. Information stating that projected water demands for each WWP 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 WWP is stated in Section 4.2 of the IPP. Please consider reiterating or moving this statement to Chapter 3.

    A sentence was added stating the above in Section 2.10.

11. Section 5.29 includes rainwater harvesting and reuse in the list of advance water conservation measures. While the TWDB acknowledges that the municipal conservation best practices guide includes rainwater harvesting and reuse, for regional water planning purposes these practices are considered separate sources and should not be classified as conservation. Please consider clarifying this information within Section 5.29 in the final, adopted regional water plan. *[Contract Exhibit C, Section 5.6]*

    Language was added clarifying rainwater harvesting and reuse practices as separate from conservation.

12. Chapter 5, page 5-134. The capacity and yield numbers reported for Lake Meredith appear to not be the most current information available. Please revise the capacity and yield for Lake Meredith to be consistent with that in DB22. –

    The capacity and yield for Lake Meredith were revised to be consistent with DB22.

13. Page 5-179. The plan states that municipal entities seeking infrastructure replacement to reduce water loss may be eligible for SWIFT funding. Please note that to be eligible for SWIFT funding, the project must be recommended in the regional and state water plan with a non-zero capital cost. The plan does not appear to recommend any conservation projects with a capital cost.

    Correct as noted.

14. Page 5-185. Please consider revising the text in Table 5.52 about open-channel metering, which does not appear applicable in Region O. Please also consider including Irrigation Scheduling and the Texas Alliance for Water Conservation (TAWC) project in the table, as these are mentioned as recommended conservation measures on page 5-180.

    Table 5.52 was revised to include language described above.

15. Page 5-180. Please consider expanding upon the TAWC and irrigation scheduling strategies, such as real-time monitoring of soil-moisture, variable rate irrigation, remote management of center-pivot irrigation systems.

    Text as described has been added to Section 5.

16. Figures 7-5 through 7-8 on pages 7-7 through 7-8. It is not clear what the solid lines indicate in these figures. and they are not identified in the legend. Please consider including a legend item for these lines in each figure in the final, adopted regional water plan.

    Figures updated as noted.

17. The GIS files submitted for WMS projects do not adhere to the contractually required naming convention. Please rename the GIS files following the naming convention outlined in Exhibit D, Section 2.4.5 in the final GIS files submitted. *[Contract Exhibit D, Section 2.4.5]*

    GIS files have been updated to include the information noted.

18. The GIS files submitted for WMS projects do not include all of the required attribute fields listed in Table 1 of Exhibit D, Section 2.4.5. Please include the following attribute fields in all submitted WMS project GIS data: Project Components and Datum, with the final GIS files submitted. *[Contract Exhibit D, Section 2.4.5]*

    GIS files have been updated to include the information noted.

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Appendix L2. City of Smyer Comments

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From: Aubrey A. Spear, P.E. [mailto:ASpear@mail.ci.lubbock.tx.us]
Sent: Thursday, May 7, 2020 4:28 PM
To: jbeard@crosswind.net
Cc: Lemonds, Paula Jo <Paula.Lemonds@hdrinc.com>
Subject: FW: Region O Water Plan- City of Smyer Water Supply Project

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.

JoAnn,

Based on our conversation, please contact Region O's technical consultant, Paula Jo Lemonds with HDR. Her contact information is as follows:

Paula Jo Lemonds, PG, PE
HDR Engineering
D 512.912.5127 **M** 512.921.7445

I have included her in this email. She should be able to let you know whether the City of Smyer's project information is included in the Regional Plan and if not what needs to be done to include it. Nice to visit. Thanks.

Aubrey

Aubrey A. Spear, P.E.
Director of Water Utilities
City of Lubbock
P.O. Box 2000 | Lubbock, TX 79457
(806) 775-2585 | aspear@mylubbock.us
City of Lubbock TEXAS
WATER DEPARTMENT

From: Perry Evans <perry.evans@e-ht.com>
Sent: Thursday, May 7, 2020 1:46 PM
To: JoAnn Beard (jbeard@crosswind.net) <jbeard@crosswind.net>
Cc: Aubrey A. Spear, P.E. <ASpear@mail.ci.lubbock.tx.us>
Subject: Region O Water Plan

JoAnn (City of Smyer),

JoAnn, see below, Aubrey Spear is the Region O Chairperson. If SPAG cannot answer your question, I'm sure Aubrey can point you in the right direction. I am copying him on this eamil aslo.

RWPG - Chairs Report

Region	Executive Office	First Name	Last Name	Entity	Mailing Address	City	Zipcode	Phone	EMail
A	Chair	C.E.	Williams	Panhandle GCD	P.O. Box 637	White Deer	79097	806-883-2501	cew@pgcd.us
B	Chair	Russell	Schreiber	City of Wichita Falls	P.O. Box 1431	Wichita Falls	76307	940-761-7477	russell.schreibe
C	Chair	Kevin	Ward	Trinity River Authority	P.O. Box 60	Arlington	76004	817-467-4343	wardk@trinityr
D	Chair	Jim	Thompson	Ward Timber	1101 US 59	Linden	75563	903-756-7700	jimthompson@
E	Chair	Jesus "Chuy"	Reyes	El Paso Co. WID #1	13247 Alameda Ave	Clint	79836	915-872-4000	jreyes@epcwid
F	Chair	John	Grant	Colorado River Municipal Water District	P.O. Box 869	Big Spring	79721	432-267-6341	jgrant@crmwd
G	Chair	Wayne	Wilson	Wilson Cattle Company	7026 East OSR	Bryan	77808	979-218-1800	wlwilsoncattle
H	Chair	Mark	Evans	N.Harris Co.Regional Water Authority	P.O. Box 2342	Trinity	75862	281-440-3924	mevans@nhcr
I	Chair	Kelley	Holcomb	Angelina & Neches River Authority	2901 N. John Reddit Dr.	Lufkin	75904	936-633-7543	kholcomb@an
J	Chair	Jonathan	Letz	Kerr County Commissioners Court	700 Main Street, #101	Kerrville	78028	830-792-2216	jletz@co.kerr.t
K	Chair	John E.	Burke	John Burke & Associates	17310 Hill Lakes Court	Cypress	77429	512-914-3474	johnburke41@
L	Chair	Suzanne B.	Scott	San Antonio River Authority	100 East Guenther St.	San Antonio	78283	210-227-1373	sbscott@sara-t
M	Chair	Tomas	Rodriguez, Jr.		310 Chetumal Dr	Laredo	78045	956-744-0668	trodriguez1943
N	Co-Chair	Carola	Serrato	South Texas Water Authority	P.O. Box 1701	Kingsville	78364	361-592-9323	mcgserrato@S
N	Co-Chair	Scott	Bledsoe, III	Live Oak UWCD	P.O. Box 3	Oakville	78060	361-362-5030	WSB3@aol.com
O	Chair	Aubrey	Spear	City of Lubbock	P.O. Box 2000	Lubbock	79457	806-775-2585	ASpear@mail.c
P	Chair	Phillip	Spenrath	Wharton County Judge	100 S Fulton Street	Wharton	77488	979-532-4612	judge.spenrath

Thanks,

Perry Evans, PE, PG
Vice President / Lubbock Branch Manager
Enprotec / Hibbs & Todd, Inc. (eHT)
T (806) 794-1100 l **F** (806) 794-0778 l **M** (806) 746-2810 l **E** perry.evans@e-ht.com
6310 Genoa Avenue, Suite E l Lubbock, Texas 79424
www.e-ht.com

Enprotec / Hibbs & Todd

PE Firm Registration No. 1151 l PG Firm Registration No. 50103
RPLS Firm Registration Nos. 10011900

Appendix L3. City of New Deal Comments

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From: Perry Evans <perry.evans@e-ht.com>
Sent: Friday, June 5, 2020 9:48 AM
To: Aubrey A. Spear, P.E. <ASpear@mail.ci.lubbock.tx.us>
Subject: Region O Water Plan Update- New Deal

Aubrey,

Not sure if its to late to get an update in for another small town? New Deal – Future recommendation- I would think they would want at least additional water wells as an option. They own 20-acres for that purpose now. They have 2 developers looking to build houses out there. One has already submitted a Conceptual Master Development Plan. I would think having an option to add additional wells in the Regional Plan would help them in future funding efforts.

eHT is working on evaluating the possible impact on their water and wastewater systems from the proposed annexation and development.

Any thoughts? They have a new Mayor (Regina Hobson) and new City Secretary (Brittney Moore), so I can put them in touch with you if it is appropriate.

Thanks,

Perry Evans, PE, PG
Vice President / Lubbock Branch Manager
Enprotec / Hibbs & Todd, Inc. (eHT)
T (806) 794-1100 l **F** (806) 794-0778 l **M** (806) 746-2810 l **E** perry.evans@e-ht.com
6310 Genoa Avenue, Suite E l Lubbock, Texas 79424
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Enprotec / Hibbs & Todd

PE Firm Registration No. 1151 l PG Firm Registration No. 50103
RPLS Firm Registration Nos. 10011900

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Appendix L4. J. Collier Adams

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J. Collier Adams, Jr.
Attorney at Law
109 W. Washington Ave.
Morton, Texas 79346
806 266-5582
June 11. 2020

To: Region O
c/o Kelly Davila, Director of Regional Services
South Plains Association of Governments
P.O. Box 3730
Lubbock, Texas 79452

Re: Comments to the Llano Estacado Regional Water Planning Group (LERWPG) 2021 Initially Prepared Plan (IPP) for the Llano Estacado Regional Water Planning Area also referred to as Region O.

Dear Director;

The enclosed comments are submitted in accordance with notice of public hearing to receive comments which were scheduled for May 14, 2020, the deadline for which is July 13, 2020 at 5:00 p.m.

These comments are intended to apply to the IPP and any exhibit/addendum or other document made a part of the IPP. A careful reading and understanding of these comments negate responses to the effect that SB 1 of 1997 or the Texas Conservation Amendment nevertheless support the IPP. There might well be conflicting provisions in the Water Code or agency regulation, nevertheless, the Water Code is not the only law that affects our preexisting contractual land law rights to groundwater.

The corollary of the foregoing rule is that no state agency has any right to convey those private land title interests, or to subject those private land title interests, to the goals (think unlawful involuntary servitudes) of any federal agency under any federal law.

Yours truly,

J. Collier Adams, Jr.

Comments regarding IPP.

From: James Adams (dontkickmuch@yahoo.com)

To: dontkickmuch@yahoo.com

Date: Thursday, May 21, 2020, 03:33 PM CDT

In summary of my following comments, I object to the listing of, or reference to, any federally endangered species under the Endangered Species Act in the IPP or any exhibit attached thereto for the reason that such recognition of the federal act does a great deal of harm to the Texas land title law and our groundwater rights that federal courts have repeatedly stated govern federal action, not the other way around.

I agree with the lawyers' paper attached in pdf format and request that their paper be submitted with my comments.

The Water Code says, in Section 1.001 that (c) This restatement shall not in any way make any changes in the substantive laws of the State of Texas.

And Section 36.002 states OWNERSHIP OF GROUNDWATER. (a) The legislature recognizes that a landowner owns the groundwater below the surface of the landowner's land as real property.

Please note that the code also calls for voluntary management of the land by the owner which precludes imposition of the involuntary servitudes retroactively, and therefore unlawfully imposed upon Americans and their lands.

May 12, 2020

J. Collier Adams. Jr

109 W. Washington Ave.

Morton, Cochran County, Texas

806 266-5582

I think it would be helpful if we better understood our rights so that we do no harm to our God-given rights.

The pertinent language of the cited paper is highlighted below and can be found (below) on bottom left column of page 5 of the pdf file but I encourage a reading of the entire paper.

While the language highlighted expressly applies to land still in the public domain, claims by federal agencies cannot apply to land patented in perpetuity to owners because those patents of "all right, title and interest" of the State cannot constitutionally be altered by retroactive legislation.

In fact, Kring v. Missouri 107 US 221 (1883) stands for the proposition that even if a state amends its constitution, it cannot retroactively change vested contractual rights. (The case applies the prohibition of retroactive action from the Civil Law (Contracts Clause) to the Criminal Law (Ex Post Facto) in the instance of a confessed and convicted murderer. I submit that law-abiding citizens should get the same rights.)

In addition, J. Joseph Story's annotated Commentaries on the US Constitution's discussion can be read to mean that the obligation to honor preexisting rights also extends to restoration of any rights retroactively (unlawfully) taken.

Imposing involuntary servitudes upon lands through the Endangered Species Act should violate the 13th Amendment against slavery and cannot be made legal through a passage of time. America's founders knew well the yoke of slavery of the Feudal Law Land system wherein we lived on the King's land and did the King's bidding without Just Compensation. If you need a cite this last assertion, I can give it, too.

I looked over Water Code sec. 16.053 (Bob Duncan's 2004 HB 1763) and its many amendments over the years and am still of the opinion that bending to the Endangered Species Act in the IPP is inappropriate.

All the best.

J. Adams

109 W. Washington Ave.

Morton, Texas 79346

806 266-5582

http://www.cailaw.org/media/files/IEL/ConferenceMaterial/2015/title/MLeaverton-paper.pdf

This article would indicate the ESA has no place in Texas, and certainly not when it comes to privately owned land.

On the state level, examples of designated public lands would likely include Texas state parks and recreational areas, wildlife areas, and other property set aside for state government use. Similarly, on the federal level, although Texas contains almost no federal lands relative to most other western states, public lands would include those under the jurisdiction of the United States Department of Defense, Fish and Wildlife Service, National Park Service, and Forest Service. Neither the Bureau of Land Management (BLM) nor the Bureau of Indian Affairs (BIA) claim any federal lands within Texas, mostly likely because Texas retained its entire public domain when joining the Union, relinquishing control of **no** lands to the federal government and thereby making the Texas public domain less accessible to claims by federal agencies.

See generally: NATIONALATLAS.GOV, Federal Land Map, Texas, at: http://nationalatlas.gov/printable/images/pdf/fedlands/TX. pdf (link last accessed on Mar. 28, 2013) and NATIONALATLAS.GOV, Federal Land Map, U.S., at: http://nationalatlas.gov/printable/images/pdf/fedlands/fed lands3.pdf (link last accessed on Mar. 28, 2013).

THE GENESIS OF TITLE:

LAND GRANTS, PATENTS & STATE OWNED MINERALS

MARK K. LEAVERTON
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2nd Texas Mineral Title Examination Course
May 14 & 15, 2015
JW Marriott Hotel, Houston, TX

MARK K. LEAVERTON

Rash, Chapman, Schreiber, Leaverton & Morrison, L.L.P.
2112 Rio Grande
Austin, Texas 78705

Biographical Information

Mark is a Lubbock boy who received his Bachelor of Business Administration with Honors from Texas Tech University in 1972 and his Doctor of Jurisprudence from the University of Texas School of Law School in 1974. He was admitted to the State Bar of Texas in 1974 and the State Bar of Pennsylvania in 2011 and is Board Certified in Oil, Gas and Mineral Law (1985 - Texas Board of Legal Specialization). Mark's primary area of practice is oil and gas which includes title examination for oil and gas exploration and production projects and the purchase and sale of producing properties; preparation of contracts and instruments; and acting as an expert in oil and gas cases. He has been a speaker before State Bar and oil and gas industry seminars and workshops and is the co-author (together with Michael H. Atnipp) of *Kanes Manual of Oil and Gas Forms* published by Dos Manos Publishing Company ©1989 and 1990. Mark is a Partner with the Austin firm of Rash Chapman Schreiber Leaverton & Morrison LLP which specializes in oil and gas matters including the preparation of title opinions, due diligence work on oil and gas property sales, and representation of clients before State of Texas agencies including the Railroad Commission and the Texas Commission on Environmental Quality.

Mark has been heavily involved in Christian ministry through his church, Young Life, Fellowship of Christian Athletes, Community Bible Study, and Community Bible Study International. He and his wife, Vicki were married on December 21, 1974 and have a son, David, and daughter, Lindsey, and 4 fabulous granddaughters and 1 stinky grandson.

Mary Anna M. Turner
Attorney At Law
Phone: 512-922-4601
E-mail: maryannaturner@gmail.com

Born and raised in West Virginia as a coal mining attorney's daughter, Mary Anna attended Vanderbilt University on a full academic scholarship, graduating in 1999 with high honors in Political Science. She received her J.D. in 2003 from the University of Tennessee College of Law where she served on *Tennessee Law Review* and was president of Christian Legal Society.

Mary Anna moved to the Promised Land (a/k/a Texas) in May 2003, the day after graduating law school, and spent 7 years in the estate planning and charitable trust arena before shifting her focus to oil and gas. She has done field landwork in the Eagle Ford Shale, Permian Basin, New Mexico, and Colorado, in addition to in-house due diligence for acquisitions and divestitures. Mary Anna currently lives in Austin where she practices oil and gas law.

TABLE OF CONTENTS

THE GENESIS OF TITLE: LAND GRANTS, PATENTS & STATE OWNED MINERALS

I. INTRODUCTION

Texans tend to be a confident bunch. But it hasn't always been this way. After the Battle of the Alamo, when the young Republic of Texas organized her first government in 1836, she had $55.68 in her treasury and 251,000,000 [1] acres of land within her borders. Talk about land rich and cash poor. Land records were so vital to the functioning of the early Republic that, in 1842, a canon was fired at the first Texas General Land Office in what came to be known as the "Archive War." TEX. GLO, "Hist. Pub. Lands," at 14-15.

Faced with heavy war debt, wounded veterans to pay, canals to construct, ditches to dig, and a new nation to settle and cultivate, the Republic had to rely on her one and only resource to address all these needs: LAND. Almost immediately land became the currency of the day as a complex land grant system quickly developed to finance all of the budding nation's needs. Issuing grants based on headrights and military service, as well as in exchange for loan and sales script, Texas made the most of her wide, open spaces well past annexation to the United States in 1845. By 1898 the Texas Supreme Court declared the State's unappropriated public domain to be depleted, with 216,314,560 acres of public land having been distributed within the 62 years since independence. *Id.* at 20-21.

Of course, all these new land grants meant that the Lone Star State now had thousands more title records to keep track of, including many patents issued by the Texas General Land Office (GLO). Tracing a clear chain of title on any tract of land through various periods of Texas history raises many complicated questions and controversies both above and below the surface – literally.

If you are going to be a real, authentic, and capable title attorney, you need to start at the beginning. Understanding the foundation of Texas titles requires learning "from whence they cometh." As life emanates from our Creator, Texas title emanates from the government – in this case Spain, Mexico, Republic of Texas, and State of Texas.

II. SOVEREIGNS: PAST & PRESENT

A. The Spanish Crown: c. 1720-1821

Spain first laid claim to the territory that is now Texas in 1519, but it was not until 1716 that permanent occupation began. In 1720, the Spanish Crown granted the first official land title to a tract within Texas, and in 1727 the territory of Texas officially became subject to the Spanish monarchy as a province of New Spain. Aloysius A. Leopold, LAND TITLES AND TITLE EXAMINATION (Texas Practice), 3rd ed., §1.1.

When the initial group of 16th century Spanish explorers to Texas did not stumble upon readily accessible mineral riches, the Court of Madrid showed little interest in the area until the French established an outpost at Matagorda Bay in 1685, claiming the area for France. TEX. GLO, "Hist. Pub. Lands," at 1. In order to protect their own interest, the Spanish quickly sought to establish a presence in East Texas. *Id.* In 1690, Spanish missionaries established the first Spanish mission and presidio in Texas near the current site of Nacogdoches. This was the first of a number of mission-presidio settlements that Spain would establish in East Texas, followed by others in the 1700s near the headwaters of the San Antonio River and La Bahia (today known as Goliad). *Id.*

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[1] *See* TEXAS GENERAL LAND OFFICE, "History of Texas Public Lands," p. 9 (Sept. 2010), *available at:* http://www.glo.texas.gov/what-we-do/history-and-archives/_documents/history-of-texas-public-lands.pdf. (For the sake of brevity, this source will hereinafter be cited within the text as "TEX. GLO, 'Hist. Pub. Lands.'")

Farming and ranching operations also developed along the Rio Grande near both El Paso and Laredo (although neither area was within the territory that would become the New Spain Province of Texas). The Spanish Crown classified all land as arable or pasture land, and meted out land grants accordingly. Ranchers received a league of land (4,428.4 acres) to allow ample room for grazing, and farmers received a labor (177.1 acres) of land. The Spanish measurement of the *vara* (33 1/3 inches) took root in in Texas and was later adopted by the State of Texas as its official unit of land measurement. *Id.* at 2.

The oldest remaining record of a Spanish land grant in Texas was the 1720 title to the San Jose Mission in San Antonio, still on file at the Texas General Land Office. Records of approximately 60 land titles from the Texas Province of New Spain remain on record with the GLO of Texas, most of them for lands near Nacogdoches. The GLO has fewer than ten records of land titles from the San Antonio and Goliad areas, most likely because formal grant proceedings in the Texas Province of New Spain were not frequent since the process of perfecting title received directly from the Spanish Crown could be long and arduous. *Id.* at 2-4.

Spain's overseas possessions were considered royal domain belonging to the Spanish monarch, not property of the Spanish nation. Formal title to land in overseas territory could only be perfected by the king's confirmation after following a lengthy process beginning with subdelegates at the level of local provincial government. Ranchers could, alternatively, establish prescriptive rights against the Royal domain after 10 years of "squatting." As demonstrated by the lack of official Spanish land grants, squatting was frequently their chosen method. *Id.* at 2-4.

Until 1819, most of the land granted by the Spanish Crown was in the form of large grants, with all grantees being Spanish subjects, only 5,000 of whom lived in Texas by the end of the Mexican War for Independence. In 1819, Spain opened up Texas to foreign settlement. This prompted native Missourian, Moses Austin to seize the opportunity. Austin had formerly been a Spanish subject while living in Louisiana, so he was likely viewed with favor by the Crown. In 1821, he contracted with the Spanish government to bring 300 families, known as Austin's "Old 300" into Texas to establish a colony. *Id.* at 5.

B. Mexican Rule: State of Coahuila y Texas, 1821-1835

Colonization plans were delayed when the Mexican War for Independence ended and Agustin de Iturbide took control of the new independent Mexican nation. In the meantime, Moses Austin died of pneumonia in June, leaving his son, Stephen F. Austin, to renegotiate the contract with the new Mexican Sovereign. He successfully lobbied for the passage of the Imperial Colonization Law of 1823, and even though he was the only empresario to take advantage of it before Iturbide's reign ended, Austin's colony was so successful that it paved the way for extensive settlement. *Id.* at 5-6.

In 1823 a federal republic was established, and in 1824, the Mexican congress united the former provinces of Coahuila y Texas into one state in the new federation. The Mexican National government would not recognize Texas as an independent state within the federation because it was settled almost exclusively by settlers from the United States, a circumstance that could lead to disloyalty or even rebellion. Still, Mexican colonization laws provided inexpensive lands that attract settlers from the U.S., where empty acreage was much more expensive at the time. Under the State Colonization Law of March 24, 1825, a head of a family could obtain one league of land (4,428.4 acres) for $117 or $0.38/acre, and in the state of Coahuila y Texas, payment was due within six years, with the first payment not due until the fourth year. By contrast, in the United States under the land law of 1820, land cost

$1.25/acre, with a minimum required cash purchase of 80 acres. *Id.* at 6.

In addition to the cheaper acreage which Mexico offered, the Panic of 1819 in the United States, one of the greatest economic depressions of the 19^{th} century, gave Americans incentives to settle in the Mexican border state of Coahuila y Texas. From 1824 to 1836, a nearly 16 million acres were granted to settlers by the land commissioners in each empresario colony. *Id.* With only 10% of the Mexican state's population being Mexican, concerns abounded that Texas independence, or annexation to the United States, was inevitable. By 1830 this led the Mexican Congress to enact a ban on further immigration from the United States, a measure which probably fomented more dissent than it quelled. *Id.* at 7-9.

Tensions mounted until, on April 31, 1835, Mexican federal troops disbanded the Coahuila y Texas legislature, deposed state authorities and, in effect, declared martial law. *Id.* at 6; LEOPOLD at §1.1.

C. Republic of Texas, 1835-1845

By November 7, 1835, Anglo residents of Texas set up a provisional government and ordered a suspension of all Mexican land operations, declaring that any land titles issued after November 13, 1835 would be invalid. After the Declaration of Texas Independence on March 2, 1836, the founders of the young Republic quickly adopted a new Constitution calling for the creation of a General Land Office to house all land records and determine which lands had valid land titles from Spain and Mexico and which lands remained vacant. TEX. GLO, "Hist. Pub. Lands," at 9-10; LEOPOLD at §1.1.

In December 1836, the first Congress boldly claimed the Rio Grande River as the western border of the Republic, even though, under Spanish and Mexican rule, no territory below the Nueces River had ever been included in Texas. This shift to the southwest would add significantly more unappropriated public domain to the yet-to-be-appointed land commissioner's jurisdiction. TEX. GLO, "Hist. Pub. Lands," at 9. The first Land Commissioner, John Borden, a surveyor who laid out the town of Houston within Stephen F. Austin's Mexican colony, was appointed in June 1837. All land titles, surveys and documents were now public property, and Borden was charged with collecting all records of Spanish and Mexican land titles, as well as maps and surveys, from every local land commissioner who had operated under Mexican rule in Coahuila and Texas. Until the first GLO opened its doors on October 1, 1837, Borden had to store all the land records in the homes of his friends.

The GLO quickly began issuing land grants to settlers in exchange for cash or loans, as well as land in exchange for bonds or promissory notes which the cash-strapped Republic had previously issued to raise funds for the basic functions of government. *Id.* at 13-14. As a result, within one decade of winning independence, the Republic of Texas had distributed approximately 41,570,733 acres of unappropriated public domain, transforming from a nation dominated by large landholders into one populated by many small farmers and merchants – meaning a lot more land records in the archives! *Id.*

With the Mexican invasion and capture of San Antonio in 1842, President Sam Houston invoked executive emergency powers and ordered that the seat of government and the archives (housed in the GLO) be temporarily moved from Austin to Washington-on-the-Brazos to stay out of harm's way. President Houston noted that any damage to the archives would be very costly to the young Republic. *Id.*

Austinites suspected that this was a ploy on Houston's part to eventually move the capitol back to the city that bears his name, so they protested. Unfazed, President Houston ordered a group of Texas Rangers to go to Austin under cover of darkness to remove the Archives. Under the direction of Land Commissioner Thomas Ward, they loaded up three wagons full of records outside the GLO. As they did so, a cannon was fired at the office, and a band of vigilantes pursued the Texas Rangers' wagons all the way to Williamson County. Having been ordered by Houston to allow no bloodshed, the Rangers surrendered the records. The vigilantes took them back to Austin but did not return them to the GLO for two years. Land Commissioner War ended up closing the GLO for a year, concluding that without the land records, it was impossible to carry out the GLO's daily business functions. *Id.* Although the Archive War may have been bloodless, it was by no means costless to the new nation.

D. State of Texas, 1845-present

In 1844, the Republic of Texas, still burdened with debt and influenced by its largely Anglo population, submitted an annexation treaty to the United States Congress which proposed that Texas give 175 million acres of its public domain to the United States government in exchange for the United States assuming $10 million of the Republic of Texas's debt. *Id.* at 15. Congress rejected the treaty on the grounds that the public domain of Texas was unlikely to be worth $10 million, but the U.S. did not reject the idea itself of statehood for Texas. *Id.*

Texas was annexed on December 29, 1845, retaining both her full debt and all of her public lands. Aside from the 13 original colonies, Texas stands alone as the only state in the Union that kept its entire public domain upon annexation to the United States. *Id.* (With other states, an "Enabling Act" was part of the standard procedure of statehood, requiring that all unappropriated public lands be forever disclaimed to the federal government for its disposition.) It is because of this that the State of Texas remains the Sovereign over its public domain, vested with the authority to grant patents. "Every patent for land emanating from the State shall be issued in the name and by the authority of the State, under the seal of the state." TEX. NAT. RES. CODE § 51.243.

From the GLO's perspective, this likely made the transition from the Republic to Statehood a much more seamless one than it might otherwise have been, at least in terms of the process of issuing patents for unappropriated land. The Texas State Constitution of 1845 recognized all valid land titles issued by Spain, Mexico and the Republic of Texas, and the State made no changes to the administration of the public domain. Land titles to 4 million acres issued by the Spanish Crown and 22 million acres issued by the Mexican government before November 13, 1835 are still recognized as legal in Texas. *Id.* at 15.

Clearly defining the boundaries of the new State of Texas was a gradual process. In 1848 when the Treaty of Guadalupe Hidalgo ended the Mexican-American War, Texas's southern boundary was confirmed as the Rio Grande River, not the Nueces River, which added to the State of Texas significant acreage that it had never had while under the Spanish or Mexican Sovereigns. *Id.* The Compromise of 1850 clarified the western boundary of Texas as well, when the State of Texas ceded 67 million acres of territory, included in present day New Mexico, Colorado, Wyoming, Kansas and Oklahoma, to the United States in exchange for $10 million in federal bonds to reduce its remaining debt. *Id.*

E. Spanish Legal Legacies in Texas

In 1840, the Congress of the young Republic adopted much of English common law, but in a few key areas of property law retained Spanish civil law. Community property laws are an enduring legacy in Texas today of Spanish rule, as are certain laws preventing the forced sale of property. *Id.* at 4.

Of particular importance to any examination of mineral rights is Texas's retention of the Spanish law on submerged lands. Public ownership of submerged coastal land extended to three marine leagues (10.4 miles) from shore under Spanish law. *Id.* Other states in the United States that adopted English common law have rights in submerged land up to three miles from shore, but the State of Texas retains the 10.4 mile boundary, a fact that is very important to off-shore drilling and sets Texas apart from other states on the Gulf coast. *Id.*

The Spanish Crown's reservation of all minerals when granting lands within the public domain is also a very important legacy, as well, and one which will be discussed at greater length later in this paper.

III. THE TEXAS PUBLIC DOMAIN

The terms *public domain* and *public lands* are often used interchangeably even in official documents addressing title issues relevant to this paper. Discerning the distinctions between the two terms can be difficult, particularly because their usage appears to have evolved through the decades of Texas history. As the public domain has decreased dramatically in size through various land grant programs and other allocations, the concept of what the public domain encompasses has become somewhat more specific.

With the Act of Feb. 23, 1900, the Texas Legislature dedicated all the unappropriated land remaining in the public domain to the Permanent School Fund. LEOPOLD, at §7.3, n.2. Under the Constitution of 1876 and subsequent statutory authority, the remaining "public domain of Texas has been divided into Public Free School Lands, Asylum Lands, and University Lands, with all other lands being designated public lands. Unappropriated public domain is set apart and granted to the permanent school fund of the state." [emphasis added] LEOPOLD, at §7.3. *Schendell v. Rogan*, 63 S.W. 1001, 1002, 1003 (Tex. 1901).

On the state level, examples of designated public lands would likely include Texas state parks and recreational areas, wildlife areas, and other property set aside for state government use. Similarly, on the federal level, although Texas contains almost no federal lands relative to most other western states, public lands would include those under the jurisdiction of the United States Department of Defense, Fish and Wildlife Service, National Park Service, and Forest Service. Neither the Bureau of Land Management (BLM) nor the Bureau of Indian Affairs (BIA) claim any federal lands within Texas, mostly likely because Texas retained its entire public domain when joining the Union, relinquishing control of no lands to the federal government and thereby making the Texas public domain less accessible to claims by federal agencies. *See generally*: NATIONALATLAS.GOV, Federal Land Map, Texas, *at*: http://nationalatlas.gov/printable/images/pdf/fedlands/TX.pdf (link last accessed on Mar. 28, 2013) and NATIONALATLAS.GOV, Federal Land Map, U.S., *at*: http://nationalatlas.gov/printable/images/pdf/fedlands/fedlands3.pdf (link last accessed on Mar. 28, 2013).

Aloysius Leopold offers further explanation of the distinction between *public domain* and *public lands*. Relying on case law he states: "The term 'public domain,' in regards to lands held by the State of Texas, refers to public ownership. This meaning is also applied to the term 'public lands.'" LEOPOLD, at §7.7. He goes on to point out that the beds and channels of navigable streams or bodies of water which are held in trust by the State for the use of the public generally are not "ordinary public lands." *Id.* As such, the beds and channels of navigable streams were never intended by the Texas Legislature to be included in the Permanent School Fund. *Id.*

This would mean that the School Land Board does not have the authority to execute an oil and gas lease on acreage which includes navigable rivers and streams, even if the surrounding acreage is part of the PSF. This conclusion seems to run contrary to Section 11.041 of the Texas Natural Resources Code, which states explicitly, "In addition to land and minerals granted to the permanent school fund under the constitution and other laws of this state, the permanent school fund shall include: the mineral estate in river beds and channels."

This apparent contradiction is one that any mineral examiner would want to consider carefully and possibly research further when assessing the mineral ownership of public lands which include navigable rivers and streams.

A. Texas General Land Office: Establishment & Purpose

The Texas General Land Office, established in 1836 by the Republic, is the oldest state agency of Texas. As the Archive War serves to remind us, in the early days of the cash-strapped young Republic, the GLO may have been more important than the national treasury. The original stated duties of the GLO: managing the public domain, collecting and keeping land title records, providing maps and surveys, and issuing land titles on behalf of an entity the size of Texas both were and are an enormous set of responsibilities. LEOPOLD, at §§4.1, 4.6 - 4.15.

As the unappropriated public domain has been depleted, the duties of the GLO have evolved, but it remains a critically important revenue-producing and record-keeping agency in Texas state government. In recent years, the GLO has spent around $45 million per year while earning nearly $800 million per year for the benefit of the public education system in Texas through the Permanent School Fund. *See generally* TEXAS GENERAL LAND OFFICE, http://www.glo.texas.gov/what-we-do/energy-and-minerals/oil_gas/index.html, link last accessed Mar. 28, 2013.)

B. Distribution Process: Land Certificate, Survey & Patent

Understanding the timeline of title in the early days of the Republic and the State of Texas requires a closer look at the steps involved for both the Sovereign and the aspiring landowner. For every land title issued, there were typically three basic documents that would be filed and kept on record at the GLO: land certificates, field notes, and land patents. Both the Republic of Texas and the State of Texas issued certificates, usually by way of a County Board of Land Commissioners or the General Land Office, entitling a grantee to a certain number of acres of land in the unallocated public domain. LEOPOLD, at §§2.32-2.34. The land certificate indicated what statute authorized the grantee to claim the land (e.g., military service, settlement headrights, empresario contract, scrip or outright purchase), but it was not connected to any specific parcel or location. It was the grantee's responsibility to find his own land, which did not even have to be in the same county which issued the certificate, and then pay to have it surveyed. The land certificate conferred the right to possession to its recipient but did not divest the Sovereign of full title. *Id.*

Once the grantee had the surveyor's field notes of his chosen acreage, which would contain the legal description of the tract detailed in metes and bounds and clearly identifying its location, the grantee could file these notes with the GLO and apply for a patent. With the issuance of the patent, the land was officially severed from the public domain and ownership vested in a private party. *Id.*

Land certificates could be both sold and transferred, with assignable rights to locate, survey and patent the land. Some certificates were conditional, giving the grantee the right to occupy a portion of the public domain while fulfilling a certain requirement (e.g., three years of residence and/or building a house or barn on the property), while others were unconditional. *Id.* at §2.34. Such conditions largely depended on the type of land grant or land scrip used to obtain the land.

C. Land Grant System: 1836-present

In its 10 years of existence, the Republic of Texas distributed approximately 41,570,733 acres of the public domain, the largest portion of which was composed of headrights grants to settlers.

1. HEADRIGHTS: 36,876,492 acres

Headrights, both conditional and unconditional, were issued by the Boards of Land Commissioners in each county to encourage immigration. LEOPOLD, at §2.5

First-class headrights: Issued to settlers who arrived on or before Texas Independence on March 2, 1836. The heads of families received one league and one labor of land (4,605.5 acres) and single men age 17 and older received one-third of a league of land (1,476.1 acres). The acreage allotments for the heads of families remained similar to those initiated by the Spanish crown. *Id.* at §2.8.

Second-class headrights: Issued to immigrants who arrived after the Texas Declaration of Independence and before October 1, 1837, conditioned on remaining on the land for three years. Heads of families received 1,280 acres and single men received 640 acres. *Id.* at §2.11.

Third-class headrights: Issued to immigrants who arrived between October 1, 1837 and January 1, 1840. The Republic granted 640 acres to heads of families and 320 acres to single men, conditioned on three years of residence in the Republic. *Id.* at §2.14.

Fourth-class headrights: The Republic issued certificates to immigrants arriving between January 1, 1840 and January 1, 1842, with all conditions repealed in 1842. Heads of families received 640 acres and single men received 320 acres. *Id.* at §2.17.

2. MILITARY LAND GRANTS

The Republic did not have funds for pensions to reward its veterans from the Revolution, so land grants were the obvious solution to reward war heroes and to provide for their widows.

Bounty Grants: 5,354,250 acres
A total of 7,469 bounty grants were awarded for military service during the Texas Revolution, with 320 acres granted for every three months of service, up to 1,280 acres. From 1838 to 1842, soldiers guarding the frontier were eligible for awards of 240 acres. LEOPOLD at §§2.21-2.23.

Battle Donation Grants: 1,162,240 acres
In 1837, a total of 1,816 donation warrants were issued for participation in specific battles during the war for independence. Participants in the siege at Bexar and the battle at San Jacinto, as well as the heirs of those killed at the Alamo and Goliad were eligible for 640 acres. *Id.*

Military Headrights
Special grants issues to soldiers arriving in Texas between March 2 and August 1, 1836 who were permanently disabled in the course of their military service or who received an honorable discharge, as well as to the heirs of soldiers killed with Fannin, Travis, Grant and Johnson. *Id.*

After statehood and until 1855, Texas continued to issue bounty warrants and donation certificates to veterans of the Texas Revolution. When fire destroyed the records needed to prove the claims of veterans and their heirs in 1855, the process was suspended until 1857 when the legislature established a Court of Claims to verify unpatented land certificates and prevent fraudulent claims. TEX. GLO, "Hist. Pub. Lands," at 18. The Court of Claims expired in 1861, and after that point, no further veterans' certificates were issued except by special act of the legislature. *Id.*

Republic Veterans Donation Grant: 1,278 certificates and 1,377,920 acres
In 1879, in response to widespread need among Revolution veterans and their heirs, the legislature passed a 640-acre Veteran Donation Act to give land to veterans, their widows, and signers of the Texas Declaration of Independence who would swear under oath their indigence and physical disability. In 1881, the indigence requirement was removed and the allotted acreage was increased to 1,280 acres, with the certificate conditioned only on proof of three months of military service to the Republic. The State repealed the grant in 1887 out of concern that the public domain would soon be exhausted.

Confederate Scrip Certificates: 2,647,040 acres and 2,068 certificates

In 1881, the legislature granted certificates for 1,280 acres to disabled or indigent Confederate veterans or widows of those killed in line of duty in the Civil War. Grantees were also required to survey an equal amount of acreage for the Permanent School Fund (PSF) since half of the public domain was reserved at that time for the PSF. Texas repealed the act in 1883 due to a feared shortage of public domain. LEOPOLD, at §2.25. Only 1,726 certificates, amounting to 1,979,852 acres, were surveyed, and the remaining certificates (17% of those issued) were annulled in 1896 because the time limit for locating the land had expired. Many of the indigent recipients chose to sell their certificates for trivial amounts because, as vacant land became increasingly scarce, they could not afford to locate and survey land. TEX. GLO, "Hist. Pub. Lands," at 19. Interestingly, an 1868 act granted warrants to Texans who had fought in the Union Army, but no land was ever claimed under this law. LEOPOLD, at §2.25.

3. EMPRESARIO COLONIES: 4,494,806 acres

In 1841, the Republic of Texas adopted the Mexican empresario system of colonization contracts to encourage immigration to Texas, as well as to establish settlements on the frontier and other sparsely populated areas as a defense against Indian and Mexican raiders. *Id.* at §2.19. Four empresario colonies were established, with heads of families eligible for 640 acres of land, and single men received 320 acres. *Id.* at §2.20. As an incentive to organize and manage colonies, the Empresarios themselves received ten sections of land for every 100 colonists settled and up to half of the colonist's grants. TEX. GLO, "Hist. Pub. Lands," at 12. Colonists were to receive grants similar in amount and requirements to fourth-class headrights, with the requirements of building a house and cultivating at least 15 acres and the land had to be located within the confines of the colony. *Id.*

Fisher and Miller's Colony was established with a contract in 1842 and modified in 1844, allowing grants to 6,000 families. Miller's interest was taken over by the Society for the Protection of German Immigrants, a group of German nobleman who wanted to send settlers to Texas to combat overpopulation in Germany. Because the land allocated by the grant was far inland in Comanche territory, many of the settlers did not reach the actual area of the Fisher-Miller grant, but instead located at Fredericksburg or New Braunfels, two settlements that the Society had established as way stations on land between the coast and the grant. *Id.* at 13.

Castro's Colony, established in 1842, also brought around 2,100 German-speaking Alsatian farmers from France to settle west of San Antonio. *Id.* *Peters' Colony* in North Texas, the first phase of which began in 1841 with settlers from Kentucky and Tennessee, was successful in enticing settlers to come, however it was plagued with the problem of other land grantees attempting to settle within the boundaries of the colony. *Id.* In fact, the contract for *Mercer's Colony* (1844) was ruled invalid, partly because it overlapped with the territory set aside for *Peters' Colony*, but before this ruling colonists did claim 691,840 acres. *Id.*

The Republic of Texas repealed the "Empresarios Act" on January 30, 1844, after using it to convey nearly 4.5 million acres. *Id.* During the time it was in effect and land prices had risen, the population had increased from 38,000 to 130,000, although the Republic still faced financial woes and trouble with the Indians. *Id.*

4. PRE-EMPTION ACTS: 4,847,136 acres

The Republic of Texas passed the first pre-emption act in 1845, similar to the United States Pre-Emption Act of 1841, granting settlers the right to purchase up to 320 acres of land for $0.50 per acre after three years of residence and the making of improvements (e.g., building a barn). TEX. GLO, "Hist. Pub. Lands," at 15-16. In 1853, the law was changed so that settlers only had to pay a $12.00 filing fee. *Id.* In 1854, the state reduced to 160 acres the amount of land that one person could obtain. LEOPOLD, at §2.60. The goal of this was to ensure that the public domain was distributed to small landowners, rather than corporations or speculators, in order to avoid the problems seen in the days leading up to Texas Independence. *Id.* at §2.61.

The pre-emption act was repealed in 1856, reinstated in 1866, repealed with an Act of the State Legislature in 1889 and confirmed dead 1898 when the Texas Supreme Court declared the public domain depleted in *Hogue v. Baker*. *Id.* at §2.64. *See also*, *Hogue*, 45 S.W. 1004, 1006, 1007 (Tex. 1898.)

5. LOAN & SALES SCRIP: 1,329,203 acres

The Republic financed government operations by authorizing agents to sell various types of land scrip-certificates. Approximately 1,329,203 acres of land were sold through various types of scrip. TEX. GLO, "Hist. Pub. Lands," at 13-14.

Funded Debt Scrip: Beginning on February 5, 1841, any holder of promissory notes, bonds, funded debt or any other liquidated claims against the government could surrender this for land scrip at the rate of $2.00 per acre. TEX. GLO, "Land Grants," at 5.

General Land Office Scrip: Beginning February 11, 1850, the GLO Commissioner was authorized to issue land scrip at $0.50/acre for the liquidation of the public debt of the former Republic of Texas. *Id.*

Sales Scrip: Beginning February 11, 1858, the Land Commissioner was authorized to issue land scrip in certificates of at least 160 acres at $1.00 per acre for the sale of the public domain. *Id.*

6. INTERNAL IMPROVEMENT SCRIP: 4,088,640 acres

Infrastructure for efficient transportation was critical to the economic development of Texas in the 1850s, allowing farmers, ranchers and merchants to move their products to market.

Under an 1844 law, a total of 27,716 acres were issued to road commissioners, surveyors and contractors for building a *Central National Road* from the Red River to the Trinity River in what is now Dallas. Other land grant incentives for the construction of roadways proved less effective, and very few applied for land granted for road construction. Land grants offered for other internal improvements proved far more effective. LEOPOLD, at §2.58.

Beginning in 1854, Texas issued scrip certificates for the *improvement of rivers and bayous* (*Id.* at §2.55), and the construction of *ship channels and ships* (steamboats, steamship and other vessels). *Id.* at §2.52. Scrip was also issued for the building of *irrigation canals and ditches* (*Id.* at §2.56) of at least three miles in length, resulting in the granting of another 584,000 acres in land. The construction of the ship channel across Mustang Island resulted in the issuing of 320 certificates for 620 acres each. Seven steamboats to Texas rivers and nine other ships resulted in the granting of almost 17,000 acres of land.

In 1858, the Land Commissioner began issuing certificates up to eight sections of land for the boring of *artesian wells* between the Nueces River and Rio Grande River, the land secured by the Treaty of Guadalupe Hidalgo. Larger grants were issued for deeper wells. (LEOPOLD at § 2.53)

In 1863, the Texas Legislature started issuing scrip for building *factories*, 320 acres for every $1,000 of machinery installed. Wool and cotton producers were the primary recipients of 11,360 acres granted for the creation of industries, but much like the surface roadway grants, the factory land grants did not attract much interest. (*Id.* at § 2.54)

The state required recipients of land grants for internal improvements to have an equal amount of land surveyed and reserved for the state, causing some grantees to opt to receive only half of the acres to which they were entitled so they would not have to pay to survey land for the state. All legislation authorizing internal improvement scrip was repealed in 1882.

7. RAILROAD GRANTS: 32,152,878 acres

In 1852, the Texas Legislature chartered eight railroad companies and attempted to induce construction by granting the companies eight sections of land (equal to 5,150 acres) for each mile of railroad constructed. (EARLY LAWS OF TEXAS, art. 2365, § 5). It was widely believed that railroad construction would expedite the economic development of Texas and increase land values. Progress was slow, however, possibly due to the requirement that the railroad companies had to survey an additional eight sections of land retained by the State, for every eight sections of land which the State granted to the railroad companies. *Id.* In an effort to accelerate the process, the Texas Legislature, on January 30, 1854, passed the Act to Encourage the Construction of Railroads in Texas by Donations of Land, increasing the amount of land granted to 16 sections (equal to 10,240 acres) for each mile of railroad constructed. *Id.* at §§2-6. Land certificates were issued to each railway, giving them the responsibility to survey lands in the public domain into sections of 640 acres each, combined into square blocks of at least six miles. The sections were then to be numbered. The State would then issue a patent to the railroad company for all of the odd-numbered sections, while reserving all the even-numbered sections to the use of the State until appropriated by law. LEOPOLD at § 2.40.

Before the State actually granted land to a railroad company, however, the railroad was required to have completed construction on 25 miles of track. Only 492 miles of railway had been completed by the time of the Civil War, an amount which only increased to 511 miles by 1870, since the war and Reconstruction diverted the nation's attention for much of the decade. TEX. GLO, "Hist. Pub. Lands," at 16.

The passage of the Constitution of 1869 presented a further obstacle by prohibiting the Legislature from making land grants except to actual settlers upon the land. LEOPOLD at § 2.39. EARLY LAWS, arts. 751-753. On March 18, 1873, the Legislature amended the Constitution of 1869, allowing the State to aid railroad construction with grants of up to 20 sections per mile of track constructed. On the same day, the Texas Legislature also designated for the first time its retained even-numbered sections of land for the benefit of the Public School Fund. The Constitution of 1876 further amended the State's policy by instituting the general law that all railroad companies would receive a grant of 16 sections of 640 acres each for every mile of railway constructed, with the even numbered sections reserved for the Public School Fund. *See generally* LEOPOLD at §§2.40-2.49.

Under the Constitution of 1876, the State granted 35,777,038 acres to a number of major railroads, including the International and Great Northern Railroad Company, but faulty grants, errors in the location of land and other problems reduced the total amount granted to 32,153,878 acres. TEX. GLO, "Hist. Pub. Lands," at 16-17. From 1873 to 1881, the Texas & Pacific Railroad, for example, built a total of 972 miles of railway, entitling it to land grants of 12,441,600 acres, however the State only fulfilled the grant for the portion of the railroad east of Fort Worth, amounting to only 5,173,120 acres. The State claimed that the Texas & Pacific had not completed construction within the time frame required by the railroad's charter. The Texas Attorney General even filed suit against the railroad to recover additional acreage on the grounds that it was not properly located, reducing Texas & Pacific's acreage received to 4,917,074. S.G. Reed, *Land Grants and Other Aids to Texas Railroads*, SOUTHWESTERN HISTORICAL QUARTERLY, Apr. 1946, at 49.

Despite the controversies that plagued the railroad grant program from its inception, both with the Texas Legislature's ever-changing policies, as well as disputes between the State and the railroad companies themselves, the land grant program did result in over 3,000 miles of finished railroad track by 1880, an amount that doubled in the following decade. TEX. GLO, "Hist. Pub. Lands," at 16-17. In 1882 the Legislature rescinded all land grants to railroad companies out of concern that the state's commitment to various railways had exceeded the available lands. LEOPOLD at §2.46.

The legacy of the railroad land grants lives on, not just in the tracks still crisscrossing the State, but also in the ownership of land to the present day. Even after the Texas & Pacific merged into the Missouri Pacific in 1976, the Texas Pacific Land Trust, established in 1888 in the wake of the railway's bankruptcy, remained the largest private landowner in the state of Texas, owning the surface estate of 966,392 acres at the end of 2006. *See* "Texas and Pacific Railway," HANDBOOK OF TEXAS ONLINE *available at* http://www.tsahonline.org/handbook/online/articles/eqt08 (last accessed Mar. 20, 2013).

8. STATE CAPITOL: 3,000,000 acres

The Constitution of 1876 authorized the allocation of three million acres of the public domain in West Texas to be sold to finance the construction of a new state capitol in Austin. *Id.* at §2.57. In 1879, acreage spanning ten counties in the Texas Panhandle was set aside for this purpose. *Id.* After fire destroyed the existing Texas Capitol in November 1881, a group of Chicago investors, led by brothers Charles B. and John V. Farwell and known as the Capitol Syndicate, stepped up to the plate to fund construction of the new Capitol. *Id.* Upon completion of the red granite structure in Austin in 1888, the final cost to Capitol Syndicate was $3,244,630.60. The undertaking cost them over $1.08 per acre, even though the West Texas land at the time was being sold for $0.50/acre. Despite this, the undertaking proved to be their claim to fame, at least temporarily, as they used the lands to establish the famous XIT Ranch, which was the largest fenced cattle range in the world in the 1880s. (William Elton Green, "Capitol," *Handbook of Texas Online, available at* www.tsahonline.org, last accessed Mar. 15, 2013.)

D. Support for Education

1. PERMANENT SCHOOL FUND

With the School Law of 1854, the Third Texas Legislature established the Special School Fund with over 42 million acres from the public domain and $2 million (taken out of $10 million in United States Treasury bonds that Texas received in the Compromise of 1850). The original purpose of the Special School Fund was to establish a public school system, but the Texas Legislature soon started using the principal in the fund to meet unrelated needs, such as building railroads and state prisons and purchasing weapons for the Confederacy. TEX. GLO, "Hist. Pub. Lands," at 16-18. *See generally* LEOPOLD at §§2.72-2.84. TEX. NAT. RES. CODE § 11.041.

With the upheaval of the war and Reconstruction, the issue was put on the back burner until the Act of March 18, 1873 reaffirmed that half of the remaining public domain was to be set apart for public schools, and that this was to be achieved by allocating all alternate, or even-numbered sections from grants made to railroads or other corporations, to the public school fund. This was affirmed in Art. 7, § 2 of the Constitution of 1876 which also officially renamed the school fund the Permanent School Fund (PSF) and placed strict guidelines on the fund's use. It was established as a perpetual fund for the endowment of K-12 primary education. The State's counties also received grants of land to use for the support of local public schools for which land revenues are invested by the counties. LEOPOLD at §2.82.

In 1876, Texas still faced financial woes and debt remaining from the Civil War. At the same time, a post-war influx of Southerners created an increased demand for new land. With 20 million acres of PSF land remaining and 56 million acres of unappropriated public domain still available, largely in West Texas, the legislature sought to sell the unappropriated land quickly. In 1879, they passed the "Fifty Cent Act," which established the price of fifty cents per acre for public land in 54 counties of West Texas. TEX. GLO, "Hist. Pub. Lands," at 20. Settlers could buy a maximum of four sections with residence required in most counties, or eight sections with no residence required in other counties (primarily in west Texas.) Half of the proceeds would go the PSF and the half would help to retire the public debt. TEX. CONST. OF 1876, art. VII, §2.

From 1876 until 1898, land sales and leases produced the bulk of revenue for the PSF. By the turn of the century, however, the unappropriated public domain was nearly depleted. Fewer sales and the impending oil boom meant that most of the PSF's revenue began coming from mineral leases executed on the same lands in the early 20th century. In 1900, an act was passed "to define the permanent school fund of the State of Texas, to partition the public lands between the PSF and the State and to set apart for the PSF the residue of the public domain for the benefit of public schools." Until the Legislature mandated competitive bidding in 1905, the amount of land that could be purchased, as well as the price and eligibility requirements varied considerably. *Weatherly v. Jackson*, 71 S.W.2d 259, 266 (1934). By 1905, however, there was very little left that was available for purchase.

The School Land Board (SLB) was established in 1939 by the 46th Texas Legislature to manage the sale and mineral leasing of PSF lands. The SLB has the authority to approve land sales, trades and exchanges, and the purchase of land on behalf of the PSF. It is composed of three members, with the current Land Commissioner always serving as Chairman, and two citizen members, one appointed by the Governor and the other by the Attorney General, with each serving a two-year term.

2. PERMANENT UNIVERSITY FUND

The Congress of the Republic of Texas set aside 50 leagues (221,400 acres) of land in 1839 to fund higher education. LEOPOLD at §2.72. Using this endowment and an additional $100,000 of United States Treasury bonds, the Texas Legislature passed an act in 1858 establishing the University of Texas. This act also set aside for the University one out of every ten sections of land that had been reserved for state use under the 1854 Act to Encourage the Construction of Railroads in Texas by Donations of Land. *Id.* In the Texas Constitution of 1876, the state confirmed the previous university land grants but replaced the 1/10 allotment from the railroad land with a million acres of previous unappropriated land in West Texas. In 1883, when the University of Texas opened, supporters of the school persuaded the Texas Legislature to set aside another one million acres for the endowment, also in West Texas. Skeptics considered this West Texas acreage to be of little value and a foolish decision. TEX. GLO, "Hist. Pub. Lands," at 18.

In 1895, the Legislature gave the Board of Regents exclusive control of the sale and management of university lands, including the right to set prices on such land. TEX. EDUC. CODE ANN. §§ 65.39 and 66.41(formerly, Art. 2596, VATS). Because of this, the various general Sales Acts passed after April 1895 applied only to public school and asylum lands. The same Legislature also enacted a Mineral Act perpetuating the authority of the GLO Commissioner over mineral interests allocated to the PUF. In 1901, the Texas Legislature provided for the Board of Regents of the University of Texas to conduct a mineral survey of all lands belonging to the public schools, university, asylums or the State (Acts 1901, Chapter 28) and giving the Board of Regents for the first time, exclusive control of all minerals belonging to the University, and removing the PUF from under the umbrella authority of the PSF (Acts 1901, Chapter 102). *See generally,* LEOPOLD at §§2.72-2.74.

Mineral classification of university lands took on renewed importance in 1923 when big things finally started happening on the previously maligned West Texas acreage. After many failed attempts, much pumping, and a final deadline for leasing, oil started spewing from the Santa Rita No. 1 well in Reagan County. David F. Prindle, "Oil and the Permanent University Fund: The Early Years," *Southwestern Historical Quarterly* 86 (October 1982). At long last, it was proof that the two million acres of West Texas allocated to the PUF were a rich resource after all. By 1925, production was such that the Permanent University Fund was growing by more than $2000 per day. Because the oil profits were treated as principal rather than income, the proceeds from Santa Rita and other nearby wells were reinvested in the PUF and led to a sky-rocketing endowment for the university system in Texas. Leases on oil and gas in university lands are now governed by a board known as the Board for Lease of University Lands. TEX. EDUC. CODE ANN. §§ 65.61 and 66.80. *Schendell v. Rogan*, 63 S.W. 1001 (Tex. 1901).

3. ASYLUM FUND

The 52 million acres of land appropriated for education included 407,000 acres dedicated to the support of eleemosynary schools (i.e., charity asylums that receive support from donations or gifts). LEOPOLD at §2.71. An 1856 Act granted an additional 100,000 acres of the public domain to each of four asylums, described at the time as a "lunatic asylum," a "deaf and dumb asylum," a "blind asylum," and an "orphan asylum." *Id.* Subsequent school land sales acts also applied to eleemosynary institutions, although by 1912, the State had sold all land dedicated to the support of charitable asylums. TEX. GLO, "Hist. Pub. Lands," at 18. As with the public school lands in the PSF, any asylum lands where the State reserved an interest in the minerals continue to be managed by the GLO. LEOPOLD, at §2.71.

4. THE END OF THE PUBLIC DOMAIN

The Texas Supreme Court, in its landmark 1898 decision, *Hogue v. Baker*, declared that there was no more vacant, unappropriated land in the public domain of Texas. *Hogue* at 1005. The petitioner, Hogue, a private citizen, sought to file the field notes for his pre-emption certificate at the GLO, but when he did so, it became clear that the half of the public domain not reserved for the PSF had been exhausted, giving Hogue no recourse in fulfilling his pre-emption claim. The Constitution of 1876 would not permit invading the half of the public domain reserved to the PSF for any other purpose. TEX. CONST. OF 1876, art. VII, § 2.

In the course of investigating Mr. Hogue's pre-emption claim, Land Commissioner A.J. Baker discovered that the PSF had actually not even been given the full one-half of the public domain guaranteed by the Constitution. TEX. GLO, "Hist. Pub. Lands," at 20-21. In response, Baker refused to issue any more land patents until the PSF was given all the acreage it was due. The Legislature ordered a complete audit which revealed that the PSF was short of the amount it should have had by 5,902,076.67 acres. *Id.* The State of Texas only possessed 5,884,896.40 acres of unappropriated land, which it gave to the PSF in 1900, constituting the last land grant made by the State of Texas. *Id.* To compensate for the difference in acreage, the Texas Legislature paid the PSF $17,180.27, based on an estimate of the land's value at $1 per acre. *Id.*

After 62 years of operation, the land grant systems of the Republic and the State of Texas had distributed a total of 216,314,560 acres of surface interest. *Id.* at 21. In the century ahead, Texans and the GLO would shift their focus to that which lies beneath the surface.

IV. LAND CLASSIFICATION SYSTEM & MINERAL RESERVATIONS

A. State Mineral Reservations

Somewhat surprisingly by today's standards, it was salt and not oil that first turned mineral rights into a hot-button issue in Texas. In 1840, the Republic of Texas deviated from its adoption of English common law when it retained the Spanish Crown's policy of reserving all mineral rights unto itself when conveying public land. TEX. GLO, "Hist. Pub. Lands," at 18. The State of Texas continued the same practice without incident until the Civil War when salt was in short supply. At the time, the Texas Legislature attempted to void a patent which the GLO had issued in 1847 on land in Hidalgo County containing La Sal del Rey, a large salt lake with an enormous salt deposit. *Id.* The State's actions stirred up a sufficient furor that the Constitution of 1866, the Constitution of 1869 and the Constitution of 1876 all contain provisions releasing subsoil mineral rights to the surface owners. TEX. CONST. OF 1866, art. VII, §39; TEX. CONST. OF 1869, art. IX, §9; TEX. CONST. OF 1876, art. XIV, §7 (repealed 1969).

The Texas Legislature reversed this pattern however, with the passage of various Sales Acts from 1883 to 1889, all of which had the polar opposite effect. The Sales Act of 1883 states that, "the minerals on all lands sold or leased under this Act are reserved by the State for the use of the fund to which the land now belongs." (Acts 1883, Ch. 88, §§ 3 and 88.) This paved the way for a wave of conflicting Texas legislation and judicial rulings on the subject of the State's reservation of mineral rights that took off in the late 1800s and reached a fevered pitch after the turn of the century in the wake of Spindletop.

Contrary to the Sales Acts of the 1880s, the Texas Legislature, in the Mineral Release Act of 1895, released the rights of the State to all minerals in lands granted prior to that time. REV. STAT. OF 1895, art. 4041. Ironically, in the same year, the Texas Legislature also passed The Mining Act of 1895 which provided that "all school, university, asylum and public lands containing valuable mineral deposits were reserved from sale except as provided by the Act, and an applicant for purchase was require to make an oath that there were no minerals therein." LEOPOLD at §7.11. The effect was to reserve to the State all mineral interests in the mineral classified land. LEGIS. ACTS. 1895, Ch. 127. The constitutionality of the Mineral Release Act of 1895 was questioned (although not successfully) in several law suits in subsequent decade involving mineral classified land, as well as public lands sold prior to 1895, but with an express mineral reservation. The argument was that application of the Mineral Release Act of 1895 to mineral classified lands could result in an unconstitutional relinquishment of such land to private individuals.

In 1912, the Texas Supreme Court attempted to reconcile these mixed messages in *Cox v. Robison* when it held that the constitutional relinquishment and release of mineral rights in 1876 was intended to be curative in nature and retrospective, rather than prospective, in its effect. *Cox*, 150 S.W. 1149 (Tex. 1912). The *Cox* court also recognized the constitutionality of the 1895 Mineral Release Act, a concept that was reaffirmed in 1919. *Greene v. Robinson,* 210 S.W. 498 (Tex. 1919). In 1919, the Texas Legislature also passed an Act validating the purchasers' titles to the minerals in all sales of public school, university and asylum lands made under the authority of the Acts of 1883, unless the mineral rights in those lands were specifically reserved by the State at the time of sale.

B. Land Classification System

In 1883, the Legislature created the State Land Board (not to be confused with the School Land Board established in 1939 to manage the PSF), providing for the classification, sale and lease of lands set aside for the benefit of the "School, University and Asylum Funds." In order to set a sales price, the State Land Board was directed to classify lands as agricultural, pasture, or timberland. This was the same 1883 Legislative Act which provided that, "the minerals on all lands sold or leased under this Act are reserved by the State for the use of the fund to which the land now belongs." Acts 1883, Ch. 88, §§ 3 and 88. For this reason, a *mineral* classification for

PSF lands sold for surface use was unnecessary, since the mineral interest of PSF lands was reserved to the State.

Interestingly, the internal records of the GLO contain a resolution of the State Land Board from June 1, 1886, indicating that no valid classifications were ever made by the Board under this 1883 Act. A.T. Mullins, "Classification of Texas Public Lands," at Sept. 28, 1954 (unpublished manuscript, on file with the Texas General Land Office). Not dissuaded by this lack of compliance, the Texas Legislature, in the Sales Act of 1901 (ch. 125) explicitly assigned to the Land Commissioner the duty to notify all county clerks in writing as to the classification and valuation of each section of land in the clerk's respective county. Unlike in preceding Acts, no specific classifications were enumerated, but shortly after the enactment of the Sales Act of 1901, records indicate that many tracts in Pecos and Reeves Counties were given dual classifications, and that the classifications of *mineral* and *dry grazing* started being used regularly.

Also in 1901, the Texas Supreme Court held in *Schendell v. Rogan*, that unless land classification documents contained the word *mineral*, the state did not retain mineral rights. Consequently, the state lost the mineral rights to all school land sold before 1901 – i.e., 91.4 % of state land. *Schendell*, 63 S.W. 1001, 1002, 1003 (Tex. 1901). This ruling prompted then Land Commissioner Charles Rogan to add mineral classifications to thousands of unsold tracts, thus preserving 7.4 million acres of minerals for the PSF.

The practice of dual classification of lands was later codified in the 1907 Sales Act. In that Act, the Texas Legislature provided that land classified as *mineral* might be sold for agricultural or grazing purposes as long as the application to purchase contained an express reservation of all minerals to the fund to which the public lands belong. Even though this act presupposes a mineral classification (rather than directly authorizing one), it has been considered by some to the first and only clear-cut provision in any Texas legislation to authorize the Land Commissioner to give land a double classification. MULLINS, at 10.

Between 1901 and 1919, the state sold land both with and without mineral rights, so although the year in which land was purchased can provide some guidance as to the likelihood that the State reserved minerals, even the patent itself is not reliable evidence. A.W. WALKER, "The Texas Relinquishment Act," 1ST INST. ON OIL & GAS LAW AND TAXATION 245 (1949). Patents issued by the GLO prior to 1911 commonly lacked any reference to the mineral interest, even if the subject land was classified as mineral land. MULLINS, at 9-11. Even after it became standard practice to make such notes in the following years, references to mineral rights were often inaccurate, or at least vague and ambiguous, e.g., "[m]inerals in the above described land are reserved to the State as prescribed by law," without any further information as to what the current law was. *Id.* at 35-37.

As of 1954, it had been the practice of the GLO for over 25 years, whenever faced with an ambiguity over mineral classification, to consider final and official the <u>last</u> classification noted in the Classification Records for a particular tract. *Id.* These official records remain in the GLO today, and the GLO is in the practice of providing official Mineral Certificates, upon specific request, which will verify how a specific tract is classified in official GLO records. For a more complete history of the tract, the GLO will also provide a Certificate of Facts which includes additional significant title facts, such as the original award date, the patent, any deeds of acquittance, and any current oil and gas lease information. (As of 2015, Walter Talley is the GLO staff member in the Legal Division who issues all such certificates.)

C. The Relinquishment Act Period

In 1919, the Relinquishment Act, long the subject of much confusion and consternation, forever changed the discussion of State-reserved mineral rights. The Act is perhaps most clearly explained in words taken directly from the Relinquishment Act Lands Lease Form available for download on the GLO's website: "The Relinquishment Act reserves all minerals to the State in those lands sold with a mineral classification between September 1, 1895 and June 29, 1931. Under the Relinquishment Act, the surface owner acts as the agent for the State of Texas in negotiating and executing oil and gas leases on Relinquishment Act land. The State surrenders to the surface owner one-half of any bonus, rental and royalty as compensation for acting as its agent, and in lieu of surface damages. The owner of the soil's agency power is somewhat limited, however, because the General Land Office publishes a standard Relinquishment Act lease form which must be used to lease Relinquishment Act land. Additionally, the General Land Office must approve the consideration paid for any Relinquishment Act lease and no lease is effective until it has been approved and filed in the General Land Office." TEX. NAT. RES. CODE §§ 52.171-52.185. *See* Tex. GLO, Relinquishment Act Leasing, *available at*: http://www.glo.texas.gov/what-we-do/energy-and-minerals/_documents/oilgas/permittingleasing/relinquishment-act leasing/HROW_Tracts_Guidelines.pdf.

The following phrase taken from the above text underscores a critical reason for the Texas Legislature's passage of the Relinquishment Act: "The State surrenders to the surface owner one-half of any bonus, rental and royalty as compensation for acting as its agent, and in lieu of surface damages."

With the launch of the Texas oil boom in the early 1900s, the Legislature attempted to actively encourage oil and gas exploration on its lands with acts such as the Permit and Lease Act of 1913 and subsequent amendments in 1917. Under these acts, the lessee had only to pay the surface owner ten cents per acre annually in advance during the life of the lease as compensation for any and all surface damage that might result from oil and gas operations. Because the State had reserved the entire mineral interest to itself, the surface owner would in no way benefit from any actual production on the land, and the ten cents per acre advance compensation for surface damage often proved wholly inadequate to cover actual damage. The result was such widespread and vehement resistance among landowners to oil and gas exploration, that they would often deny entry to lessees. In some parts, tensions even escalated to "threats of violence and danger of bloodshed." WALKER at 255-56.

The Texas Legislature knew that if oil and gas exploration were to continue on lands in which the State had reserved the mineral interest, the surface owners would have to share in the benefits. The Relinquishment Act was their first major step in this direction. *Id.*

Following the Act's passage in 1919, GLO patents contained a reservation of 1/16th of the minerals, leading the GLO and most attorneys in Texas to believe that 15/16ths of the minerals were relinquished to the surface owner. The Texas Supreme Court ruled to the contrary in *Greene v. Robison* in 1928 (8 S.W.2d 655, 658-659) and in *Empire Gas and Fuel Company v. State* in 1932 (47 S.W.2d 265). In *Greene*, the Court held that with regard to PSF lands sold before or after the Relinquishment Act, the surface owner acts only as the State's agent in executing an oil and gas lease, and that while the surface owner does participate equally in the royalties and bonus, the surface owner does not receive any fractional interest in the minerals. Still, this was a marked improvement from the decade prior to the Relinquishment Act.

Despite some inconsistencies in the mineral classification records at the GLO, most PSF land sold between 1901 and 1919 contained a mineral classification which effectively reserved all minerals to the State. This practice was established much more firmly in 1919, something which continued consistently until the Sales Act of 1931. As a result, from 1895-1931, approximately 6.3 million acres granted from the public domain and located mostly in West Texas and South Texas, came to be known as the "Relinquishment Act Lands."

D. Sales Act of 1931 & The Free Royalty

Beginning on May 29, 1931, the Sales Act of 1931, now codified as Section 51.011, et seq. of the Texas Natural Resources Code, changed the state's practice regarding mineral reservations in the sale of public lands. In contrast to the Relinquishment Act policies, this Act set aside a free royalty, or non-participating royalty interest (NPRI) free of all costs of production, to the State, usually $1/8^{th}$ of the sulphur and $1/16^{th}$ of the oil and gas and all other minerals, for all future sales of public land. According to the GLO, this has resulted in 855,000 acres of free royalty lands in Texas. LEOPOLD at §§7.13-7.18.

In 1937, the Texas Supreme Court affirmed that the State would bear no cost of production, sale or delivery of oil and gas under the Sales Act of 1931, and that the patentee owes the State a duty of good faith in leasing lands covered by this Act. *Wintermann v. McDonald*, 102 S.W.2d 167 (Tex. 1937). Although the patentee/landowner is not officially deemed the State's agent for leasing purposes under the 1931 Sales Act, as had been the case under the Relinquishment Act, the *Wintermann* court ruled that the effect of the landowner's good faith duty to the State, in procuring the specified free royalty, is basically the same as if the landowner were the state's leasing agent. *Id.* at §7.14.

The only significant change to the policy since the 1930s has been the 1983 enactment by the Texas Legislature of Section 51.054(a) of the Texas Natural Resources Code, permitting the SLB to set the state's free royalty at a minimum of 1/16th of oil and gas production, but allowing the State, in many cases, to negotiate an NPRI higher than 1/16th.

V. <u>THE GLO TODAY</u>

Today the GLO continues to sell PSF land under the authority of the School Land Board (SLB), although in the last century, its primary responsibility with regard to PSF land has turned to managing and leasing the minerals on the 13 million acres for which it is responsible. In May 1914, the GLO received its first royalty payment from PSF lands from an oil and gas lease on Goose Creek field in Harris County. In the nearly 100 years since that time, the PSF has received over $11 billion from oil and gas production on PSF land, all for the benefit of Texas public schools. The substantial royalties from oil and gas leases on PSF lands make the GLO one of only two state agencies that actually brings in more revenue than it spends each year.

Managing these mineral leases is one of the core functions of today's GLO. The State of Texas retains ownership of all minerals in and under mineral-classified public lands, as well as the corresponding executive rights (with the historical exceptions noted in the aforementioned sections). In 1955 the SLB increased its basic royalty on oil and gas from 1/8 to 1/6, and the Board for Lease of University Lands applied the same increase to their basic royalty on gas in 1960 and to their basic royalty on oil in 1961. By 1995, the minimum standard royalty for PSF lands was 6.25%. Currently, the GLO receives a royalty of 20 to 25 percent on most of its leases, both on and offshore. (*See generally* TEXAS GEN. LAND OFFICE, http://www.glo.texas.gov/what-we-do/energy-andminerals/oil_gas/index.html, link last accessed Mar. 28, 2013.)

A. Purchasing Public Lands: The Process

The process of buying PSF land differs from that of buying privately owned land. TEX. NAT. RES. CODE § 51.056. The SLB continues to govern the process, subject to terms established by Chapters 32 and 51 of the Texas Natural Resources Code, and the State retains ownership of all minerals and executive rights. The specific steps of the process are laid out in detail on the GLO website: http://www.glo.texas.gov/what-we-do/statelands/_documents/property-for-sale/Purchasing%20Instructions/Purchasing%20Instructions%20%20Sovereign%20Land.pdf.

1. AWARDS

The purchaser receives an *award*, a legal document recordable in county records which carries with it the same basic rights as a contract for a deed. TEX. NAT. RES. CODE § 51.066. With the award, the buyer has right to possession of the land, but not full legal title. The right to legal title vests in the buyer when he has paid the purchase price and has met any and all other terms of the sale. At that point, the buyer has the option to apply to the State of Texas for a patent, signed by both the Governor and Land Commissioner, conveying full legal title. TEX. NAT. RES. CODE § 51.241.

2. EXCESSES & DEEDS OF ACQUITTANCE

Due primarily to past surveying errors, land that has previously been patented may contain more acreage than what is specified in the title or patent. This is called an *excess*. In such cases, the landowner may apply for a *Deed of Acquittance* which allows him to purchase the excess. TEX. NAT. RES. CODE § 51.246. The SLB sets the price for this excess acreage after having the land appraised at its current value, not its value at the time the original patent was issued. For this reason, purchasing an excess can be prohibitively expensive if the original patent was obtained many decades ago on land that has since become a producing property.

If the patentee, or his assignor, does decide to purchase the excess, he must submit an application for the Deed of Acquittance along with full payment and, in most cases, corrected field notes prepared by a credentialed surveyor. In return, the GLO will execute a Deed of Acquittance to the original patentee or his assignee with the same mineral reservation (or lack thereof) contained in the original patent. Owners of excesses are liable for local taxes on land even before the State has issued a deed of acquittance, since excess land is treated as sold land – i.e., the state has already divested itself of title with the original patent. *Cockerell v. Taylor County*, 814 S.W. 2d 892 (Tex. App. – Eastland 1991, writ denied). For this reason, excess lands are not considered part of the public domain because they are not "unsold lands." LEOPOLD at §§5.20-5.21. A full application and complete instructions for purchasing an excess is accessible on the GLO website: http://www.glo.texas.gov/what-we-do/state-lands/_documents/professional-services/Ins_App_to_Purchase_Excess_Acreage.pdf

3. VACANCIES

In contrast to an excess, a *vacancy* is unsurveyed, unsold land not covered by any patent or original survey. As such, it remains part of the public domain and, therefore, belongs to the PSF under the terms of the Constitution of 1876 and the Act of February 23, 1900, granting to the PSF all unappropriated public domain remaining in the State.

Vacancies are usually located in between original surveys, and they are usually the result of surveying errors for the adjacent tracts. Potential vacancies often come to light when land is re-surveyed for other purposes, revealing a gap between two older surveys previously assumed to be contiguous. Doctrines of adverse possession do not apply, nor does the Statute of Limitations operate against the state, in cases of land vacancies. This was made clear in 1934 with *Weatherly v. Jackson*, which interpreted the Texas Legislature's intent in 1900 when it granted to the PSF all of the remaining unappropriated public domain. 71 S.W.2d 259, 265 (Tex. Com. App. 1934). The court stated that, "Land adversely possessed was not excepted. The intention was that all the public land not then disposed of should thereafter belong to the School Fund...[a]dverse possession of a part of the public domain could not serve."

To combat land-grabbing or vacancy seizures, the 46th Legislature passed an Act on June 19, 1939, setting forth the terms on which the state will lease or convey title to a discovered vacancy to a citizen applicant. In 1940, land vacancies were estimated to amount to as much as 5% of the total area of the state, most likely occurring far more frequently in portions of the state where metes and bounds legal descriptions were used (as opposed to the rectangular system of surveying used in some counties in West Texas, where gaps between surveys would be more readily apparent since land is laid out in blocks and/or townships in advance of settlement).

The GLO has the authority to determine when a vacancy exists, and the SLB has the authority to sell or lease certain property interests in the property at fair market value.

VI. CONCLUSION

Despite humble beginnings with an empty treasury and around 250 million of acres of empty land, the indomitable Texas spirit propelled her people to greatness. Although many in the United States Congress questioned whether the public domain of Texas was worth as much as the $10 million state debt prior to annexation in 1845, the discovery of Spindletop proved them wrong in 1901.

As black gold has gushed ever since across the wide expanse of Texas and her lands have become more and more valuable, it has been confirmed beyond all doubt that understanding the origins of Texas title and the land classification attached to each tract are critical components in any examination of title.

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Appendix L5. TPWD Comments

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TEXAS PARKS & WILDLIFE

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July 13, 2020

Mr. Aubrey A. Spear, P.E.

Re: 2021 Region O Llano Estacado Initially Prepared Regional Water Plan

Dear Mr. Spear:

Thank you for seeking review and comment from the Texas Parks and Wildlife Department ("TPWD") on the 2021 Initially Prepared Regional Water Plan for the Llano Estacado Regional Planning Area Region O (IPP). Thank you for the Region's responsiveness to TPWD's comments in previous planning cycles. Water impacts every aspect of TPWD's mission to manage and conserve the natural and cultural resources of Texas. Although TPWD has limited regulatory authority over the use of state waters, we are the agency charged with primary responsibility for protecting the state's fish and wildlife resources. To that end, TPWD offers these comments intended to help avoid or minimize impacts to state fish and wildlife resources.

TPWD understands that regional water planning groups are guided by 31 TAC §357 when preparing regional water plans. These water planning rules spell out requirements related to natural resource and environmental protection. Accordingly, TPWD staff reviewed the IPP with a focus on the following questions:

Does the IPP include a quantitative reporting of environmental factors including the effects on environmental water needs and habitat?
Does the IPP include a description of natural resources and threats to natural resources due to water quantity or quality problems?
Does the IPP discuss how these threats will be addressed?
Does the IPP describe how it is consistent with long-term protection of natural resources?
Does the IPP include water conservation as a water management strategy?
Does the IPP include Drought Contingency Plans?
Does the IPP recommend any stream segments be nominated as ecologically unique?
Does the IPP address concerns raised by TPWD in connection with the 2016 Water Plan.

The population of the 21 counties that comprise the Llano Estacado Regional Water Planning Area (Region O) is projected to increase from 540,495 in 2020 to 801,719 by 2070 (an increase of 48.3 percent). In contrast, annual total water demands for the region are projected to decrease from 3,367,953 acre-feet (ac-ft) in 2020 to 2,452,931 ac-ft in 2070. Irrigation accounts for 94 percent of water demands in 2020, declining to 90 percent by 2070. As compared to the 2016 Regional Plan, projected demands decreased in every decade except 2020, resulting in 2070 demands that are approximately 750,000 ac-ft less than in the previous planning cycle. Irrigation demands are expected to decline due to reduced groundwater availability, continued implementation of more water-efficient conservation practices and irrigation technologies, and conversion to dryland farming.

Water Management Strategies (WMSs) recommended to meet future needs include conservation, reuse, new reservoirs, new groundwater development including brackish groundwater, expansion of existing well fields, and expansion of surface water supply from Lake Alan Henry. Water conservation, the most environmentally benign WMS, is projected to provide 115,256 ac-ft/year of water savings by 2070. TPWD supports the LERWPG's recognition of conservation as a primary

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opportunity to meet projected water needs and understands that many water users across all sectors are already implementing significant conservation practices.

A description of the region's natural resources is located in Chapter 1, the Planning Area Description, Section 7 of the IPP. The narrative provides a clear picture of the prominent natural features within the Llano Estacado Region. These include a description of aquifer resources and four active springs, surface water resources within four river basins, regional physiography, soil contents, vegetation including native grasslands, wildlife resources and playa lakes. TPWD appreciates the detailed description of the importance of playa lakes, arguably the most significant ecological feature in the Texas High Plains. Wildlife resources identified on page 1.7.2 and in Table 1.17 lists 16 wildlife species as endangered, threatened or rare. Please be aware of recent updates (March 30, 2020) to the list of federal and state listed species and Species of Greatest Conservation need, including species in Region O counties. We recommend that the IPP draft be updated with the latest information available at:

https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/nongame/listed-species/.

Information pointing to the relevance of playa lakes continues to be appreciated. In addition to their biological importance as wetlands, playas are a valuable mechanism that can be used to encourage aquifer recharge. TPWD supports the protection and restoration of playa lakes to improve habitat and enhance local aquifers.

Water-related threats due mainly to water quality and quantity concerns are identified in Chapter 1 Section 9 of the IPP. Improper management practices have disturbed playa lakes, raised sedimentation levels of surface water resources, altered water quality due to pesticide and fertilizer runoff, and modified native wetland vegetation. The spread of invasive species including salt cedar, juniper, zebra mussels and golden algae continue to be a concern. The zebra mussel is an invasive freshwater mollusk that could affect water management by clogging intake structures and fouling pipelines, resulting in increased maintenance needs and potentially hazardous conditions for workers. Golden algae blooms are known to produce toxins that affect organisms that have gills: all types of fish, freshwater mussels and clams, and the gill-breathing juvenile stage of frogs and other amphibians. Due to environmental concerns regarding the North Fork Scalping Operation (5.3) in which discharging stormwater from the North Fork into Lake Alan Henry could encourage golden algae growth, consultation with the TPWD Golden Alga Task Force is recommended to identify further strategies to avoid, minimize, and mitigate the effects of golden alga. As noted within the water management strategy summary, the federally listed Sharpnose and Smalleye Shiner have been found along this reach of the North Fork and could potentially be impacted by the diversion lake. The potential transport of invasive species falls under Parks and Wildlife Code §66.007 and §66.0072. To prevent the transmission of invasive species TPWD recommends avoiding transport of water from water bodies where these species are known to occur, including rivers downstream of infested lakes.

Environmental factors were considered as part of the overall evaluation of water management strategies. A summary of this evaluation can be found in Chapter 6 of the IPP. While the 2021 plan reviewed environmental information from site-specific studies, a quantitative impact analysis was not performed. Chapter 6 section 5 of the plan states that "Water management strategies have the potential of impacting instream flows. For the 2021 plan, recommended water management strategies 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." Due to the lack of quantitative reporting and analysis of environmental factors, TPWD is unable to substantiate the IPP claims of "minimal to no cumulative adverse effect" on water needs and habitat. TPWD encourages Region O to improve the quantitative impact analysis as environmental information for each WMS becomes available and to prioritize management strategies using a quantifiable gradient of least impactful measures for implementation. The TPWD 2016 IPP response letter noted that the plan included a good review of existing and historical springs and seeps. The letter also requested that potential impacts to spring flows and spring ecosystems should be identified where continued groundwater depletion and additional groundwater development are identified as water management strategies. The 2021 IPP lists 17 groundwater management strategies. However, impacts to spring flow and spring ecosystems are not identified.

Threats to natural resources are addressed in Chapter 5 of the IPP. Each WMS presented includes a discussion of environmental factors and potential impacts associated with project implementation. The chapter also includes deliberation of water quality concerns and a table of wildlife species that could be impacted by the proposed strategies. Surface water management, reuse, water conservation, and groundwater development were presented in the IPP as opportunities to meet future water needs. Chapter 6 of the IPP provides evidence of consistency with resource protection based on outlined guidance. TPWD recognizes that the IPP was developed using the principle that the described water quality and related water uses reported within the management plan should only be improved or maintained. Planning models were employed to ensure desired future conditions within groundwater and minimal impacts to streamflow. Throughout planning and evaluation, the LERWPG remained mindful of groundwater-surface water interactions when managing water resources and TAC Chapter 358 – State Water Planning Guidelines were used to ensure consistency with protection of water resources, agricultural resources, and natural resources. Conservation and reuse will also aid in the long-term protection of natural resources. However, environmental impacts due to infrastructure development and increased effluent pose a significant threat. To support a claim of consistent long-term protection further evidence of natural resource considerations would be helpful.

TPWD continues to have concerns previously expressed in IPP review comment letters regarding the Jim Bertram Lake 7, Post Reservoir, and other similar surface water strategies. TPWD supports further study and coordination of species protection with State and Federal agencies in the early stages of project planning for both reservoir projects and recommends careful attention to the resulting impacts on water quality, wetland habitat, flow regime and river fragmentation that may jeopardize the aquatic and terrestrial environment of the North Fork Double Mountain Fork watershed.

Groundwater development strategies include infrastructure expansion, brackish desalination and interregional Aquifer Storage and Recovery efforts associated with CRMWA. Consultation with TPWD is recommended for all desalination projects to ensure brine disposal regulations are closely followed. Further coordination with State and Federal agencies is also recommended to mitigate the potential alteration of water quality and subsequent impacts to aquatic and terrestrial ecosystems.

Within Chapter 5, sections 5.28 through 5.33 are devoted entirely to water conservation practices. TPWD commends LERWP in stating that municipal water conservation practices are designed to achieve the State of Texas Water Conservation Task Force target recommendation of 140 gallons per person per day (gpcd). Twenty-two municipal Best Management Practices (BMPs) are recommended within the IPP (5.29.1) and six well-designed irrigation conservation measures are recommended for all 21 counties within the Region. Industrial water conservation guidelines within the plan propose “a voluntary target reduction of 1 percent by 2020, 3 percent by 2030, and 5 percent from 2040-2070” (5.31.2). Livestock BMPs include rainwater harvesting and land conservation. Current conservation strategies reported within the IPP (5.33) and supported by the Region are also applauded as prominent actions in water conservation leadership.

The regional Drought Contingency Plan (DCP) is located in Chapter 7 of the IPP. The LERWPG states that "in the Llano Estacado Region, drought planning is a way of life as opposed to being a contingency plan" (1.3.2). TPWD recognizes the effort made to compile stage, trigger and response information for the Region and agrees that avoiding and mitigating risks and impacts associated with drought are an important planning factor. However, water conservation should be viewed as a long-term practice to reduce consumption conversely separate from drought management which should be the temporary reduction of water use in direct response to a water supply emergency.

The nomination of ecologically unique stream segments is an opportunity to demonstrate a regional commitment towards the long-term protection of natural resources. TPWD appreciates the invitation to address the LERWPG at its June 2019 meeting to discuss stream segments within the Region identified by TPWD as meeting the criteria of having "unique ecological value". These segments include portions of the Prairie Dog Town Fork Red River, the North Prong Little Red River, and the South Prong Little Red River. A review of the criteria for designation is outlined in Chapter 8 section 1 of the IPP. However, it is disappointing to note that the LERWPG has chosen not to designate any stream segments as having unique ecological value. TPWD appreciates the time taken by the planning group to review stream segments for nomination and would be happy to provide further consultation and assistance in this matter.

If you have any questions, or if we can be of any assistance, please contact me at 512-389-8715 or Cindy.Loeffler@TPWD.Texas.gov. Thank you.

Sincerely,

Cindy Loeffler

Cindy Loeffler, P.E., Chief

Water Resources Branch

CL:lc

Cc: John Clayton, Inland Fisheries Division, TPWD

Appendix L6. Protect Water Rights Coalition Comments

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From: l_stukey@sptc.net <l_stukey@sptc.net>
Sent: Monday, July 13, 2020 4:57 PM
To: Gyn Samples <Gsamples@spag.org>
Subject: LERWPG public comment

Public Comment for the IPP by LERWPG
From: Protect Water Rights Coalition

We object to the LERWPG IPP's assertion that "The LERWPG no longer supports the concept of justifiable long-term water table decline by any stakeholder or user group. for the reason that the Water Code cannot support such a drastic action.

Parts of the Water Code were passed to protect our preexisting rights. However, due to competing lobbying efforts some, if not much, of the water code is not consistent with the protection of our rights.

But other fundamental law and statutes also protect our federal civil rights such as 18 USC sec. 241, 242 and 42 USC sec. 1983 (passed in 1871 to prevent involuntary servitude prohibited by the Thirteenth Amendment)

In the land patents, the state made a contract, a social compact with each purchaser of "all right, title and interest" of the state which includes groundwater, just as it includes all oil and gas unless specifically reserved by the land patent......... in perpetuity thereby making the affirmative duty of the state (which includes TCEQ, TWDB, TPWD and all other parts of the state) to protect our rights. Any circumvention of the laws that protect our private property rights are unlawful.

We also object to the omission in LERWPG's IPP of surface water importation as a potential source for public water supply.

In looking back at the LERWPG plan submitted to the TWDB in 2001, one can see the great potential for a surface water importation plan. With the advancements in large diameter pipeline technology and the potential use of excess wind energy as a power source for the lift stations, it seems this should be included as part of the 2021 plan. This would benefit some of those regions that could be harmed by flooding in times of excess rain and could be a potential PWS source for this region, as well as other regions in the state in times of drought. As seen below, this would also appear to be aligned with the original intent of the citizens of Texas when passing the 1917 Conservation Amendment concerning state owned water.

FULL REPORT:

Hon. F. O. Fuller,

Speaker of the House of Representatives,

Sir:-

Your Committee on Constitutional Amendments to which was referred [redacted] S. J. R. No. 12, we have considered the same, and I am directed to report it with the recommendation that it do pass. This resolution, providing for a constitutional amendment, is the same as [redacted] H. J. R. No. 23. ~~The identical resolution~~ [redacted] The Senate amended the Resolution slightly, and your House committee concurs in this amendment.

This proposed constitutional amendment declares the conservation and preservation of all natural resources of the State, public rights and duties; and the Legislature is authorized to enact all laws deemed necessary to carry the purposes of the amendment into effect.

The plan of improvement contemplated by the amendment is for the creation by the Legislature of conservation and reclamation districts of such size and following such lines as have coordinate interests in the storing of surface waters, of irrigation, of flood control, of drainage, and other like developement measures. Existing methods of dealing with reclamation and conservation work are wholly inadequate to meet the necessities of the State in dealing with ~~the grave~~ problems of such gravity. [redacted]

Thanks,
Protect Water Rights Coalition