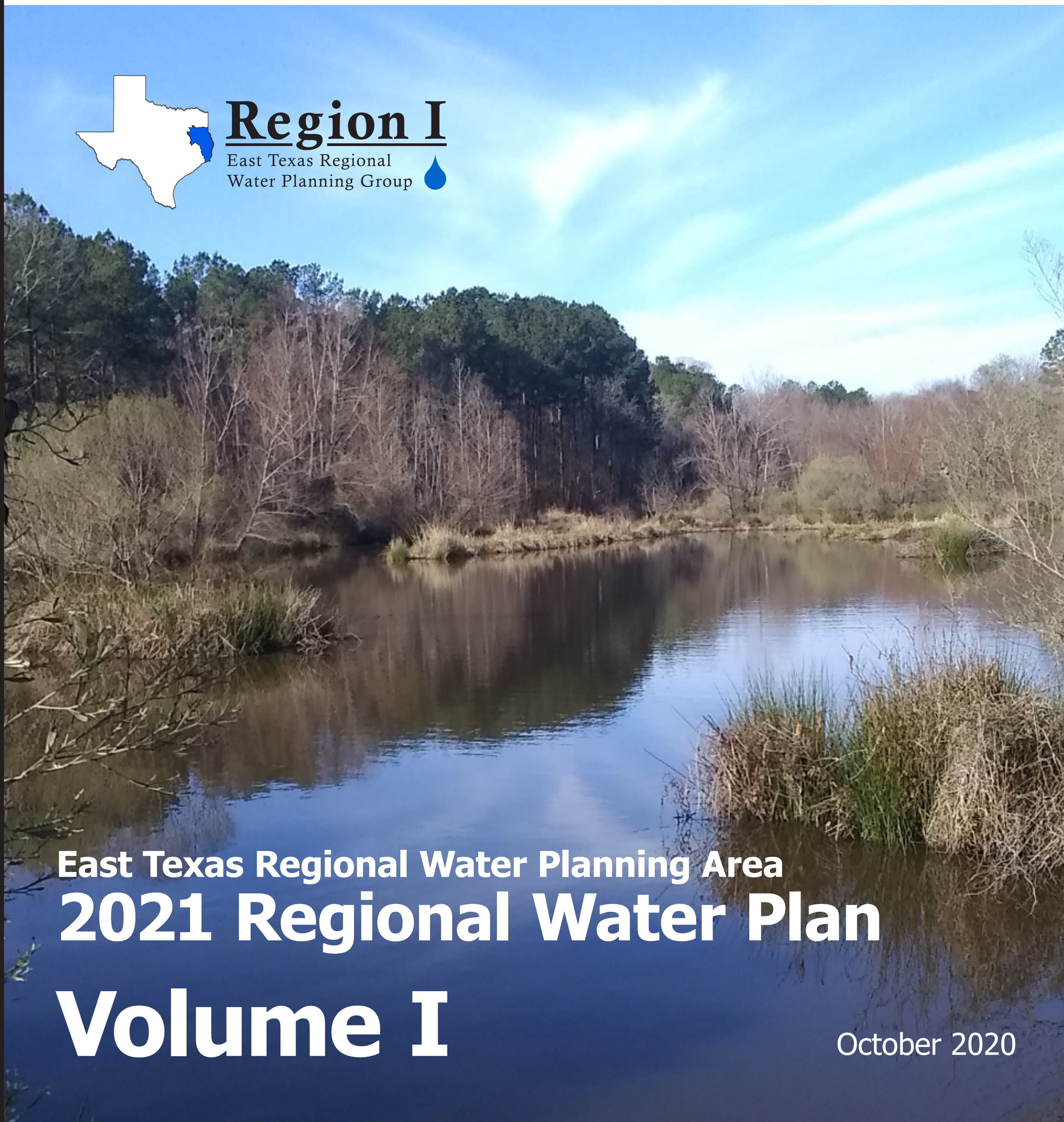

Region I
East Texas Regional Water Planning Group

East Texas Regional Water Planning Area

2021 Regional Water Plan

Volume I

October 2020

PLUMMER

WSP

FREESE AND NICHOLS

Region I Planning Group Voting Members

Region I
East Texas Regional
Water Planning Group

Executive Committee Members

Kelley Holcomb – Chair, River Authorities

David Brock – 1st Vice Chair, Municipalities

Josh David – 2nd Vice Chair, Agriculture

John Martin – Secretary, GMA-14

David Montagne – Assistant Secretary, River Authorities

David Alders – At-Large, Agriculture

Mark Dunn – At-Large, Small Business

Interest Group Members

Judge Chris Davis – Counties

Roger Fussell – Water Utilities

Stevan Gelwicks – Public

David M. Gorsich – Industries

Scott Hall – River Authorities

Fred Jackson – Counties

Matthew McBroom, PhD – Environmental

John McFarland – GMA-11

Gregory M. Morgan, P.E. – Municipalities

Monty Shank – River Authorities

Darla Smith – Industries

Randy Stanton – Electric Power

Terry D. Stelly – Public

Region I Planning Group Consulting Team

Region I
East Texas Regional
Water Planning Group

Rex Hunt, PE – Plummer Associates, Inc.

Cynthia A. Syvarth, PE – Plummer Associates, Inc.

Dexter F. May, PE – Plummer Associates, Inc.

Reza Malek, PhD – Plummer Associates, Inc.

Cody McCann, EIT – Plummer Associates, Inc.

Spandana Tummuri, PhD, PE – Freese and Nichols, Inc.

Jordan Skipwith, EIT – Freese and Nichols, Inc.

James Beach, PG – WSP

Volume I

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List of Abbreviations and Acronyms

°F	degrees Fahrenheit
µg/L	micrograms per liter
2011 Plan	2011 East Texas Regional Water Plan
2016 Plan	2016 East Texas Regional Water Plan
2021 IPP	2021 East Texas Initially Prepared Plan
2021 Plan	2021 East Texas Regional Water Plan
ac-ft/yr	acre-feet per year
amsl	annual mean sea level
AMWA	Athens Municipal Water Authority
AN WCID#1	Angelina-Nacogdoches Water Control & Improvement District No. 1
ANRA	Angelina and Neches River Authority
AWWA	American Water Works Association
bgl	below ground level
BMP	Best Management Practices
CCN	Certificate of Convenience and Necessity
cfs	cubic feet per second
CRP	Texas Clean Rivers Program
CWA	Clean Water Act
DB22	2022 Regional Water Planning Application Web Interface
DCP	drought contingency plan
DFC	desired future condition
EDAP	Economically Distressed Areas Program
EIS	environmental impact study
ES	Executive Summary
ETRWPA	East Texas Regional Water Planning Area, or Region I
ETRWPG	East Texas Regional Water Planning Group
GAM	groundwater availability model
GCD	groundwater conservation district

GMA	groundwater management areas
gpcd	gallons per capita per day
gpm	gallons per minute
HB 1763	2005 Texas House Bill 1763
HCWCID #1	Houston County Water Control & Improvement District No. 1
IBT	Inter-Basin Transfer
IFR	Infrastructure Financing Report
IPP	Initially Prepared Plan
IWA	International Water Association
LNG	liquid natural gas
LNVA	Lower Neches Valley Authority
MAG	modeled available groundwater
mg/L	milligrams per liter
MGD	million gallons per day
MSA	Metropolitan Statistical Area
msl	mean sea level
MUD	municipal utility district
MWA	municipal water authority
MWD	municipal water district
MWP	major water provider
NEPA	National Environmental Policy Act
No.	number
NRCS	National Resources Conservation Service
PCFWSD No. 1	Panola County Freshwater Supply District No. 1
pCi/L	picocuries per liter
PHDI	Palmer Hydrological Drought Index
ppm	parts per million
ppt	parts per thousand
RWP	Regional Water Plan
RWPG	Regional Water Planning Group
SB 1	1997 Texas Legislature Senate Bill 1
SB 2	2001 Texas Legislature Senate Bill 2
SB 3	2007 Texas Legislature Senate Bill 3
SDWA	Safe Drinking Water Act
SFA	Stephen F. Austin State University
SRA	Sabine River Authority of Texas
STATSGO	State Soil Geographic Database
SUD	special utility district
SWIFT	State Water Implementation Fund for Texas
SWP	State Water Plan
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TCRP	Texas Clean Rivers Program
TDS	total dissolved solids
TDSHS	Texas Department of State Health Services
THC	Texas Historical Commission
TIFP	Texas Instream Flow Program
TMDL	total maximum daily load
TPWD	Texas Parks and Wildlife Department
TRA	Trinity River Authority

TSDC	Texas State Data Center
TTWP	Trans-Texas Water Program
TWC	Texas Workforce Commission
TWDB	Texas Water Development Board
TXBCD	Texas Biological and Conservation Data System
UNRMWA	Upper Neches River Municipal Water Authority
USACE	United States Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWCD	underground water conservation district
WAM	Water Availability Model
WCID	water control & improvement district
WCITF	Water Conservation Implementation Task Force
WIF	Water Infrastructure Fund
WMA	wildlife management area
WMS	water management strategy
WSC	water supply corporation
WTP	water treatment plant
WUG	water user group
WWP	wholesale water provider

List of Water Measurement Conversions

1 ac-ft	=	325,851 gallons
1 cfs	=	448.8 gpm
1 liter per second	=	15.85 gpm
1 MGD	=	1,120 ac-ft per year
1 MGD	=	694.444 gpm

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Executive Summary

In 1997, the State Legislature, through Senate Bill 1, determined that water planning should be accomplished at a regional level rather than with the centralized approach employed previously by the Texas Water Development Board (TWDB). To accomplish this task, the TWDB divided the state into 16 regional water planning areas and appointed representational Regional Water Planning Groups (RWPGs) to guide the development of each region's plan. The TWDB guides the process for each cycle of planning through rules and guidance by the agency. The planning process is cyclic, with updated Regional Water Plans and State Water Plans produced every five years.

The designated water planning area for the east and southeast portions of Texas is the East Texas Regional Water Planning Area (ETRWPA), also known as Region I or the East Texas Region. The water planning process in the ETRWPA is guided by the East Texas Regional Water Planning Group (ETRWPG). These individuals are charged with the responsibility for development of the 2021 ETRWPA Water Plan (2021 Plan). The ETRWPG is currently comprised of the following voting members representing specific community interests:

- David Alders, Agriculture
- Josh David, Agriculture
- Judge Chris Davis, Counties
- Fred Jackson, Counties
- Randy Stanton, Electric Power
- Dr. Matthew McBroom, Environmental
- John McFarland, Groundwater Management Areas
- John Martin, Groundwater Management Areas
- Darla Smith, Industries
- David Gorsich, Industries
- David Brock, Municipalities
- Gregory M. Morgan, Municipalities
- Stevan Gelwicks, Public
- Terry Stelly, Public
- David Montagne, River Authorities
- Monty Shank, River Authorities
- Kelley Holcomb, River Authorities
- Scott Hall, River Authorities
- Mark Dunn, Small Business
- Worth Whitehead*, Water Districts
- Roger Fussell, Water Utilities

**Mr. Whitehead retired from the ETRWPG prior to final plan approval.*

The regional water planning process involves the evaluation of Texas Water Development Board projected water demands, identification of water supplies, and development of water management strategies designed to meet identified water shortages. However, the process also involves the evaluation of a broad range of issues that directly relate to water planning. Some of these issues notably include protection of natural resources and agricultural resources, water conservation and drought contingency, and water management strategy quantity, reliability, and cost.

Regional water planning in the ETRWPA is a public process, involving frequent public meetings of the ETRWPG, careful consideration of the requests and needs of various water user groups and wholesale water providers in the region, and an understanding of the need to allow for public comment throughout the planning cycle. For an in-depth discussion of any of the topics addressed in this Executive Summary, the reader is referred to the full 2021 Plan. An electronic copy of the 2021 Plan is available online at the ETRWPA website: http://www.etexwaterplan.org/ and at the TWDB website: http://twdb.state.tx.us.

ES.1 REGIONAL DESCRIPTION

The ETRWPA consists of all or portions, as indicated, of the following 20 counties located in the Neches, Sabine, and Trinity River Basins, and the Neches-Trinity Coastal Basin:

- Anderson
- Angelina
- Cherokee
- Hardin
- Henderson (partial)
- Houston
- Jasper
- Jefferson
- Nacogdoches
- Newton
- Orange
- Panola
- Polk (partial)
- Rusk
- Sabine
- San Augustine
- Shelby
- Smith (partial)
- Trinity (partial)
- Tyler

The region extends from the southeastern corner of the state for over 150 miles north and northwest as illustrated in Figure ES.1. The ETRWPA consists of approximately 10,329,800 acres of land, accounting for roughly six percent of the total area of the State of Texas.

Much of the ETRWPA is forested, supporting various types of timber industry. Plant nurseries are common in portions of the region. Oil production is scattered through the region, and beef cattle are prominent. Poultry production and processing are prevalent and there is diverse manufacturing in addition to timber industries. Commercial fishing is an important economic characteristic of Sabine Lake. Tourism is important in many areas, especially on and around large reservoirs, Sabine Lake, and the Gulf of Mexico. Timbered areas include a number of state parks and national forests, etc., that offer recreational and hunting opportunities.

Agriculture is a vital component of the ETRWPA economy and culture. According to the United States Department of Agriculture, the 20 counties that make up the ETRWPA contain over 21,000 farms with a total of over 3.6 million acres of cropland [1].

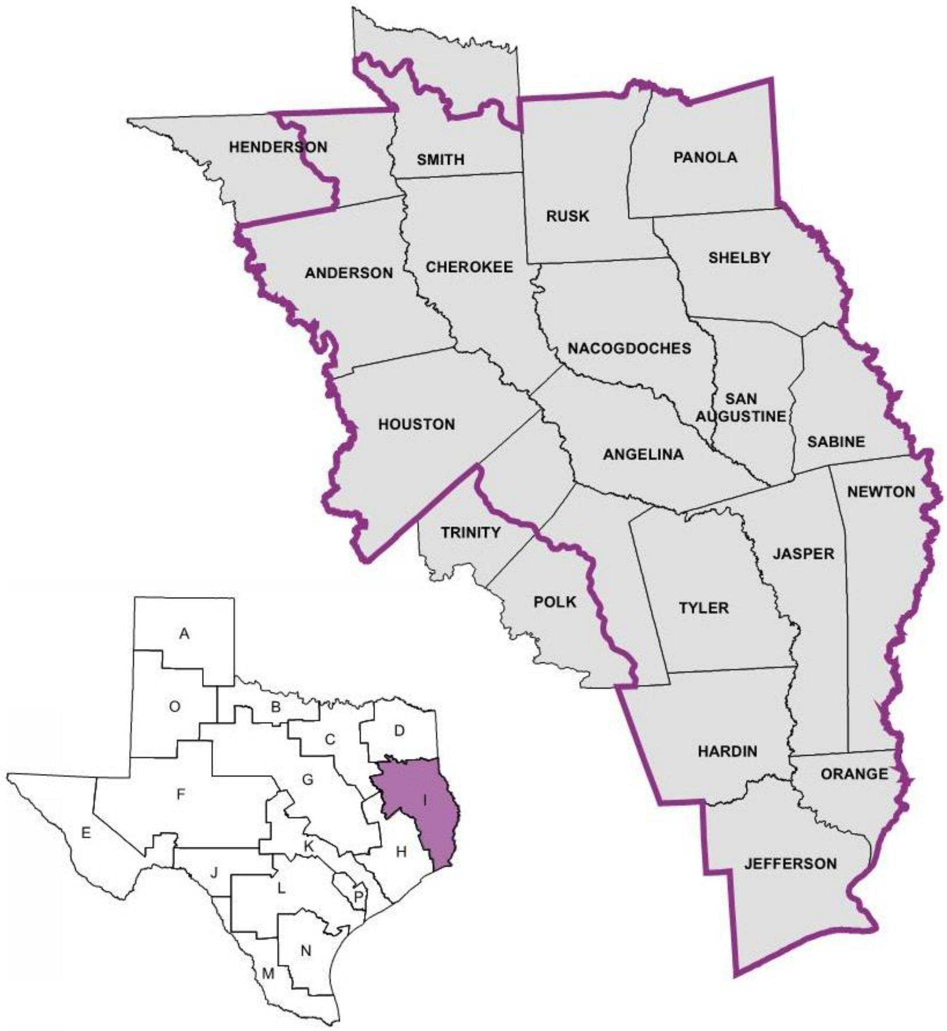

Figure ES.1 Region I Reference Map

SOURCE: TEXAS WATER DEVELOPMENT BOARD

ES.2 COUNTY SUMMARY SHEETS

Following the Executive Summary is a section with a summary sheet for each county in the ETRWPA. Each sheet includes the water-dependent economy, water sources, population projections, demand projections, available supply summary, and Recommended Water Management Strategies for the county.

ES.3 REGIONAL WATER PLANNING APPLICATION

The State Water Planning Database (DB22) is an online database created by the Texas Water Development Board (TWDB). RWPGs submit all data generated during the planning cycle to the TWDB through the DB22's web interface. Once data is entered into the DB22 by each RWPG, the data can be queried to generate various summary reports referred to as DB22 Reports. The following 25 DB22 Reports are required by the TWDB to be included in this Executive Summary and can be found in Volume II of the 2021 Plan as Appendix ES-A.

County Summary Sheets

The following includes a summary sheet for each county in the East Texas Regional Water Planning Area. Each sheet includes the water-dependent economy, water sources, population projections, demand projections, available supply summary, and Recommended Water Management Strategies for the county.

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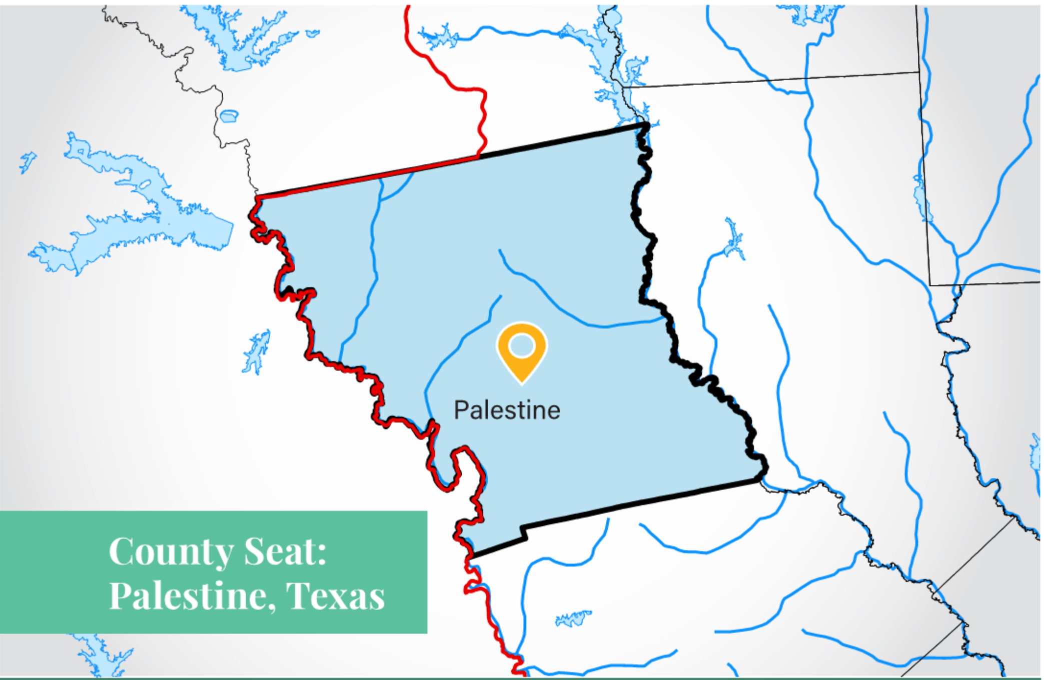
Anderson County



County Seat: Palestine, Texas

Anderson County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Lance Gooden

Your State Senator:
Robert Nichols

Your State Representative:
Cody Harris

Your County Judge:
Robert D. Johnston

Your East Texas Regional Water Planning Group Member(s):
John McFarland (GMA 11),
Monty Shank

Your Municipal Water Users:

- Anderson County Cedar Creek WSC
- BBS WSC
- BCY WSC
- Brushy Creek WSC
- Elkhart
- Four Pines WSC
- Frankston
- Frankston Rural WSC
- Neches WSC
- Norwood WSC
- Palestine
- Pleasant Springs WSC
- Slocum WSC
- TDCJ Beto Gurney & Powledge Units
- TDCJ Coffield Michael
- The Consolidated WSC
- Tucker Water Supply
- Walston Springs WSC

Your Water-Dependent Economy:

Livestock
Oil & Gas Production
Recreation

Your Water Sources:

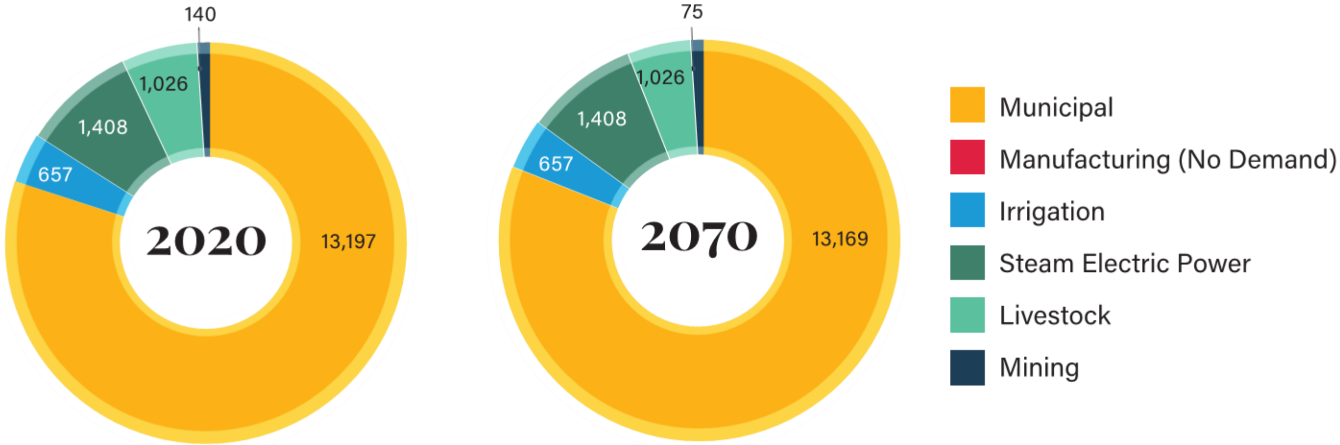
Groundwater Wells
Lake Palestine
Local Supplies
Neches River
Trinity River

Projected Growth

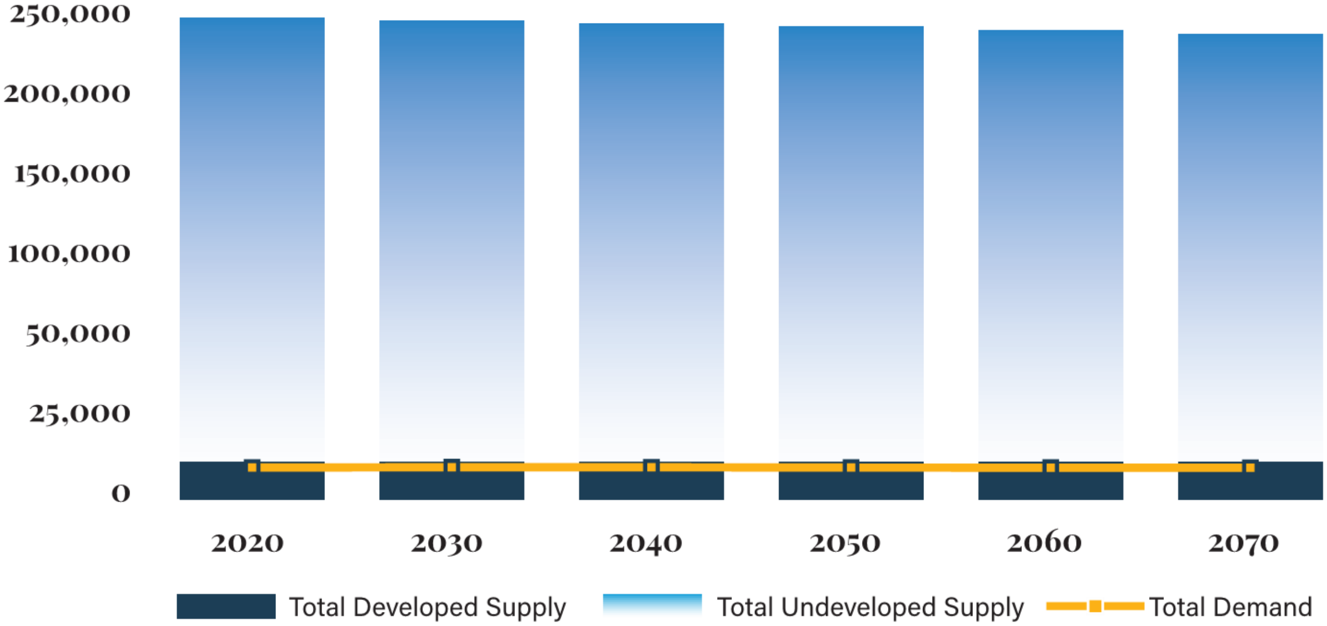
per TWDB Population Projections

2020	61,016
2030	63,017
2040	63,746
2050	63,746
2060	63,746
2070	63,746

Your County Water Demand (acre-feet)



Your Available Water Supply (ac-ft/yr)



Anderson County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Municipal	–	No Water Shortage Identified
Manufacturing	–	No Demand Projected
Irrigation	–	No Water Shortage Identified
Livestock	–	No Water Shortage Identified
Mining	–	No Water Shortage Identified
Steam Electric Power	–	No Water Shortage Identified

Angelina County

County Seat:
Lufkin, Texas

Angelina County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Louie Gohmert

Your State Senator:
Robert Nichols

Your State Representative:
Trent Ashby

Your County Judge:
Don Lymbery

Your East Texas Regional Water Planning Group Member(s):
Kelley Holcomb, John McFarland (GMA 11), Mark Dunn

Your Municipal Water Users:

- Angelina WSC
- Central WCID of Angelina County
- Diboll
- Four Way SUD
- Hudson WSC
- Huntington
- Lufkin
- M&M WSC
- Pollok-Redtown WSC
- Redland WSC
- Upper Jasper County Water Authority
- Woodlawn WSC
- Zavalla

Your Water-Dependent Economy:

- Agriculture
- Industry
- Recreation
- Timber

Your Water Sources:

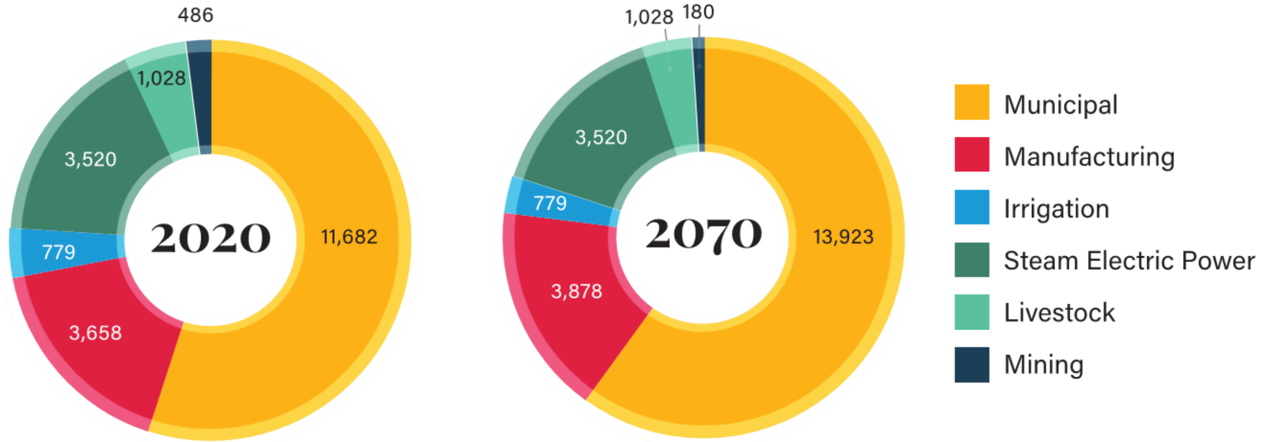
- Lake Kurth
- Local Supplies
- Neches River
- Sparta Aquifer

Projected Growth

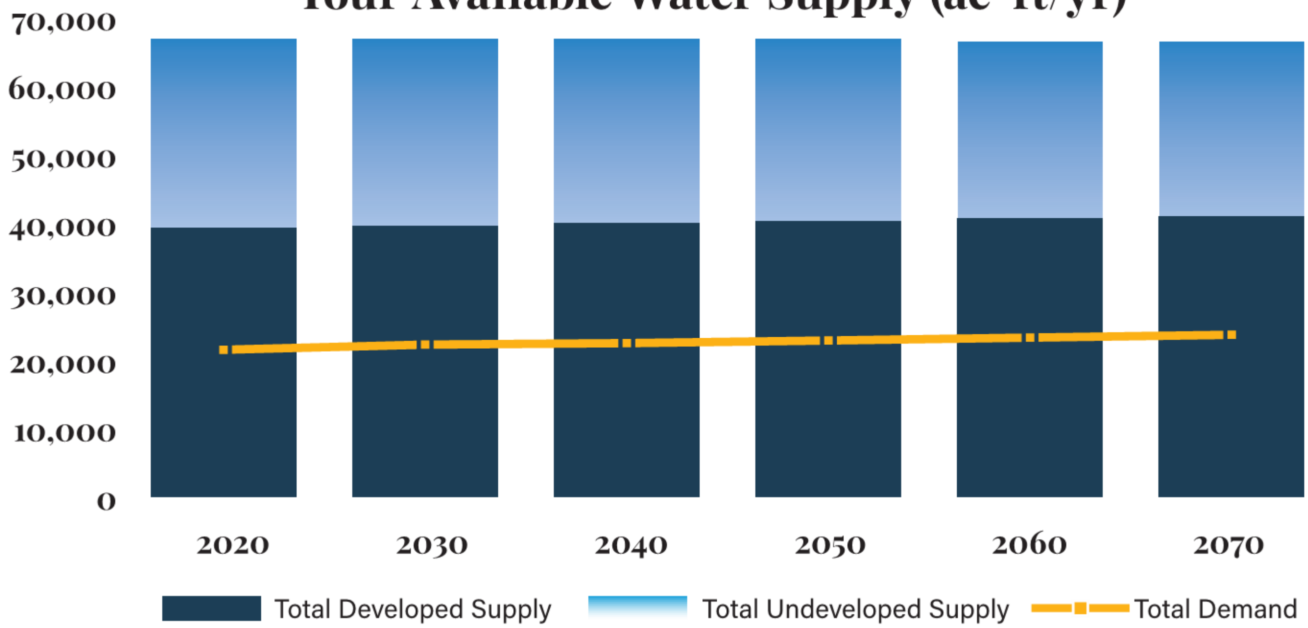
per TWDB Population Projections

2020	93,316
2030	99,848
2040	105,329
2050	110,332
2060	114,808
2070	118,772

Your County Water Demand (acre-feet)



Your Available Water Supply (ac-ft/yr)



Angelina County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Municipal	–	No Water Shortage Identified
Manufacturing	2020	Purchase Additional Supply from Lufkin
Irrigation	–	No Water Shortage Identified
Steam Electric Power	–	No Water Shortage Identified
Livestock	–	No Water Shortage Identified
Mining	2020	Purchase Additional Supply from ANRA

Cherokee County

County Seat: Rusk, Texas

Cherokee County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Lance Gooden

Your State Senator:
Robert Nichols

Your State Representative:
Travis Clardy

Your County Judge:
Chris Davis

Your East Texas Regional Water Planning Group Member(s):
Chris Davis, David Brock, John McFarland (GMA 11)

Your Municipal Water Users:

- Afton Grove WSC
- Alto
- Alto Rural WSC
- Blackjack WSC
- Bullard
- Craft Turney WSC
- Gum Creek WSC
- Jacksonville
- New Summerfield
- North Cherokee WSC
- Pollok-Redtown WSC
- Rusk
- Rusk Rural WSC
- South Rusk County WSC
- Southern Utilities
- Troup
- Wells
- West Jacksonville WSC
- Wright City WSC

Your Water-Dependent Economy:

Agriculture
Oil & Gas Production
Timber

Your Water Sources:

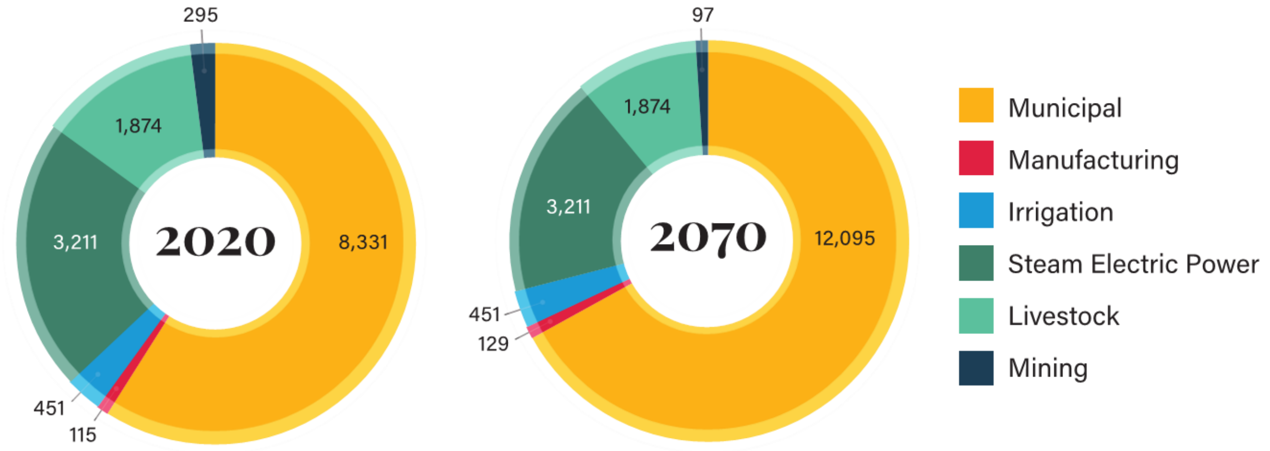
Lake Jacksonville
Rusk City Lake
Neches River
Local Supplies

Projected Growth

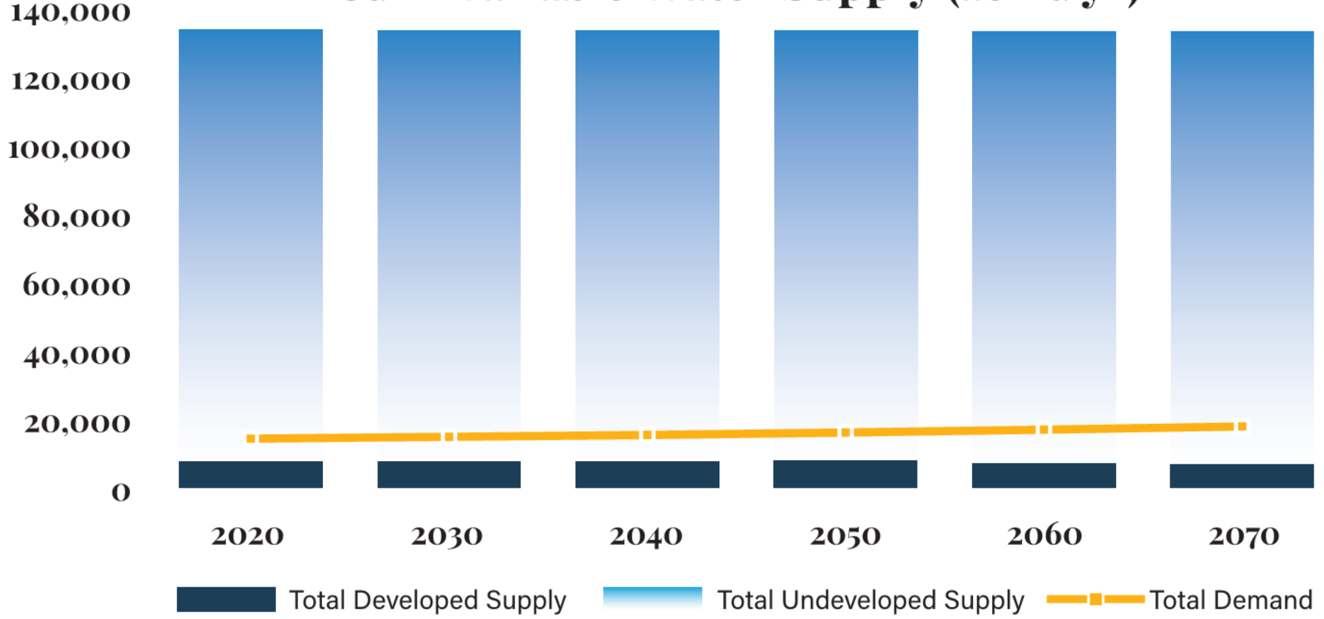
per TWDB Population Projections

2020	55,634
2030	61,005
2040	66,277
2050	72,560
2060	79,148
2070	86,269

Your County Water Demand (acre-feet)



Your Available Water Supply (ac-ft/yr)

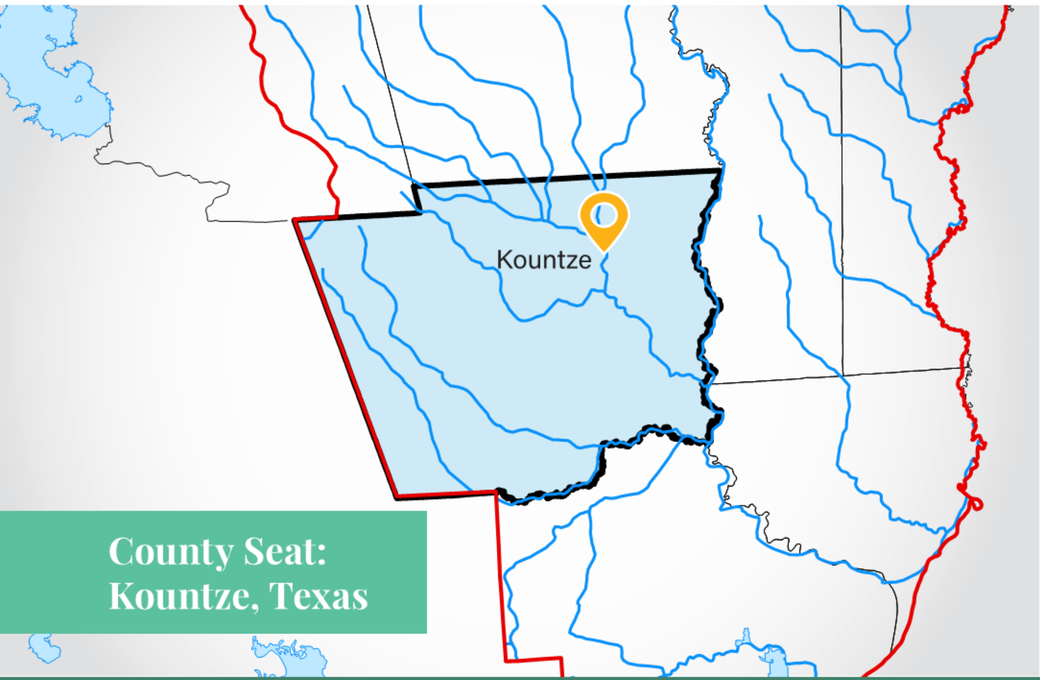


Cherokee County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Alto Rural WSC	2050	Additional Wells in Carrizo Aquifer, Municipal Conservation
Rusk	2070	Additional Wells in Carrizo Aquifer, Municipal Conservation
Wright City WSC	2050	Additional Wells in Carrizo Aquifer
Manufacturing	–	No Water Shortage Identified
Irrigation	–	No Water Shortage Identified
Steam Electric Power	–	No Water Shortage Identified
Livestock	–	No Water Shortage Identified
Mining	2020	Purchase Additional Supply from ANRA

Hardin County

The East Texas Water Planning Area (Region I)



County Seat: Kountze, Texas

Hardin County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Brian Babin

Your State Senator:
Robert Nichols

Your State Representative:
James White

Your County Judge:
Wayne McDaniel

Your East Texas Regional Water Planning Group Member(s):
John McFarland (GMA 11),
Roger Fussell

Your Municipal Water Users:
- Hardin County WCID 1
- Kountze
- Lake Livingston Water Supply Corp.
- Lumberton MUD
- North Hardin WSC
- Silsbee
- Sour Lake
- West Hardin WSC
- Wildwood POA

Your Water-Dependent Economy:
Industry
Oil & Gas Production
Timber

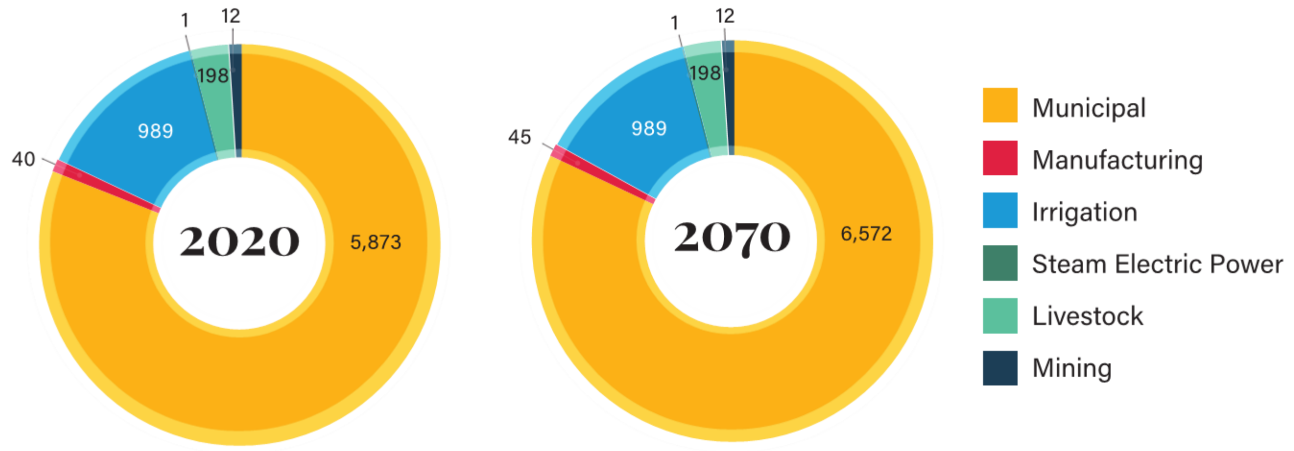
Your Water Sources:
Groundwater Wells
Local Supplies
Neches River

Projected Growth

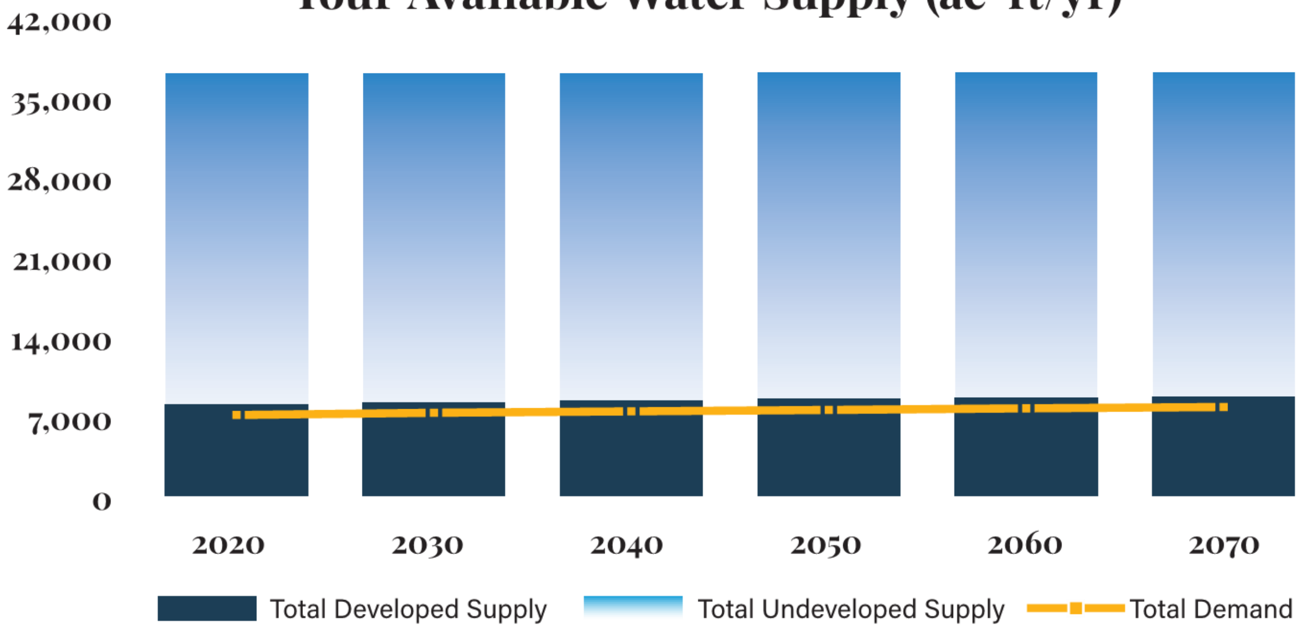
per TWDB Population Projections

2020	59,477
2030	63,986
2040	67,194
2050	69,560
2060	71,410
2070	72,798

Your County Water Demand (acre-feet)



Your Available Water Supply (ac-ft/yr)



Hardin County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Municipal	–	No Water Shortage Identified
Manufacturing	–	No Water Shortage Identified
Irrigation	–	No Water Shortage Identified
Steam Electric Power	–	No Water Shortage Identified
Livestock	–	No Water Shortage Identified
Mining	–	No Water Shortage Identified

Henderson County

County Seat: Athens, Texas

This county is split between more than one TWDB regional water planning area. The projections shown in these summary sheets represent data for the portion of the county that falls within the East Texas Regional Water Planning Area.

Henderson County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Jeb Hensarling

Your State Senator:
Robert Nichols

Your State Representatives:
Keith Bell, John Wray

Your County Judge:
Wade McKinney

Your East Texas Regional Water Planning Group Member(s):
John McFarland (GMA 11),
Monty Shank

Your Municipal Water Users:

- Athens
- Berryville
- Bethel Ash WSC
- Brownsboro
- Brushy Creek WSC
- Caney City
- Chandler
- Coffee City
- East Cedar Creek FWSD
- Enchanted Oaks
- Eustace
- Frankston
- Gun Barrel City
- Log Cabin
- Malakoff
- Moore Station
- Murchison
- Payne Springs
- Poynor
- R P M WSC
- Seven Points
- Star Harbor
- Tool
- Trinidad
- Virginia Hill WSC
- West Cedar Creek MUD City

Your Water-Dependent Economy:

Livestock
Oil & Gas Production
Recreation

Your Water Sources:

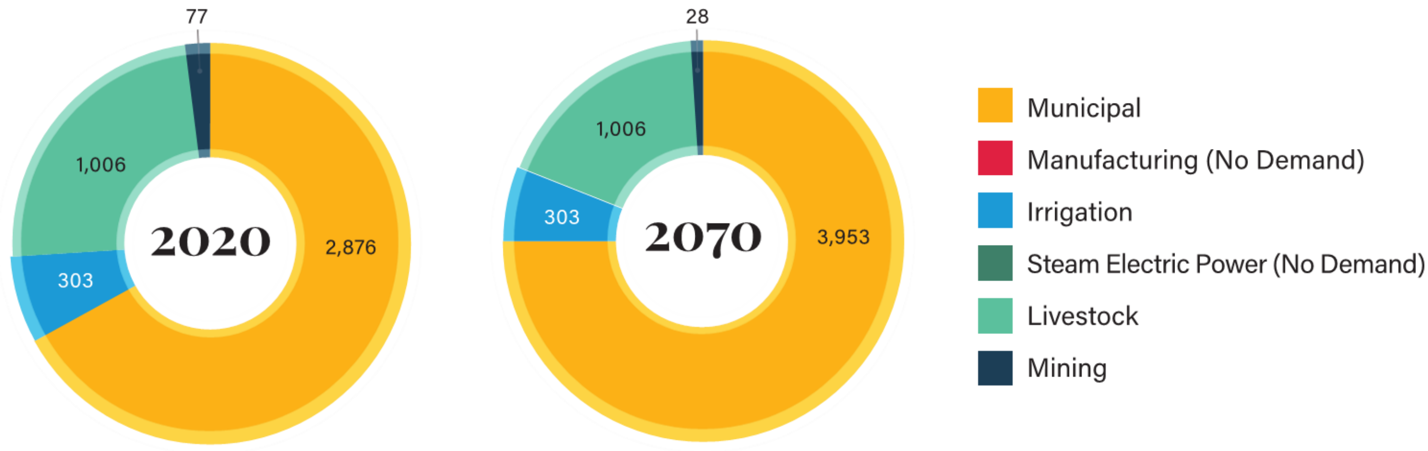
Groundwater Wells
Lake Athens
Lake Cherokee
Lake Palestine
Local Supplies

Projected Growth

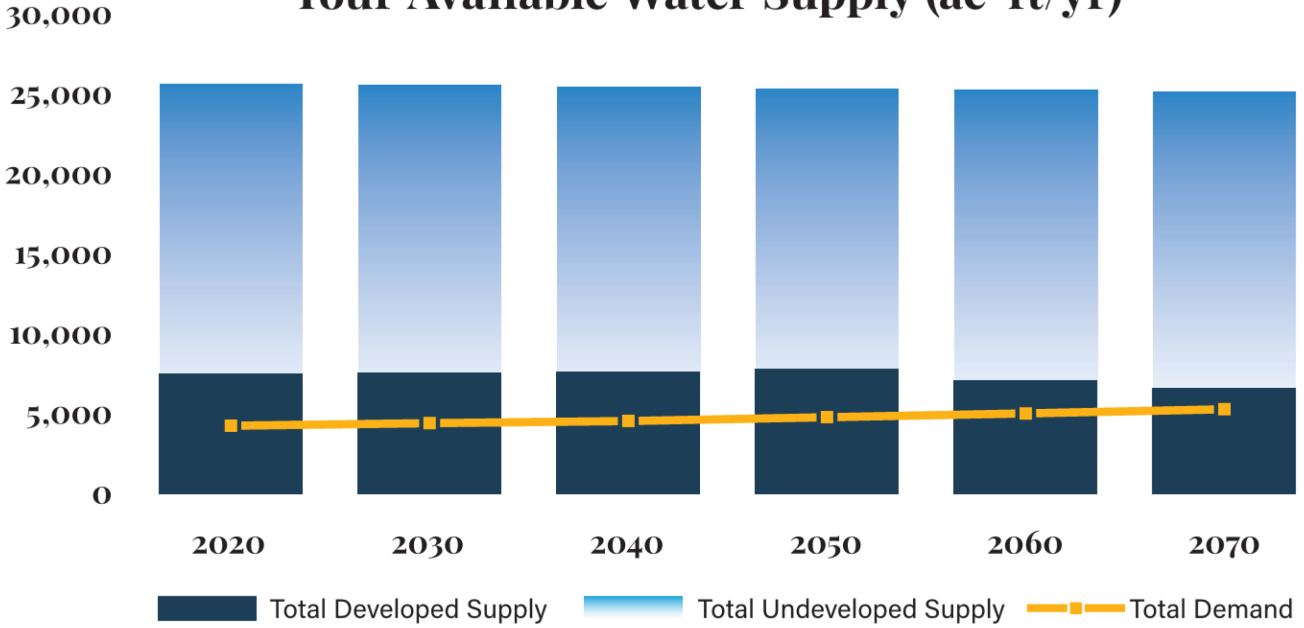
per TWDB Population Projections

2020	24,804
2030	26,644
2040	28,177
2050	30,199
2060	31,948
2070	33,644

Your County Water Demand (acre-feet)



Your Available Water Supply (ac-ft/yr)

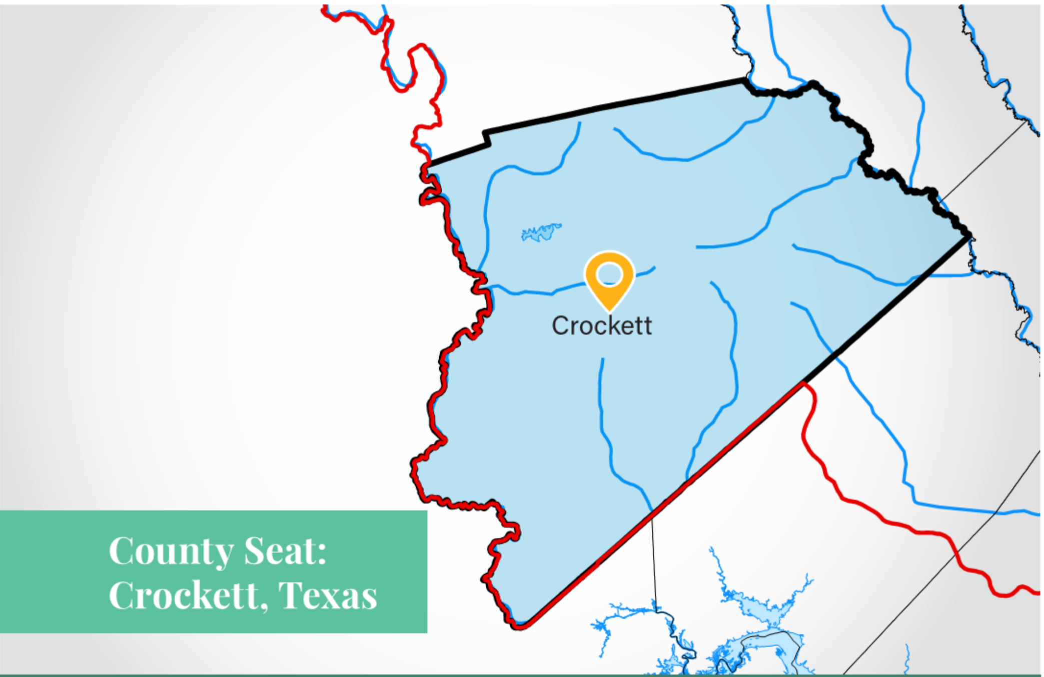


Henderson County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Athens	2020	Athens MWA Groundwater Wells, Municipal Conservation
Edom WSC	2020	Additional Wells in Carrizo Aquifer
Chandler	2070	Additional Wells in Carrizo Aquifer, Municipal Conservation
Moore Station WSC	2060	Additional Wells in Carrizo Aquifer
RPM WSC	2030	Additional Wells in Carrizo Aquifer
Manufacturing	–	No Demand Projected
Irrigation	2020	Additional Wells in Carrizo Aquifer
Steam Electric Power	–	No Demand Projected
Livestock	–	No Water Shortage Identified
Mining	2020	Additional Wells in Carrizo Aquifer

Houston County

The East Texas Water Planning Area (Region I)



County Seat: Crockett, Texas

Houston County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Kevin Brady

Your State Senator:
Robert Nichols

Your State Representative:
Trent Ashby

Your County Judge:
Jim L. Lovell

Your East Texas Regional Water Planning Group Member(s):
John McFarland (GMA 11)

Your Municipal Water Users:
- Crockett
- Grapeland
- Lovelady
- Pennington WSC
- TDCJ Eastham Unit
- The Consolidated WSC

Your Water-Dependent Economy:

Agriculture
Livestock
Oil & Gas Production

Your Water Sources:

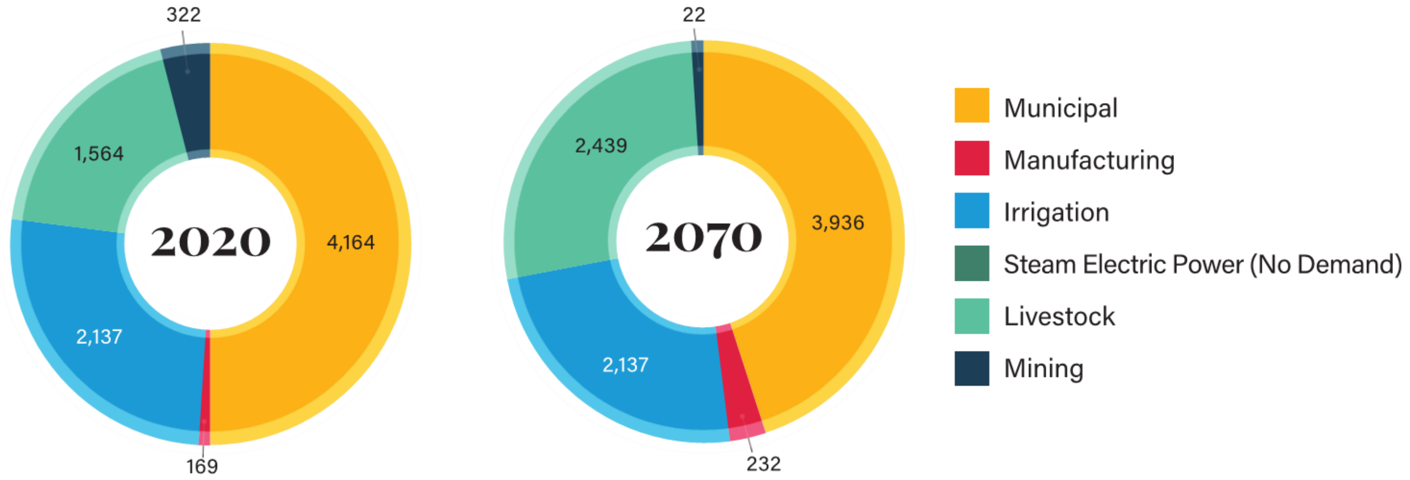
Houston County Lake
Local Supplies
Neches River
Trinity River

Projected Growth

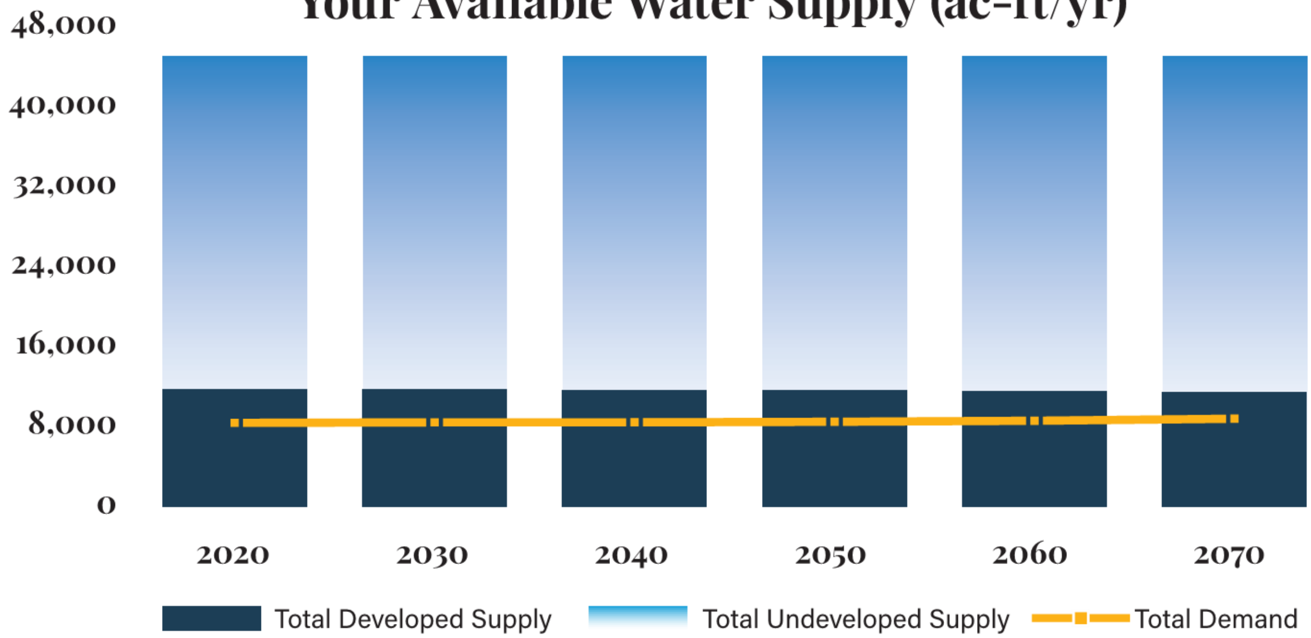
per TWDB Population Projections

2020	24,151
2030	24,260
2040	24,260
2050	24,260
2060	24,260
2070	24,260

Your County Water Demand (acre-feet)



Your Available Water Supply (ac-ft/yr)

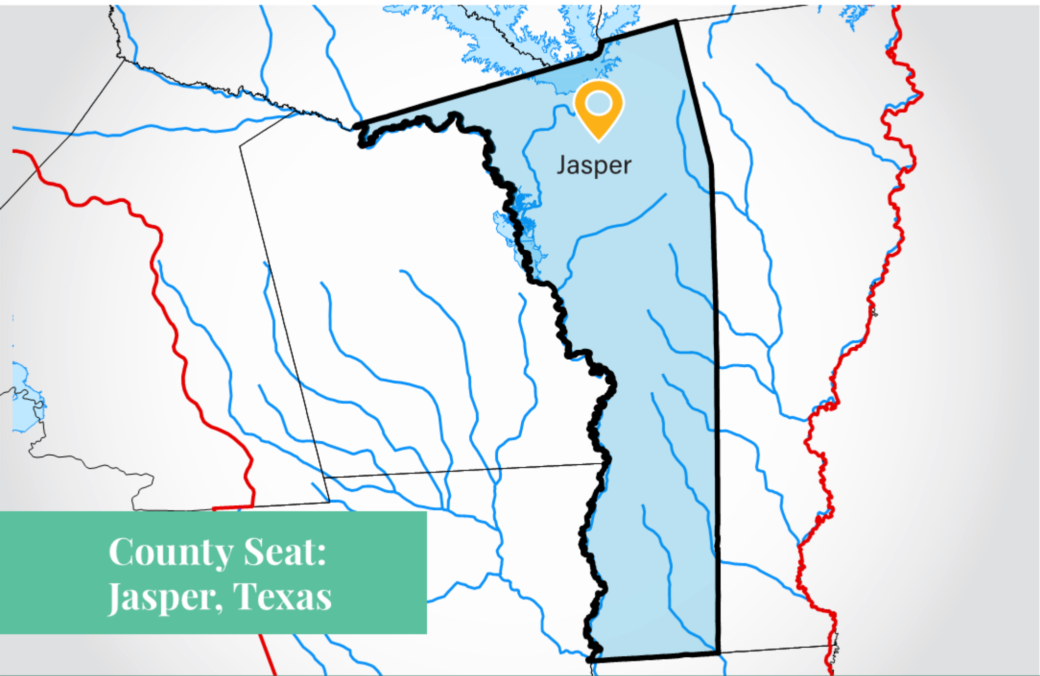


Houston County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Municipal	-	No Water Shortage Identified
Manufacturing	-	No Water Shortage Identified
Irrigation	-	No Water Shortage Identified
Steam Electric Power	-	No Demand Projected
Livestock	2070	Additional Wells in Yegua-Jackson Aquifer
Mining	-	No Water Shortage Identified

Jasper County

The East Texas Water Planning Area (Region I)



County Seat:
Jasper, Texas

Jasper County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Brian Babin

Your State Senator:
Robert Nichols

Your State Representative:
James White

Your County Judge:
Mark Allen

Your East Texas Regional Water Planning Group Member(s):
John Martin (GMA 14)

Your Municipal Water Users:
- Brookeland FWSD
- Jasper
- Jasper County WCID 1
- Kirbyville
- Mauriceville SUD
- Rayburn Country MUD
- Rural WSC
- South Jasper County Rural WSC
- Upper Jasper County Water Authority

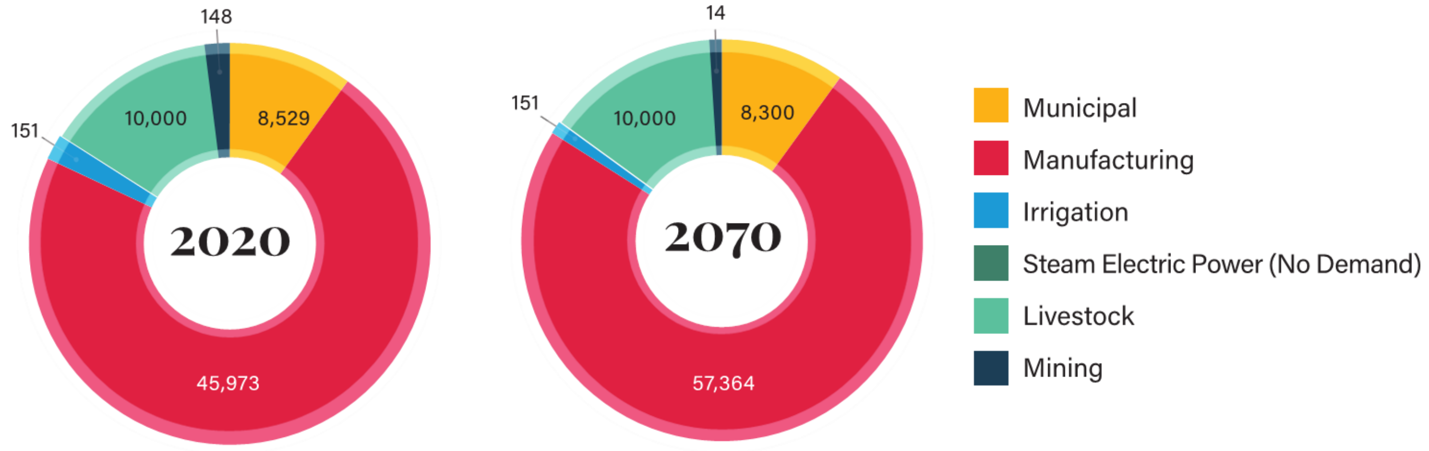
Your Water-Dependent Economy:
- Agriculture
- Timber

Your Water Sources:
- BA Steinhagen Lake
- Groundwater Wells
- Local Supplies
- Neches River

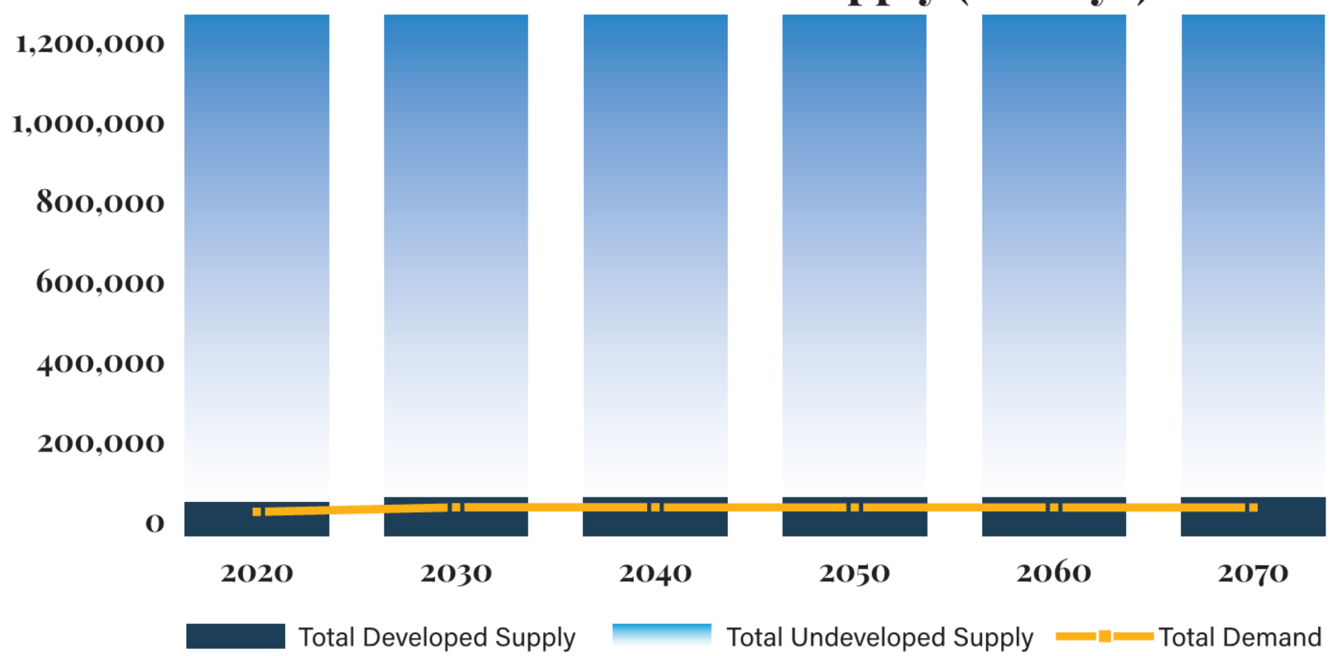
Projected Growth
per TWDB Population Projections

2020	36,878
2030	37,695
2040	37,849
2050	37,849
2060	37,849
2070	37,849

Your County Water Demand (acre-feet)



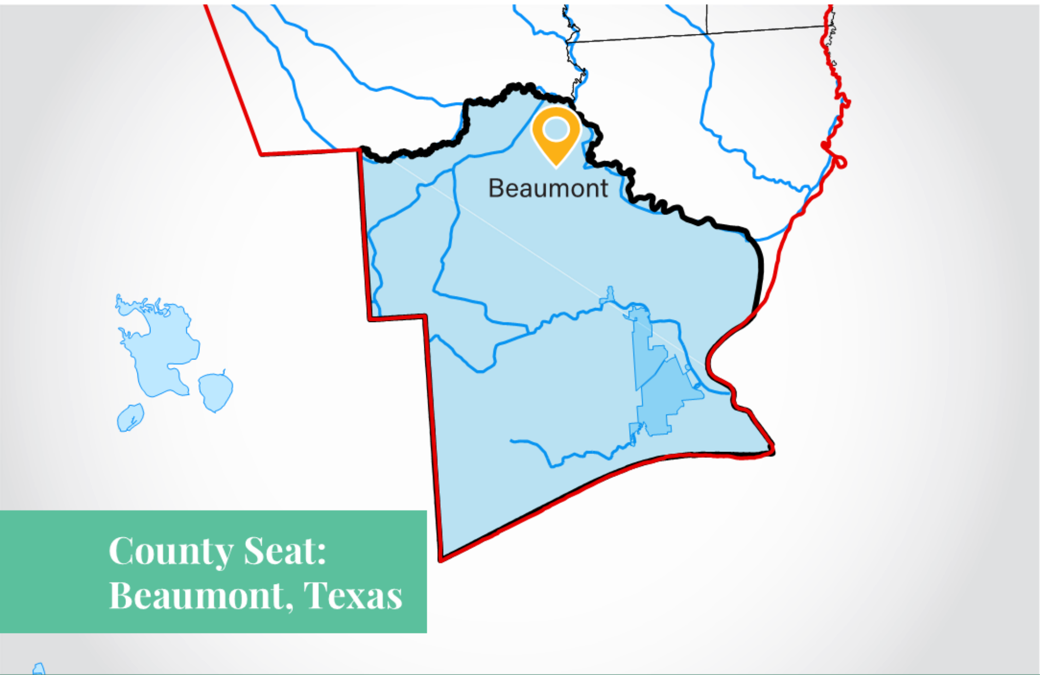
Your Available Water Supply (ac-ft/yr)



Jasper County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Municipal	–	No Water Shortage Identified
Manufacturing	–	No Water Shortage Identified
Irrigation	–	No Water Shortage Identified
Steam Electric Power	–	No Demand Projected
Livestock	2020	Purchase from LNVA (Sam Rayburn)
Mining	–	No Water Shortage Identified

Jefferson County



County Seat: Beaumont, Texas

Jefferson County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Randy Weber

Your State Senator:
Brandon Creighton

Your State Representatives:
Dade Phelan, Joe D. Deshotel

Your County Judge:
Jeff Branick

Your East Texas Regional Water Planning Group Member(s):
David M. Gorsich, Randy Stanton, Darla Smith, Fred L. Jackson, John Martin (GMA 14), Scott Hall, Terry D. Stelly

Your Municipal Water Users:
- Beaumont
- Bevil Oaks
- China
- Groves
- Jefferson County WCID 10
- Meeker MWD
- Nederland
- Port Arthur
- Port Neches
- West Jefferson County MWD

Your Water-Dependent Economy:
- Agriculture
- Education
- Industry
- Recreation

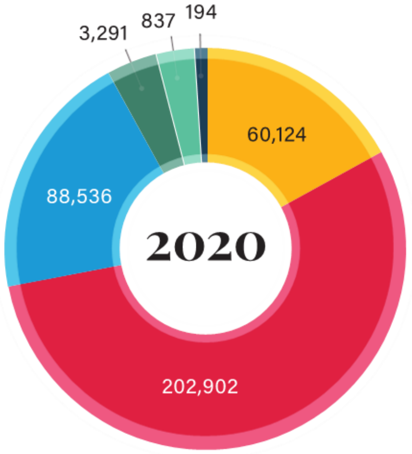
Your Water Sources:
- BA Steinhagen Lake
- Indirect Reuse
- Local Supplies
- Neches River
- Neches-Trinity River

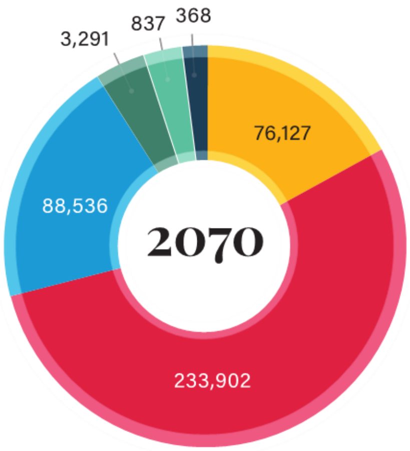
Projected Growth

per TWDB Population Projections

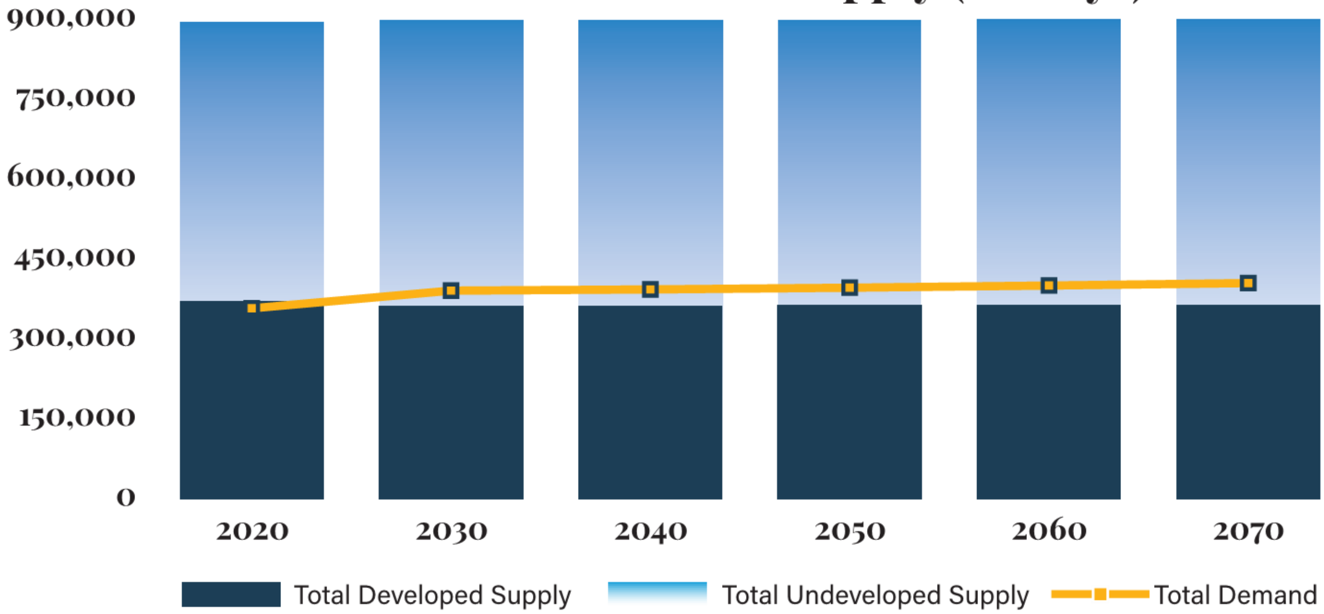
2020	267,379
2030	284,620
2040	302,744
2050	323,802
2060	347,030
2070	373,041

Your County Water Demand (acre-feet)





Your Available Water Supply (ac-ft/yr)



Jefferson County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Beaumont	2040	Purchase Additional Supply from LNVA, Municipal Conservation
County-Other	2060	Purchase Additional Supply from LNVA, Municipal Conservation
Manufacturing	2020	Purchase Additional Supply from LNVA
Irrigation	–	No Water Shortage Identified
Steam Electric Power	2020	Purchase Additional Supply from LNVA
Livestock	–	No Water Shortage Identified
Mining	–	No Water Shortage Identified

Nacogdoches County

The East Texas Water Planning Area (Region I)

County Seat: Nacogdoches, Texas

Nacogdoches County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Louie Gohmert

Your State Senator:
Robert Nichols

Your State Representative:
Travis Clardy

Your County Judge:
Greg Sowell

Your East Texas Regional Water Planning Group Member(s):
Matthew McBroom, John McFarland (GMA 11), David Alders

Municipal Water Users:

- Appleby WSC
- Caro WSC
- Cushing
- D & M WSC
- Etoile WSC
- Garrison
- Lilly Grove SUD
- Melrose WSC
- Nacogdoches
- Swift WSC
- Woden WSC

Your Water-Dependent Economy:

- Agriculture
- Education
- Livestock
- Timber

Your Water Sources:

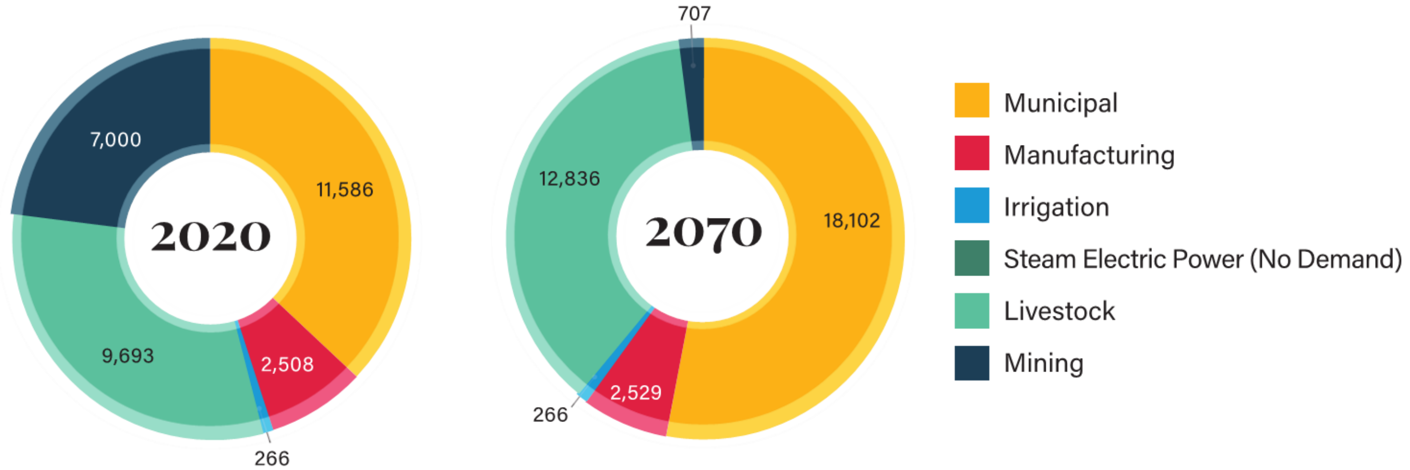
- Lake Nacogdoches
- Local Supplies
- Neches River

Projected Growth

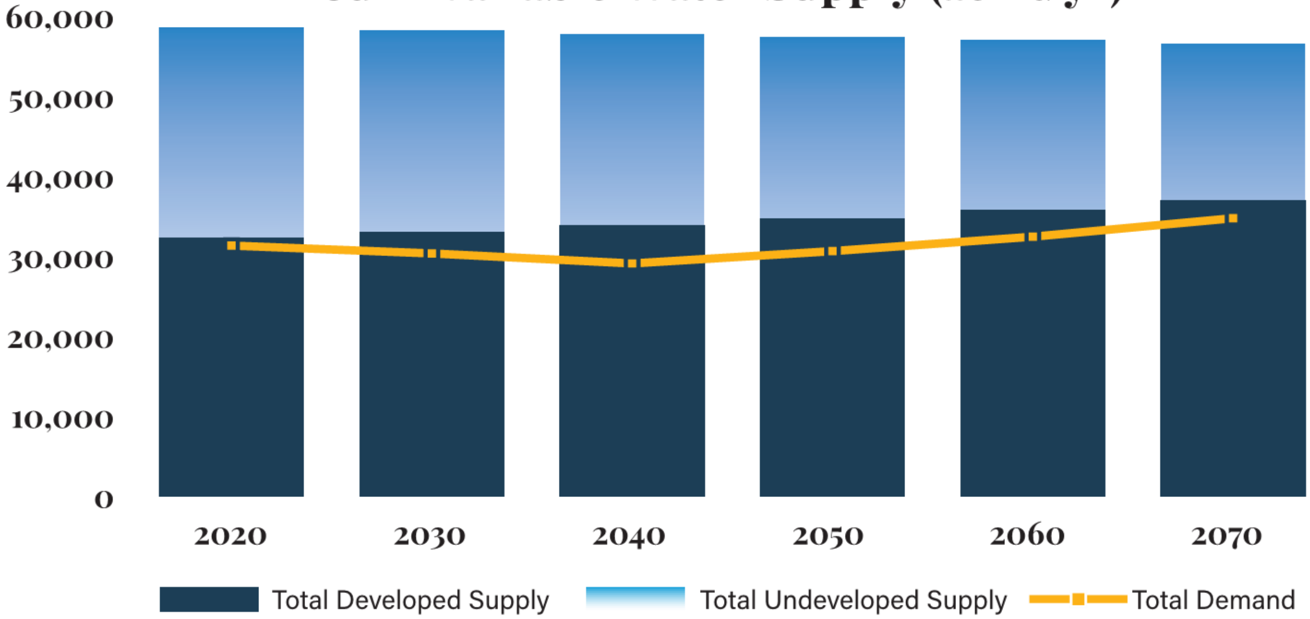
per TWDB Population Projections

2020	72,136
2030	81,040
2040	89,815
2050	99,155
2060	109,035
2070	119,364

Your County Water Demand (acre-feet)



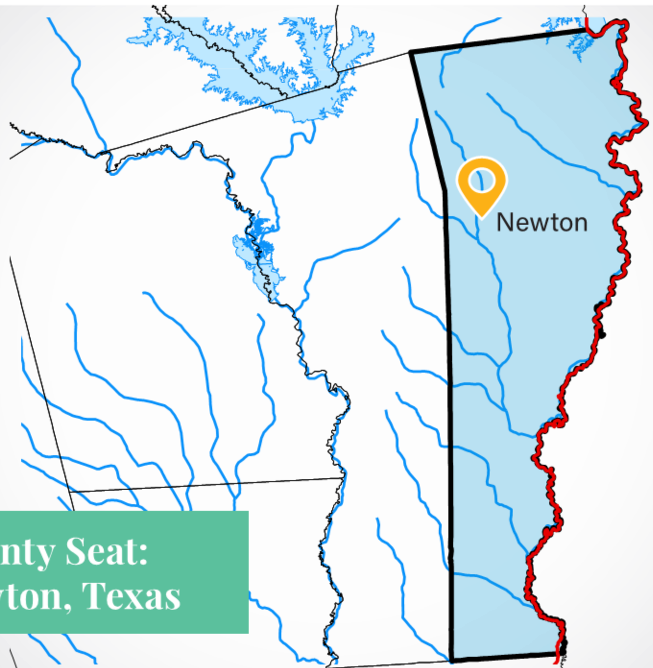
Your Available Water Supply (ac-ft/yr)



Nacogdoches County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Cushing	2060	Municipal Conservation
D & M WSC	2040	Additional Wells in Carrizo Aquifer
Manufacturing	–	No Water Shortage Identified
Irrigation	–	No Water Shortage Identified
Steam Electric Power	–	No Demand Projected
Livestock	2020	Additional Wells in Carrizo Aquifer
Mining	2020	Purchase Additional Supply from ANRA

Newton County



County Seat: Newton, Texas

Newton County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Brian Babin

Your State Senator:
Robert Nichols

Your State Representative:
Kenneth Weeks

Your County Judge:
John Stevens

Your East Texas Regional Water Planning Group Member(s):
John Martin (GMA 14)

Municipal Water Users:
- Brookeland FWSD
- Mauriceville SUD
- Newton
- South Newton WSC

Your Water-Dependent Economy:
Recreation
Timber

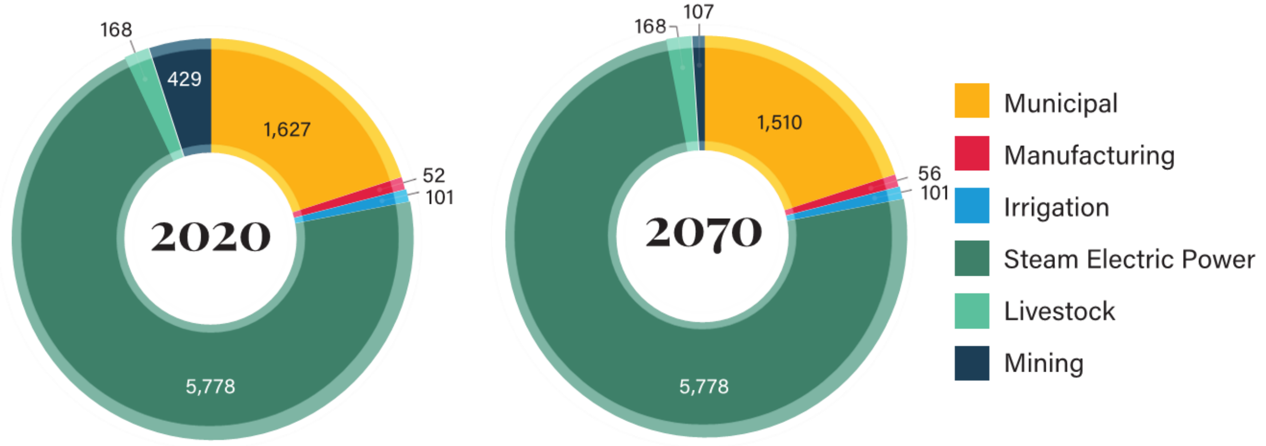
Your Water Sources:
Local Supplies
Sabine River
Gulf Coast Aquifer
Neches River

Projected Growth

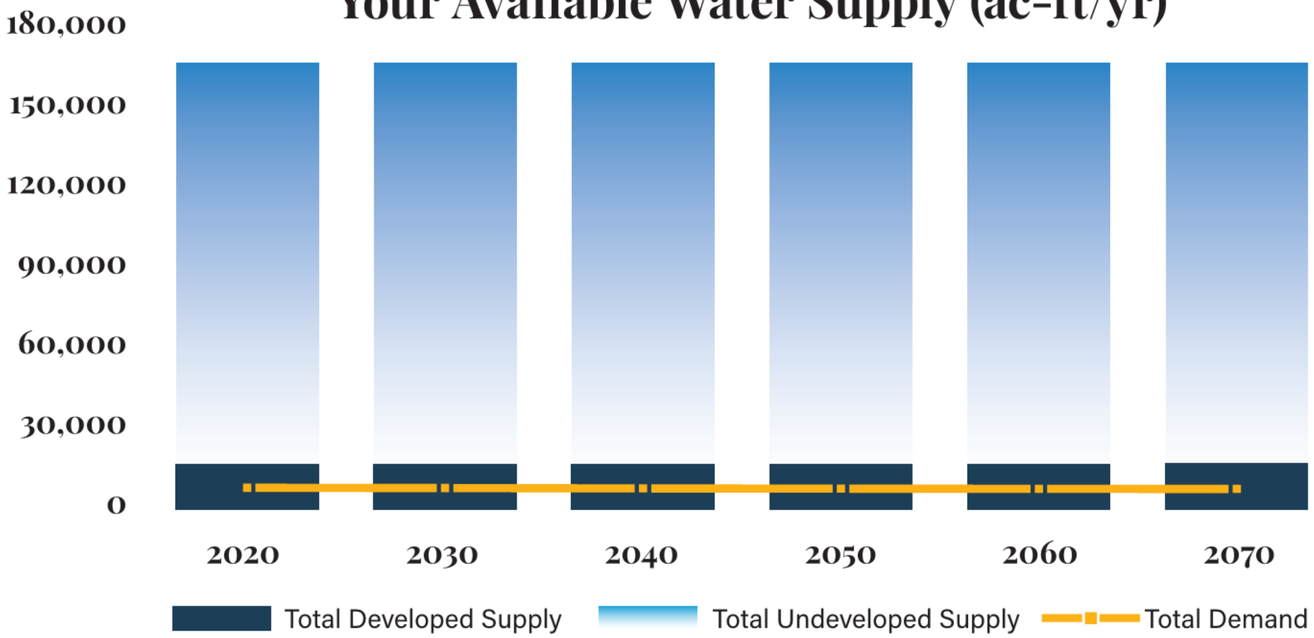
per TWDB Population Projections

2020	14,445
2030	14,445
2040	14,445
2050	14,445
2060	14,445
2070	14,445

Your County Water Demand (acre-feet)



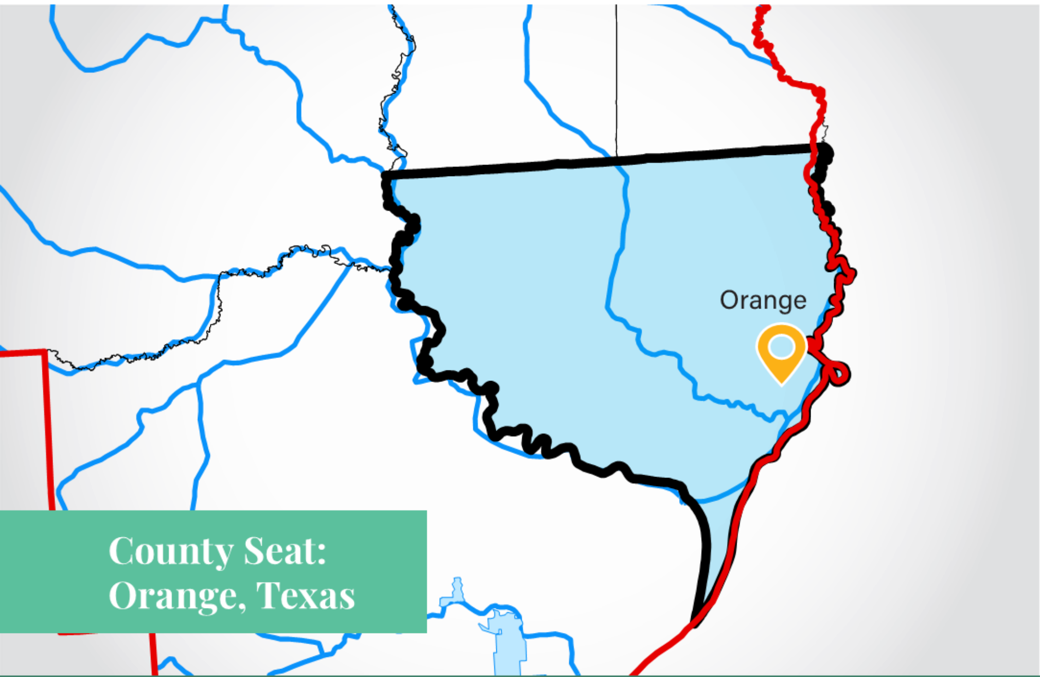
Your Available Water Supply (ac-ft/yr)



Newton County – Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Municipal	–	No Water Shortage Identified
Manufacturing	–	No Water Shortage Identified
Irrigation	–	No Water Shortage Identified
Steam Electric Power	–	No Water Shortage Identified
Livestock	–	No Water Shortage Identified
Mining	2020	Purchase Additional Supply from SRA

Orange County



County Seat:
Orange, Texas

Orange County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Brian Babin

Your State Senator:
Robert Nichols

Your State Representative:
Dade Phelan

Your County Judge:
John H. Gothia

Your East Texas Regional Water Planning Group Member(s):
David Montagne, John Martin (GMA 14)

Municipal Water Users:
- Bridge City
- Kelly G Brewer
- Mauriceville SUD
- Orange
- Orange County WCID 1
- Orange County WCID 2
- Orangefield WSC
- Pinehurst
- Port Arthur
- South Newton WSC

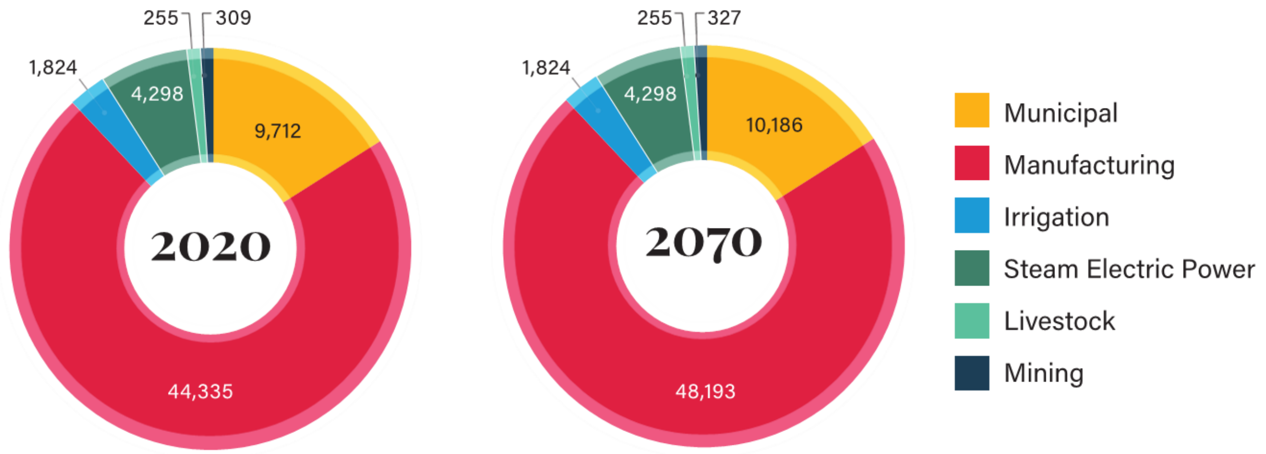
Your Water-Dependent Economy:
- Industry
- Recreation
- Timber

Your Water Sources:
- Direct Reuse
- Local Supplies
- Gulf Coast Aquifer
- Neches River
- Sabine River

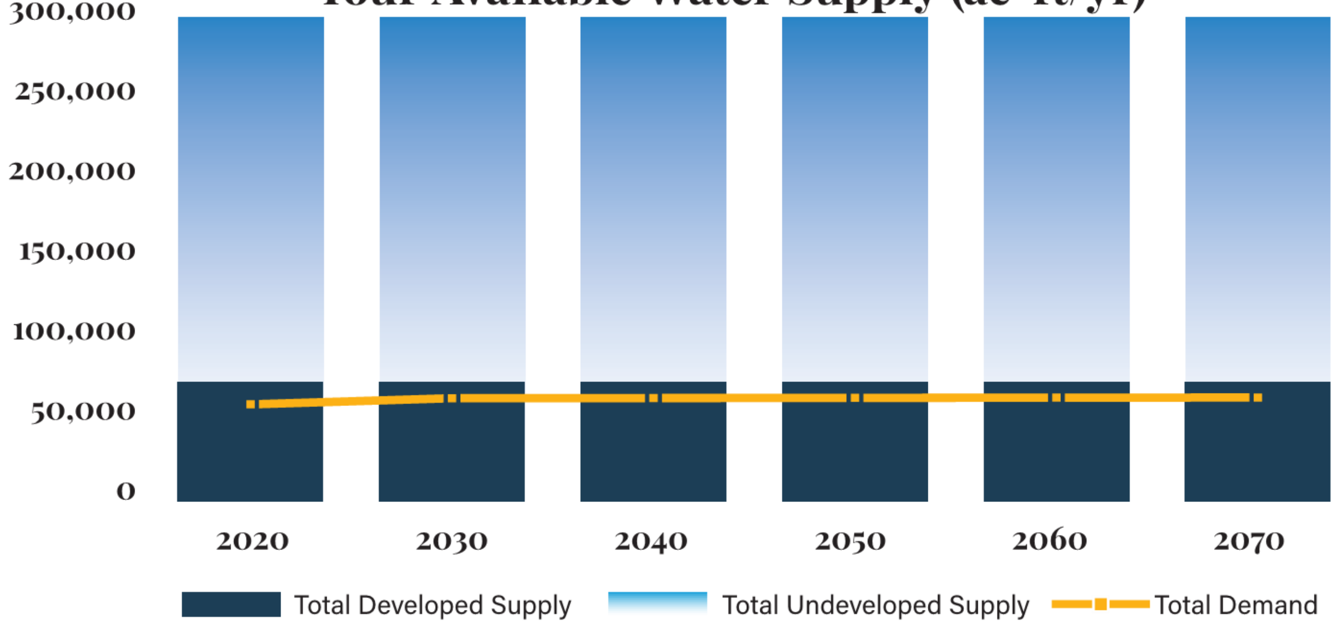
Projected Growth
per TWDB Population Projections

2020	86,327
2030	90,233
2040	92,984
2050	94,848
2060	96,269
2070	97,298

Your County Water Demand (acre-feet)



Your Available Water Supply (ac-ft/yr)

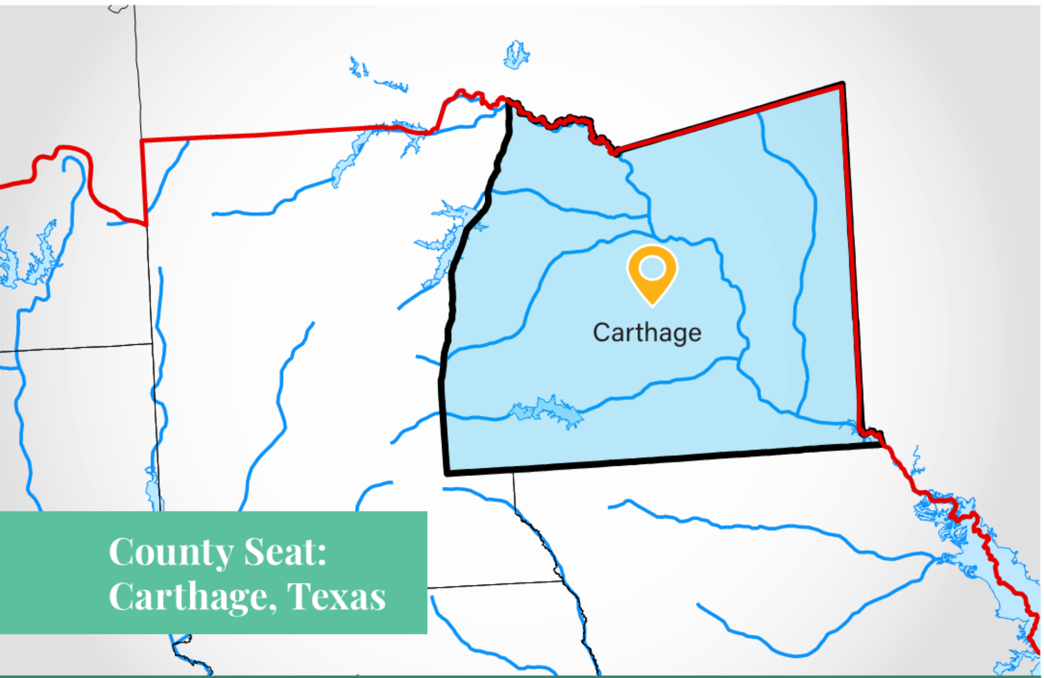


Orange County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Municipal	–	No Water Shortage Identified
Manufacturing	–	No Water Shortage Identified
Irrigation	2020	Purchase Additional Supply from SRA
Steam Electric Power	–	No Water Shortage Identified
Livestock	–	No Water Shortage Identified
Mining	–	No Water Shortage Identified

Panola County

The East Texas Water Planning Area (Region I)



County Seat: Carthage, Texas

Panola County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Louie Gohmert

Your State Senator:
Bryan Hughes

Your State Representative:
Chris Paddie

Your County Judge:
Lee Ann Jones

Your East Texas Regional Water Planning Group Member(s):
John McFarland (GMA 11)

Municipal Water Users:
- Beckville
- Carthage
- Gill WSC
- Minden Brachfield WSC
- Panola-Bethany WSC
- Tatum

Your Water-Dependent Economy:

Agriculture
Livestock
Oil & Gas Production

Your Water Sources:

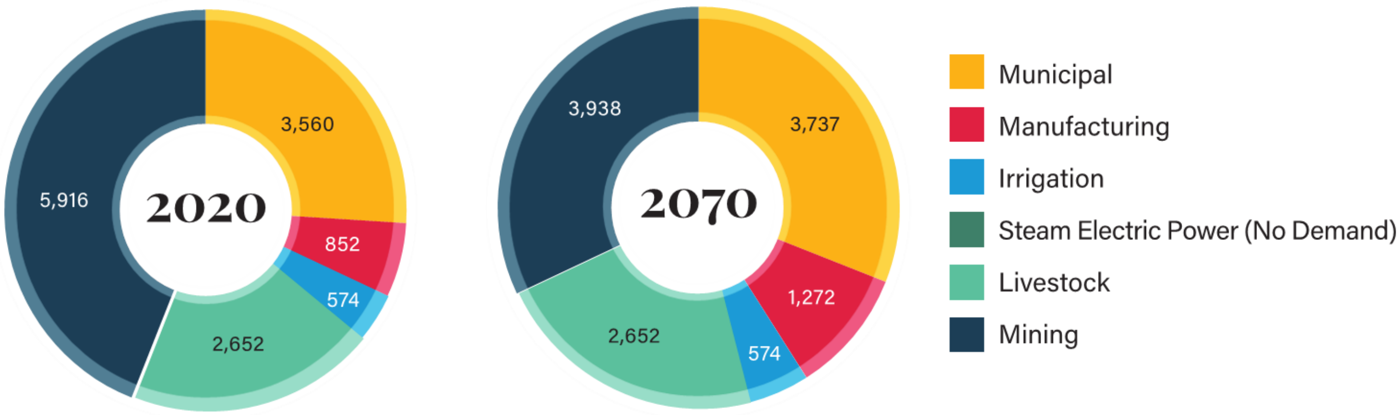
Lake Murvaul
Local Supplies
Martin Lake
Carrizo-Wilcox Aquifer
Sabine River

Projected Growth

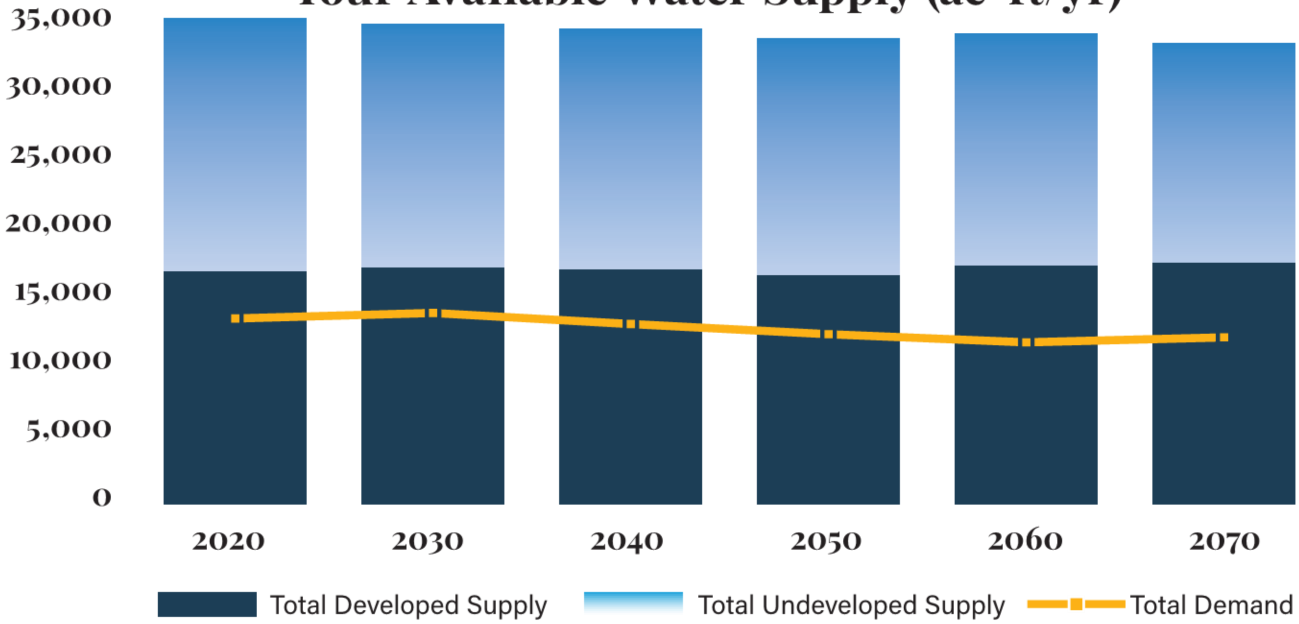
per TWDB Population Projections

2020	25,111
2030	26,378
2040	27,154
2050	27,873
2060	28,412
2070	28,832

Your County Water Demand (acre-feet)



Your Available Water Supply (ac-ft/yr)



Panola County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Municipal	–	No Water Shortage Identified
Manufacturing	–	No Water Shortage Identified
Irrigation	–	No Water Shortage Identified
Steam Electric Power	–	No Demand Projected
Livestock	2020	Additional Wells in Carrizo Aquifer
Mining	–	No Water Shortage Identified

Polk County

The East Texas Water Planning Area (Region I)

County Seat: Livingston, Texas

This county is split between more than one TWDB regional water planning area. The projections shown in these summary sheets represent data for the portion of the county that falls within the East Texas Regional Water Planning Area.

Your Water-Dependent Economy:

Agriculture

Livestock

Your Water Sources:

Gulf Coast Aquifer

Yegua-Jackson Aquifer

Local Supplies

Projected Growth

per TWDB Population Projections

2020	8,959
2030	10,008
2040	10,834
2050	11,537
2060	12,112
2070	12,574

Polk County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Brian Babin

Your State Senator:
Robert Nichols

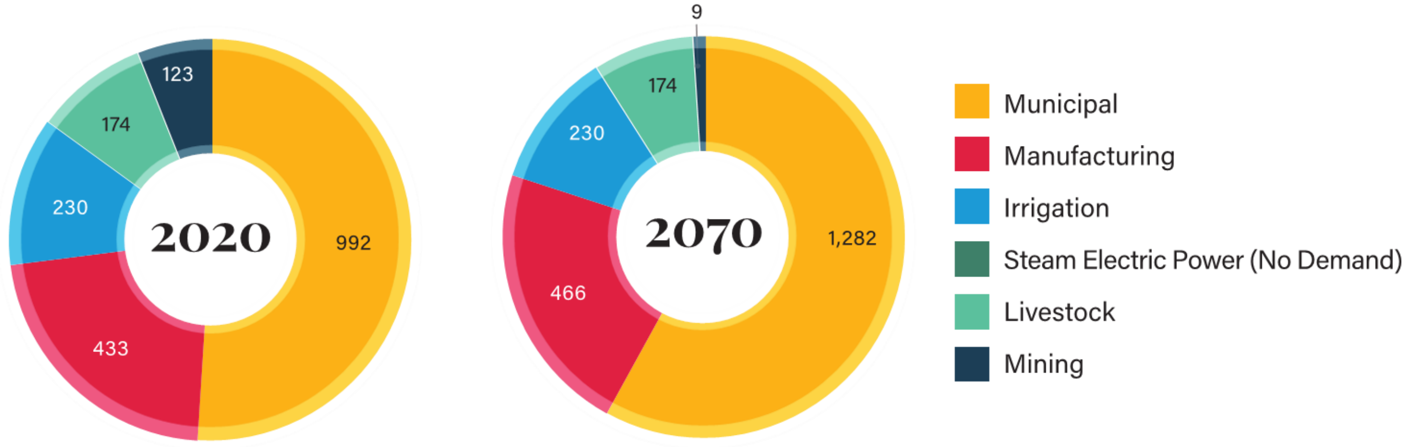
Your State Representative:
James White

Your County Judge:
Sydney Brown Murphy

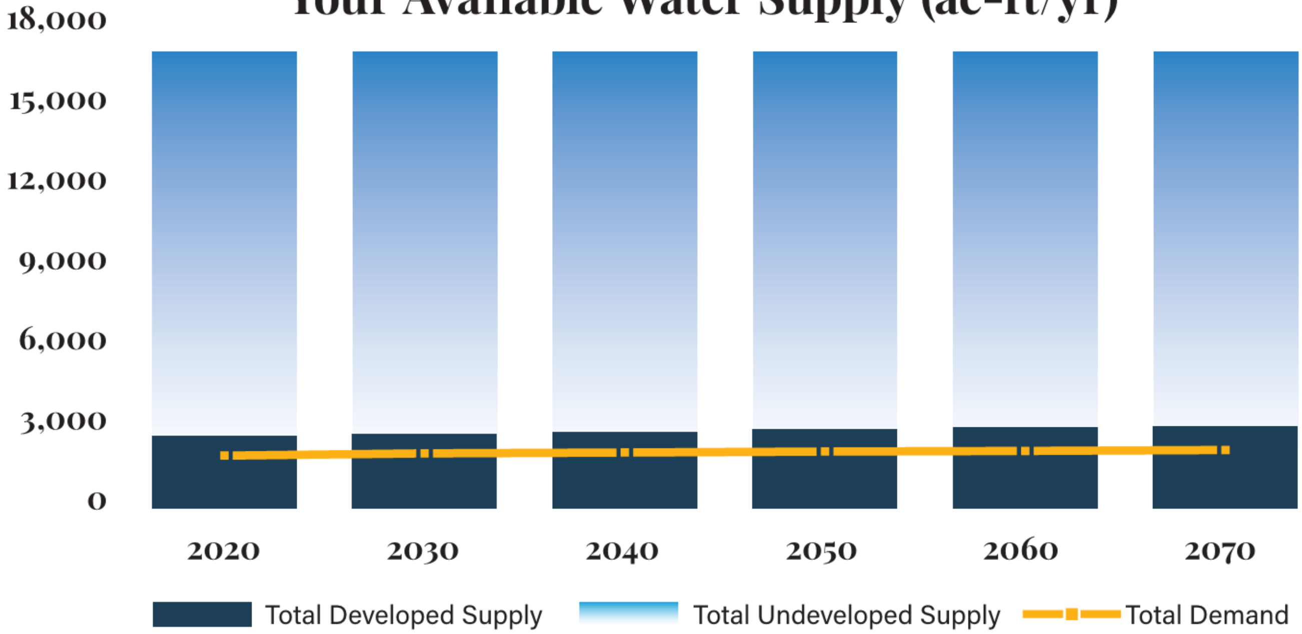
Your East Texas Regional Water Planning Group Member(s):
John Martin (GMA 14)

Municipal Water Users:
- Chester WSC
- Corrigan
- Damascus-Stryker WSC
- Lake Livingston Water Supply Corp.
- Moscow WSC
- Soda WSC

Your County Water Demand (acre-feet)



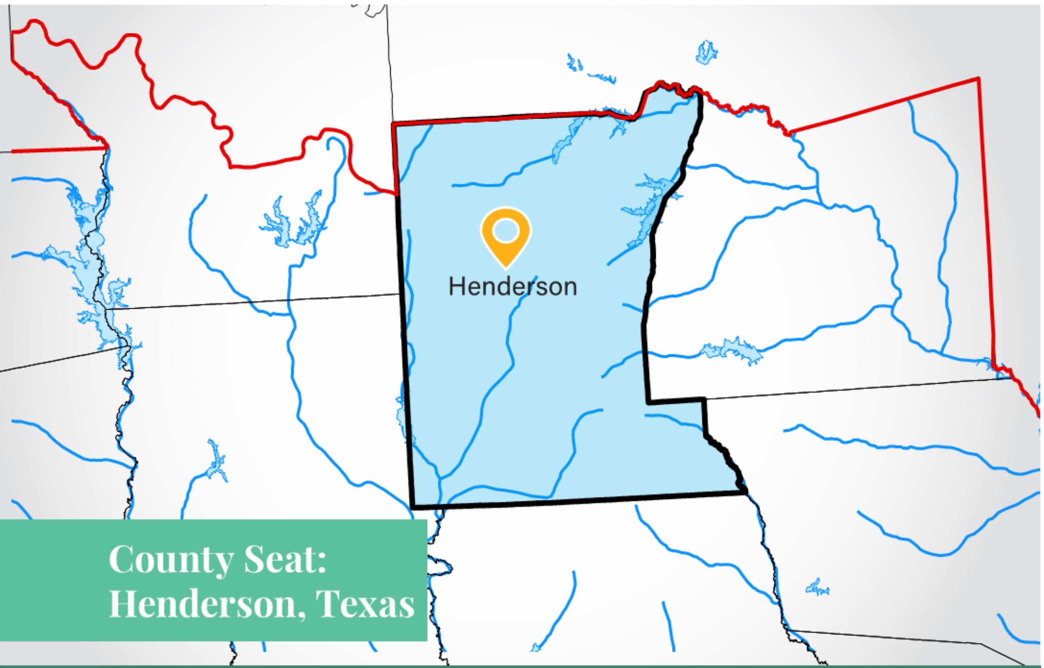
Your Available Water Supply (ac-ft/yr)



Polk County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Municipal	–	No Water Shortage Identified
Manufacturing	–	No Water Shortage Identified
Irrigation	–	No Water Shortage Identified
Steam Electric Power	–	No Demand Projected
Livestock	–	No Water Shortage Identified
Mining	–	No Water Shortage Identified

Rusk County



County Seat: Henderson, Texas

Rusk County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Louie Gohmert

Your State Senator:
Bryan Hughes

Your State Representative:
Travis Clardy

Your County Judge:
Joel Hale

Your East Texas Regional Water Planning Group Member(s):
John McFarland (GMA 11), Stevan Gelwicks

Municipal Water Users:
- Chalk Hill SUD
- Cross Roads SUD
- Crystal Farms WSC
- Ebenezer WSC
- Elderville WSC
- Gaston WSC
- Goodsprings WSC
- Henderson
- Jacobs WSC
- Kilgore
- Minden Brachfield WSC
- Mt Enterprise WSC
- New London
- New Prospect WSC
- Overton
- South Rusk County WSC
- Southern Utilities
- Tatum
- West Gregg SUD
- Wright City WSC

Your Water-Dependent Economy:

Agriculture
Livestock
Oil & Gas Production

Your Water Sources:

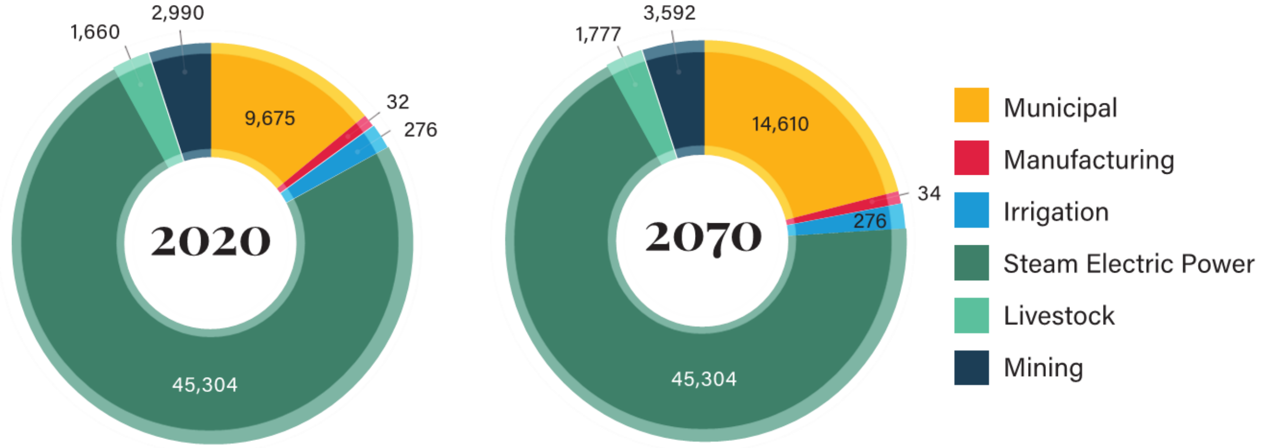
Lake Striker
Martin Lake
Neches River
Sabine River
Local Supplies

Projected Growth

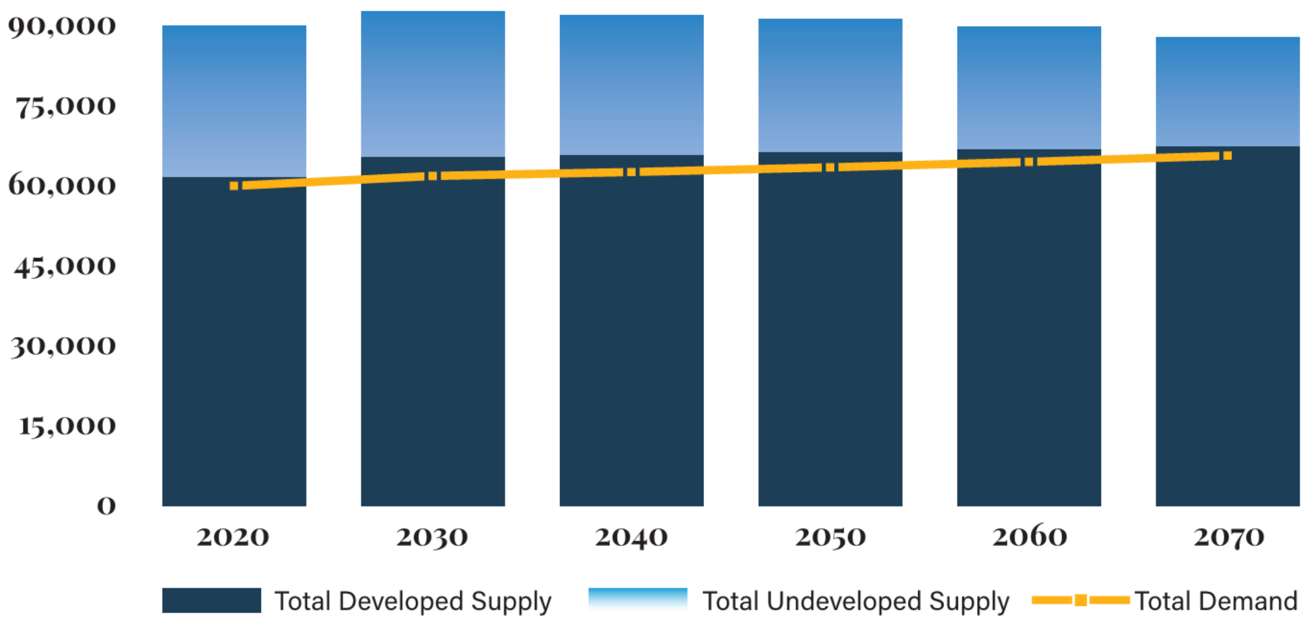
per TWDB Population Projections

2020	59,272
2030	66,067
2040	72,669
2050	79,763
2060	87,138
2070	94,780

Your County Water Demand (acre-feet)



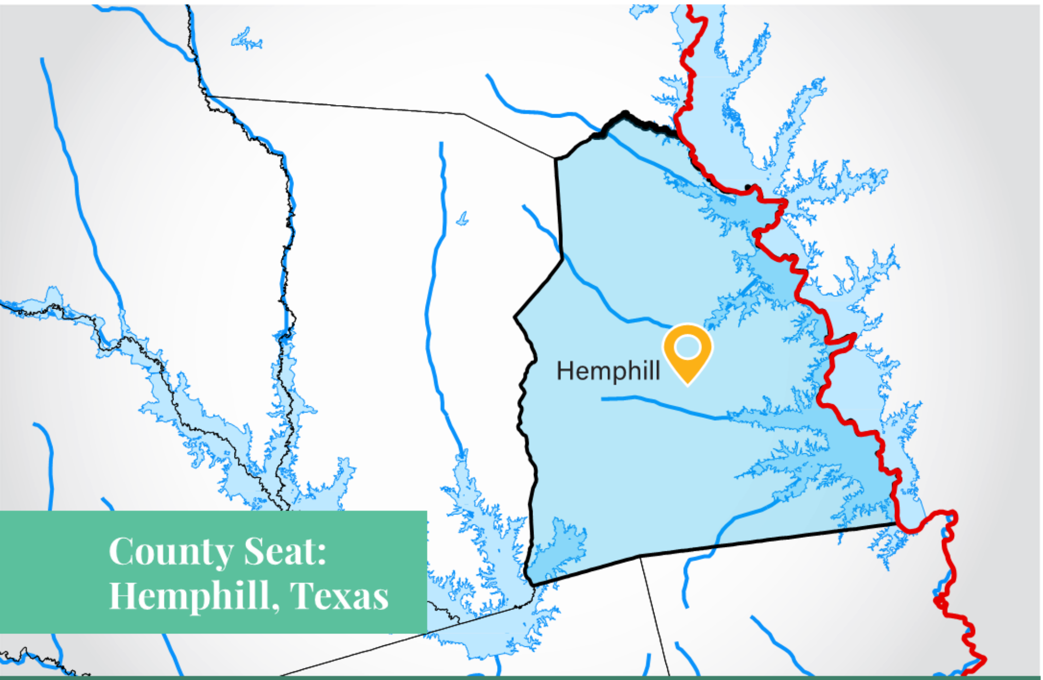
Your Available Water Supply (ac-ft/yr)



Rusk County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Jacobs WSC	2070	Additional Wells in Carrizo Aquifer
Overton	2020	Additional Wells in Carrizo Aquifer, Municipal Conservation
Wright City WSC	2070	Additional Wells in Carrizo Aquifer
Manufacturing	–	No Water Shortage Identified
Irrigation	–	No Water Shortage Identified
Steam Electric Power	2020	Purchase Additional Supply from SRA
Livestock	2040	Additional Wells in Carrizo Aquifer
Mining	2030	Purchase Additional Supply from ANRA

Sabine County



**County Seat:
Hemphill, Texas**

Sabine County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Louie Gohmert

Your State Senator:
Robert Nichols

Your State Representative:
Chris Paddie

Your County Judge:
Daryl D. Melton

Your East Texas Regional Water Planning Group Member(s):
John McFarland (GMA 11)

Municipal Water Users:
- Brookeland FWSD
- G-M WSC
- Hemphill
- Pineland

Your Water-Dependent Economy:

Agriculture
Recreation
Timber

Your Water Sources:

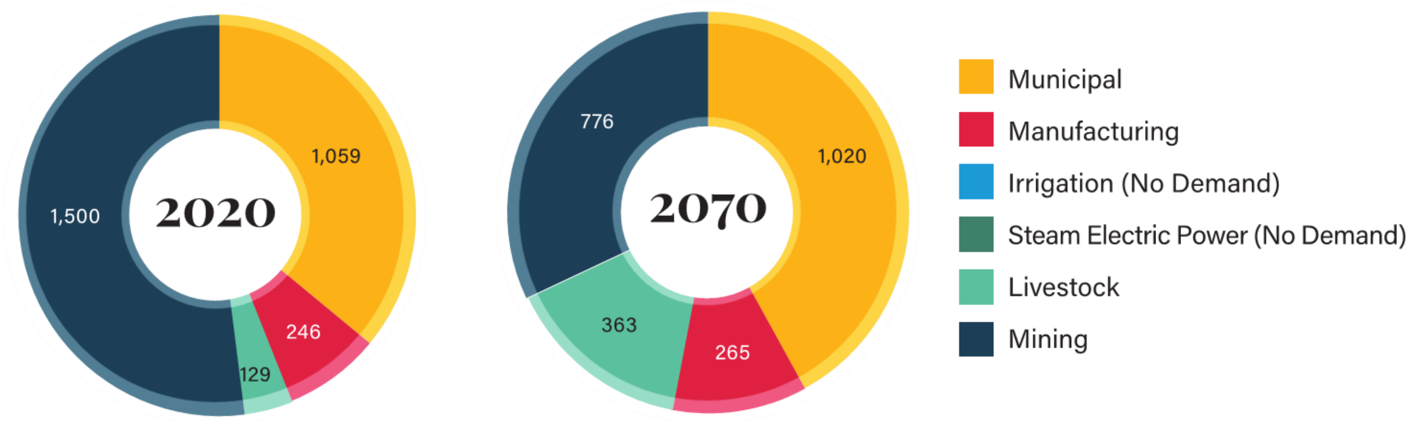
Direct Reuse
Local Supplies
Neches River
Toledo Bend Reservoir

Projected Growth

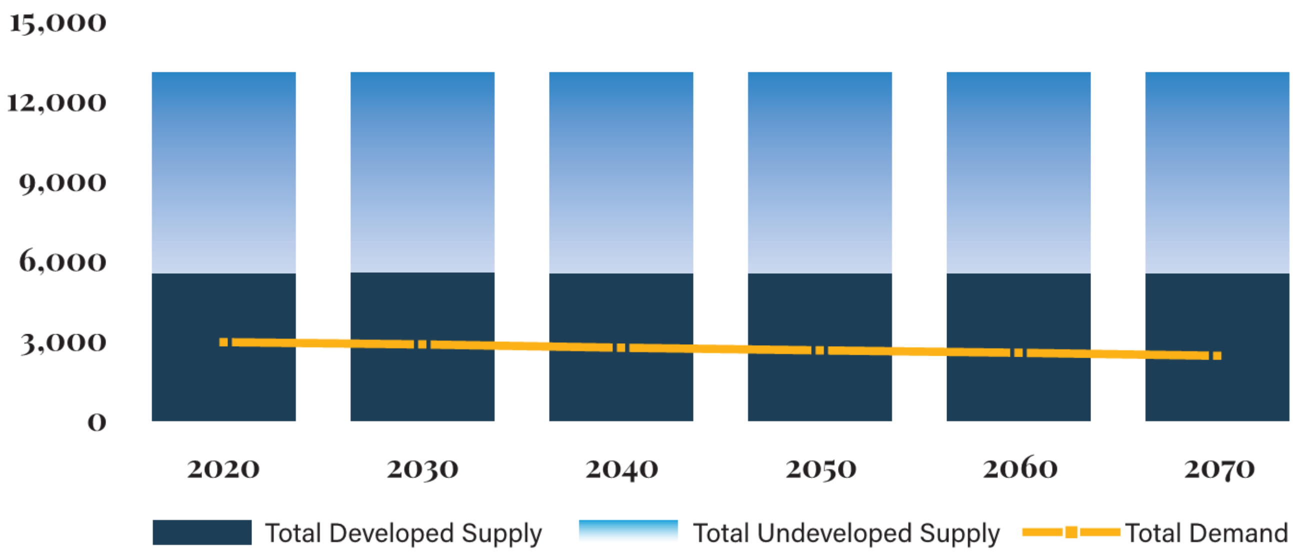
per TWDB Population Projections

2020	11,217
2030	11,249
2040	11,249
2050	11,249
2060	11,249
2070	11,249

Your County Water Demand (acre-feet)



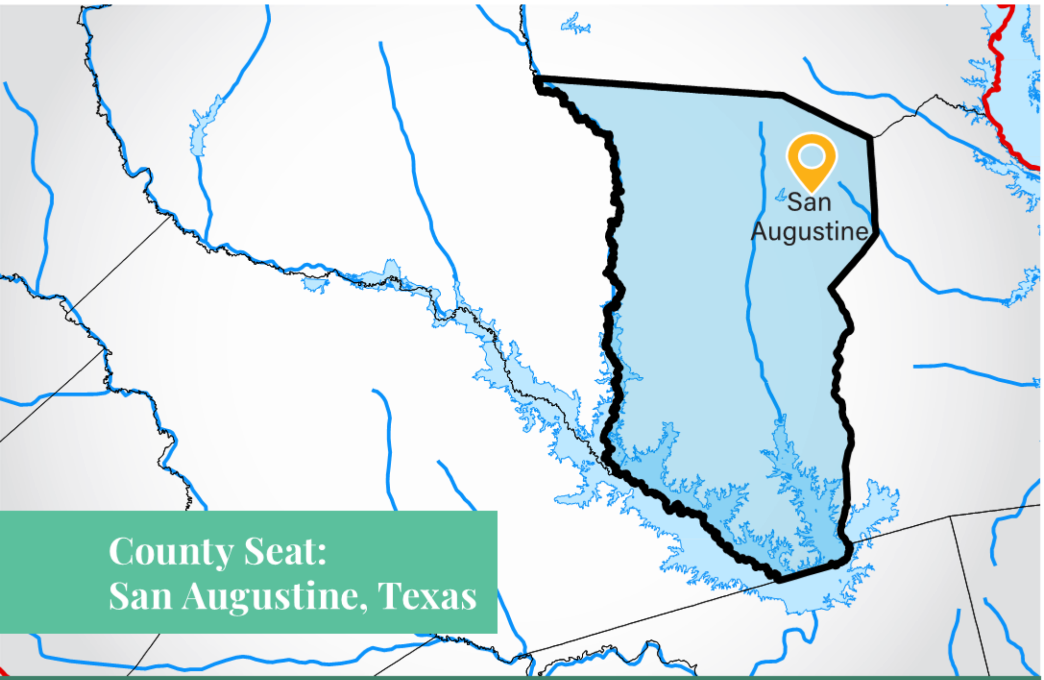
Your Available Water Supply (ac-ft/yr)



Sabine County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Municipal	–	No Water Shortage Identified
Manufacturing	–	No Water Shortage Identified
Irrigation	–	No Demand Projected
Steam Electric Power	–	No Demand Projected
Livestock	–	No Water Shortage Identified
Mining	–	No Water Shortage Identified

San Augustine County



County Seat:
San Augustine, Texas

San Augustine County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Louie Gohmert

Your State Senator:
Robert Nichols

Your State Representative:
Trent Ashby

Your County Judge:
Jeff Boyd

Your East Texas Regional Water Planning Group Member(s):
John McFarland (GMA 11)

Municipal Water Users:
- G-M WSC
- San Augustine
- San Augustine Rural WSC

Your Water-Dependent Economy:

Agriculture
Recreation
Timber

Your Water Sources:

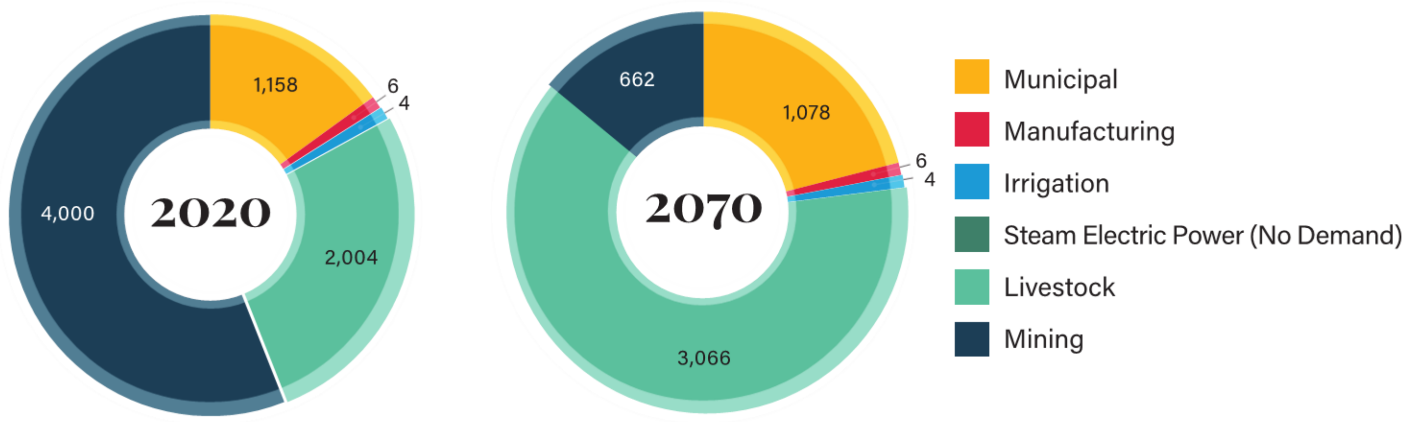
Yegua-Jackson Aquifer
Sparta Aquifer
Carrizo Wilcox Aquifer
Other Aquifer
Local Supplies
San Augustine City Lake

Projected Growth

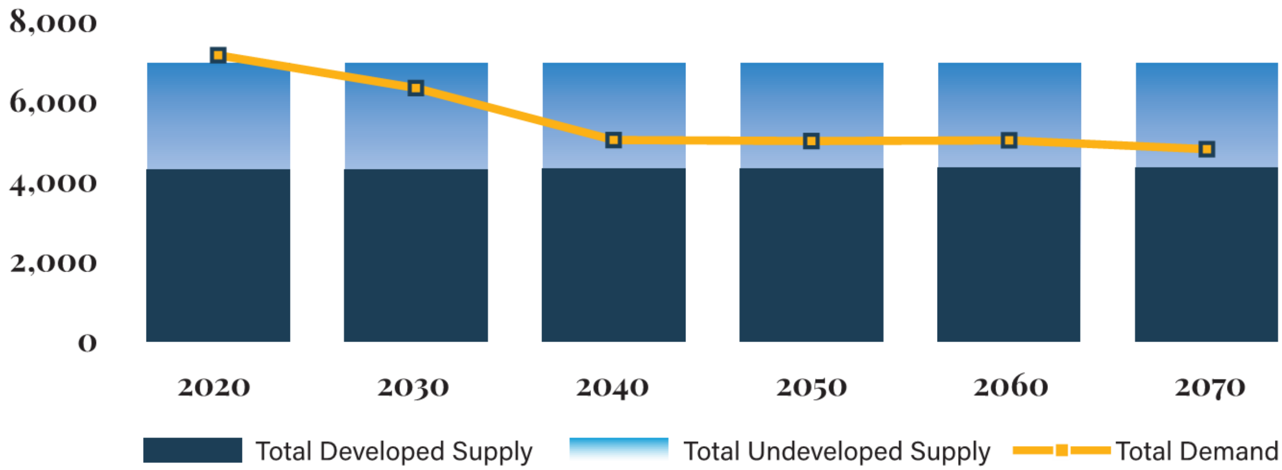
per TWDB Population Projections

2020	8,917
2030	8,917
2040	8,917
2050	8,917
2060	8,917
2070	8,917

Your County Water Demand (acre-feet)



Your Available Water Supply (ac-ft/yr)

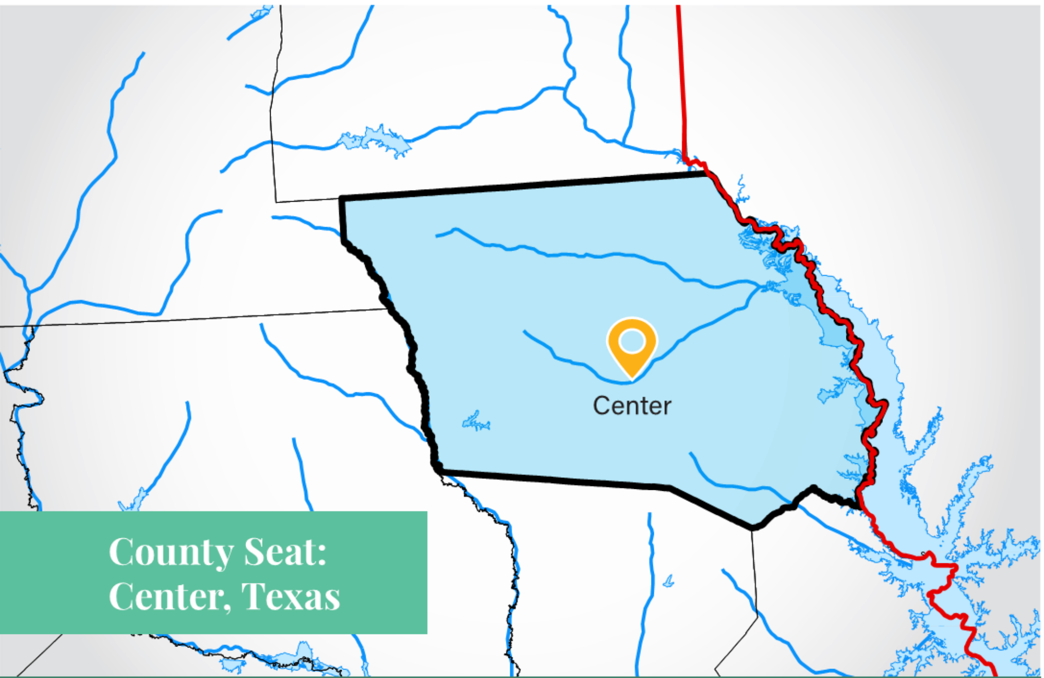


San Augustine County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
San Augustine	2020	Additional Wells in Carrizo Aquifer, Municipal Conservation
Manufacturing	–	No Water Shortage Identified
Irrigation	–	No Water Shortage Identified
Steam Electric Power	–	No Demand Projected
Livestock	2020	Purchase Additional Supply from SRA
Mining	2020	Purchase Additional Supply from ANRA

Shelby County

The East Texas Water Planning Area (Region I)



County Seat: Center, Texas

Shelby County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Louie Gohmert

Your State Senator:
Robert Nichols

Your State Representative:
Chris Paddie

Your County Judge:
Allison Harbison

Your East Texas Regional Water Planning Group Member(s):
John McFarland (GMA 11)

Municipal Water Users:
- Center
- Choice WSC
- East Lamar WSC
- Five Way WSC
- Flat Fork WSC
- Huxley
- Joaquin
- McClelland WSC
- Sand Hills WSC
- Tenaha
- Timpson

Your Water-Dependent Economy:

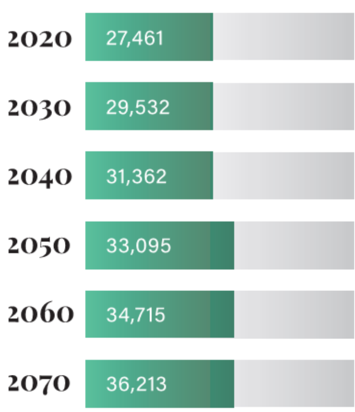
Agriculture
Oil & Gas Production
Recreation

Your Water Sources:

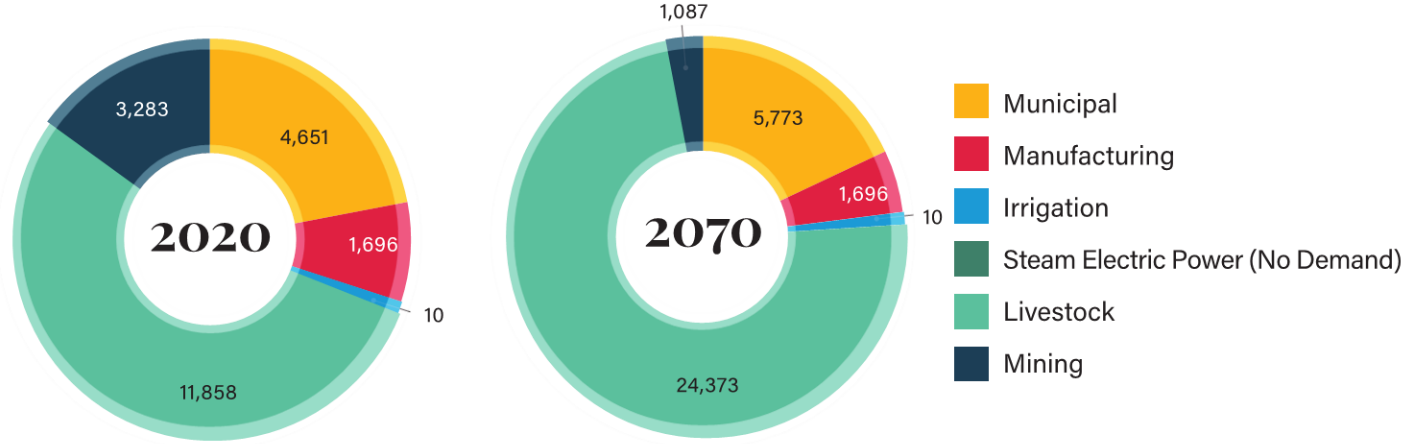
Direct Reuse
Local Supplies
Lake Center
Pinkston Reservoir
Lake Timpson
Carrizo-Wilcox Aquifer

Projected Growth

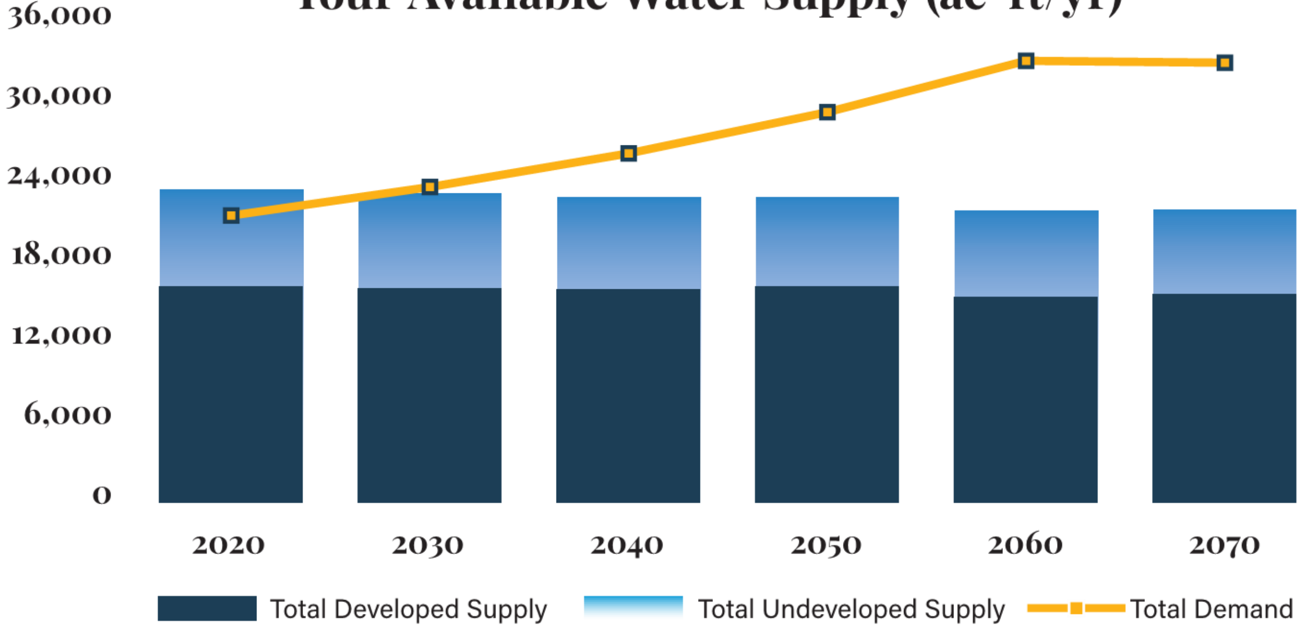
per TWDB Population Projections



Your County Water Demand (acre-feet)



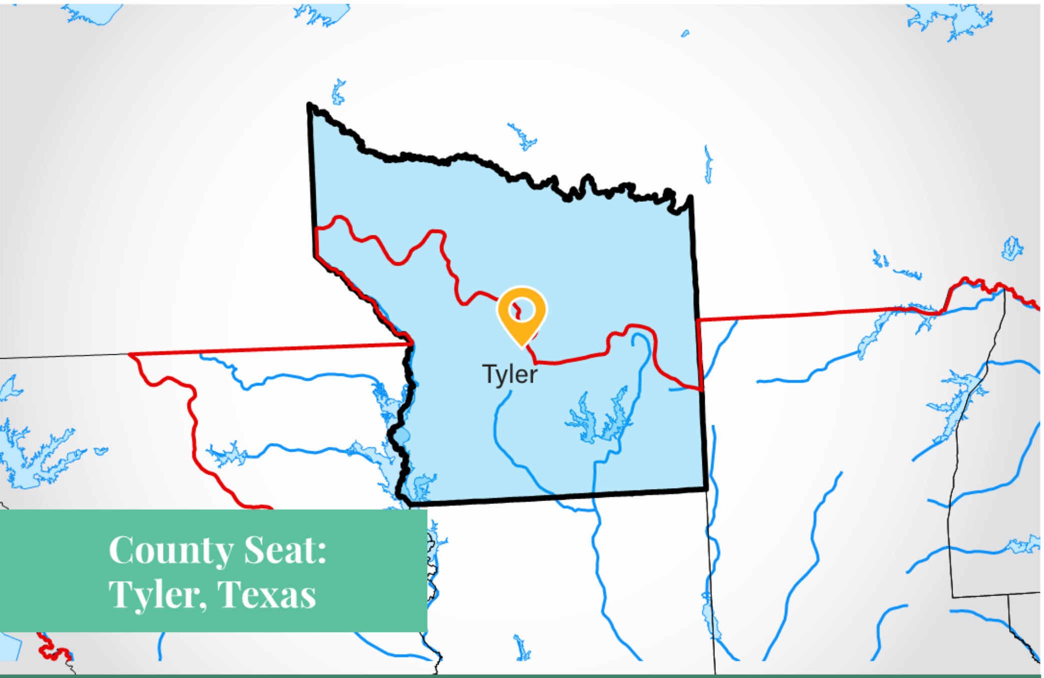
Your Available Water Supply (ac-ft/yr)



Shelby County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Sand Hills WSC	2020	Purchase Additional Supply from SRA, Municipal Conservation
Manufacturing	–	No Water Shortage Identified
Irrigation	–	No Water Shortage Identified
Steam Electric Power	–	No Demand Projected
Livestock	2020	Purchase Additional Supply from SRA
Mining	–	No Water Shortage Identified

Smith County



County Seat:
Tyler, Texas

This county is split between more than one TWDB regional water planning area. The projections shown in these summary sheets represent data for the portion of the county that falls within the East Texas Regional Water Planning Area.

Smith County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Louie Gohmert

Your State Senator:
Bryan Hughes

Your State Representatives:
Cole Hefner and Matt Schaefer

Your County Judge:
Nathaniel Moran

Your East Texas Regional Water Planning Group Member(s):
John McFarland (GMA 11), Gregory M. Morgan

Municipal Water Users:

- Arp
- Algonquin Water Resources of Texas
- Ben Wheeler WSC
- Bullard
- Carroll WSC
- Crystal Systems Texas
- Dean WSC
- Emerald Bay MUD
- Jackson WSC
- Lindale
- Lindale Rural WSC
- Overton
- RPM WSC
- Southern Utilities
- Troup
- Tyler
- Walnut Grove WSC
- Whitehouse
- Wright City WSC

Your Water-Dependent Economy:

- Education
- Industry
- Livestock
- Medical

Your Water Sources:

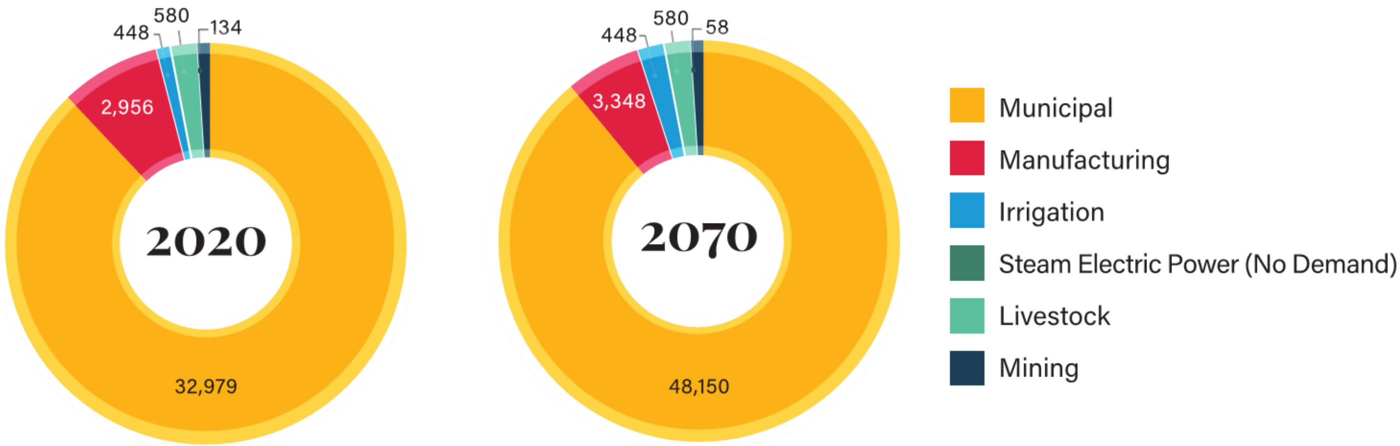
- Bellwood Lake
- Lake Tyler/Tyler East
- Local Supplies
- Neches River
- Carrizo-Wilcox Aquifer
- Queen City Aquifer

Projected Growth

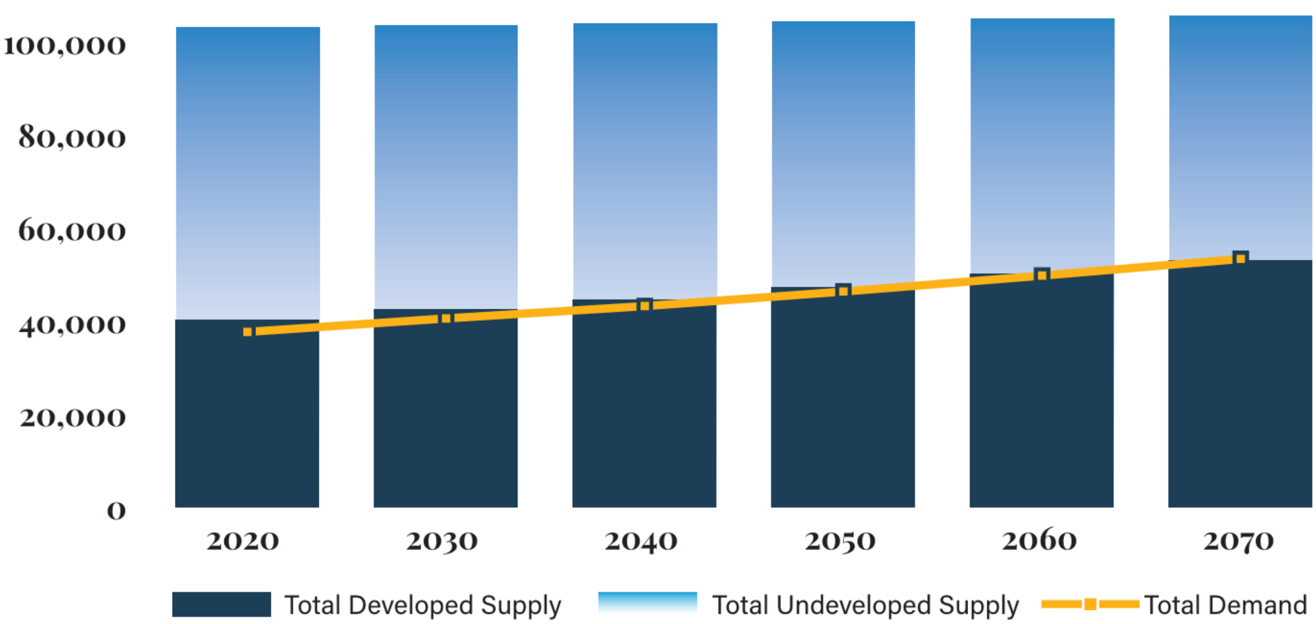
per TWDB Population Projections

2020	189,020
2030	208,579
2040	228,196
2050	249,312
2060	270,803
2070	292,859

Your County Water Demand (acre-feet)



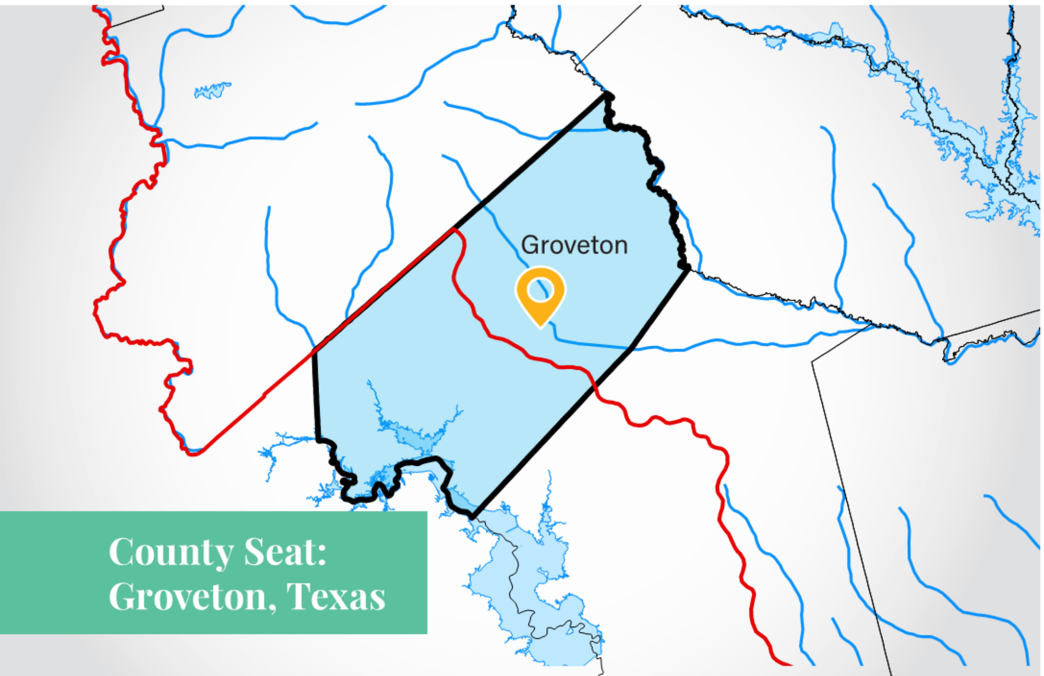
Your Available Water Supply (ac-ft/yr)



Smith County – Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Bullard	2020	Purchase Additional Supply from Tyler, Municipal Conservation
Crystal Systems Texas	2040	Additional Wells in Carrizo Aquifer, Municipal Conservation
Lindale	2020	Additional Wells in Carrizo Aquifer, Municipal Conservation
Overton	2020	Additional Wells in Carrizo Aquifer
RPM WSC	2030	Additional Wells in Carrizo Aquifer
Southern Utilities	2020	Municipal Conservation
Whitehouse	2060	Purchase Additional Supply from Tyler
Manufacturing	2030	Purchase Additional Supply from Tyler
Irrigation	–	No Water Shortage Identified
Steam Electric Power	–	No Demand Projected
Livestock	–	No Water Shortage Identified
Mining	–	No Water Shortage Identified

Trinity County



County Seat: Groveton, Texas

This county is split between more than one TWDB regional water planning area. The projections shown in these summary sheets represent data for the portion of the county that falls within the East Texas Regional Water Planning Area.

Trinity County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Kevin Brady

Your State Senator:
Robert Nichols

Your State Representative:
Trent Ashby

Your County Judge:
Steven D. Page

Your East Texas Regional Water Planning Group Member(s):
John McFarland (GMA 11)

Municipal Water Users:
- Centerville WSC
- Groveton
- Pennington WSC

Your Water-Dependent Economy:

Agriculture
Livestock

Your Water Sources:

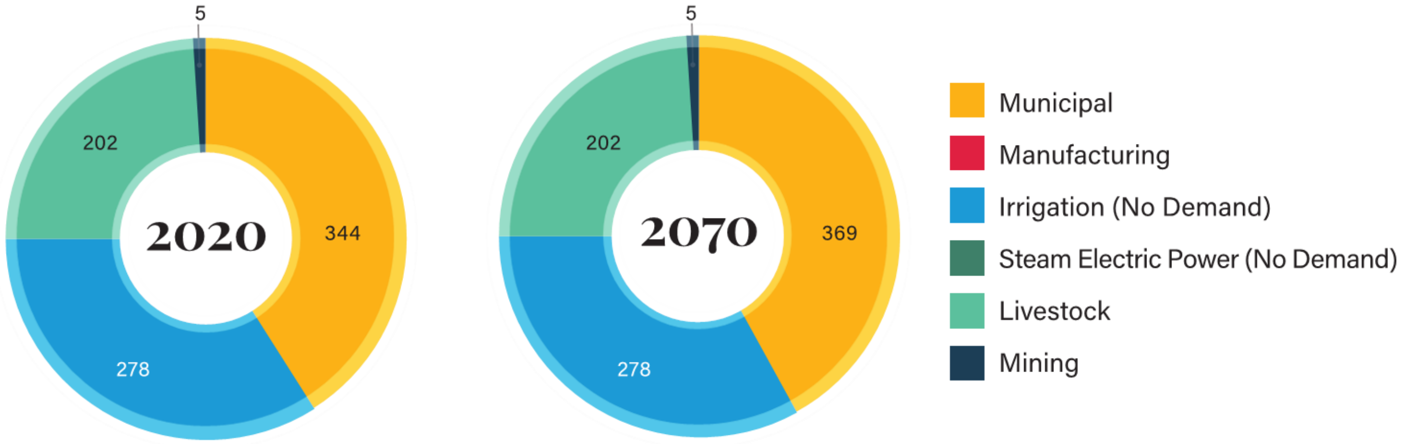
Local Supplies
Neches River
Carrizo-Wilcox Aquifer
Sparta Aquifer
Yegua-Jackson Aquifer

Projected Growth

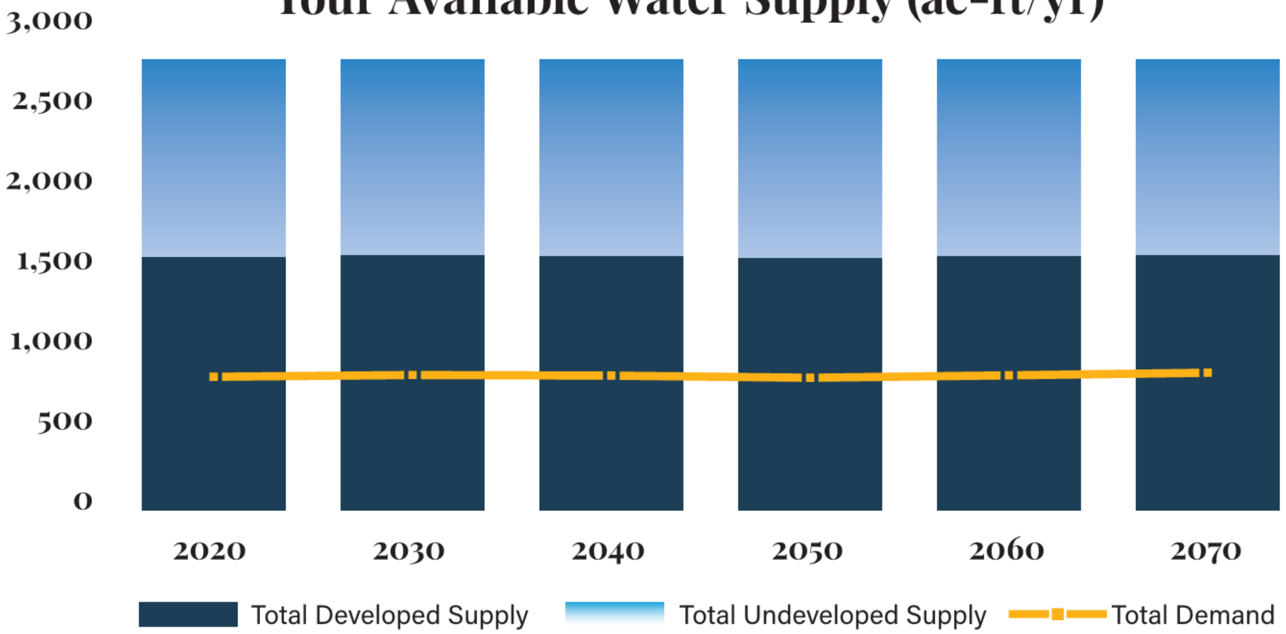
per TWDB Population Projections

2020	3,748
2030	4,054
2040	4,084
2050	3,969
2060	4,153
2070	4,346

Your County Water Demand (acre-feet)



Your Available Water Supply (ac-ft/yr)

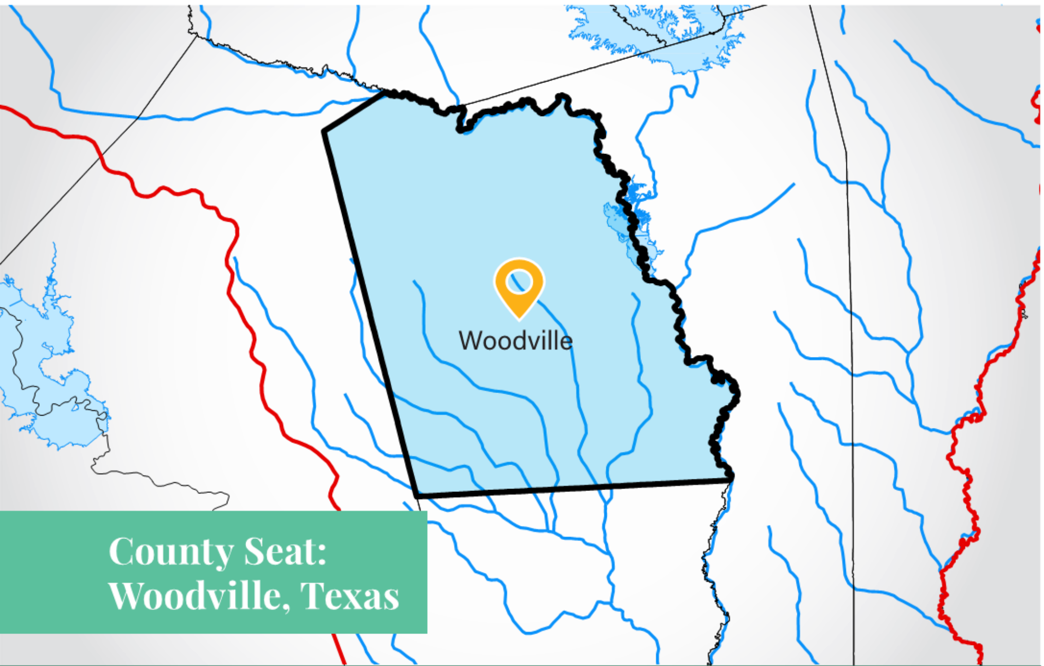


Trinity County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Municipal	–	No Water Shortage Identified
Manufacturing	–	No Demand Projected
Irrigation	–	No Water Shortage Identified
Steam Electric Power	–	No Demand Projected
Livestock	–	No Water Shortage Identified
Mining	–	No Water Shortage Identified

Tyler County

The East Texas Water Planning Area (Region I)



County Seat:
Woodville, Texas

Tyler County at a Glance

Your US Senators:
John Cornyn, Ted Cruz

Your US Representative:
Brian Babin

Your State Senator:
Robert Nichols

Your State Representative:
James White

Your County Judge:
Jacques L. Blanchette

Your East Texas Regional Water Planning Group Member(s):
John Martin (GMA 14), Josh David

Municipal Water Users:
- Chester WSC
- Colmesneil
- Cypress Creek WSC
- Lake Livingston Water Supply Corp.
- Moscow WSC
- Tyler County WSC
- Warren WSC
- Wildwood POA
- Woodville

Your Water-Dependent Economy:

Agriculture
Timber

Your Water Sources:

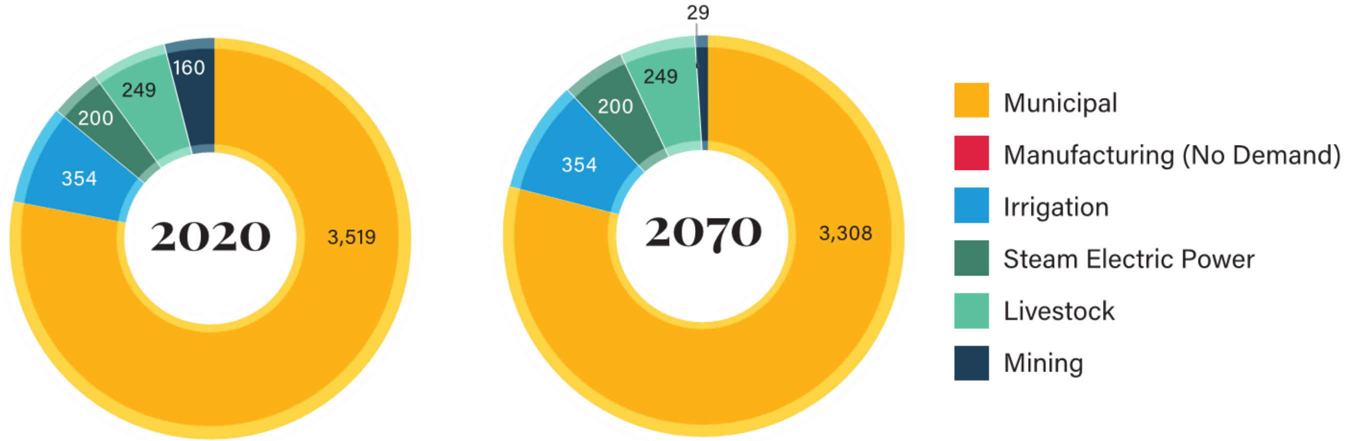
Gulf Coast Aquifer
Neches Run-of-River Supplies
Local Supplies

Projected Growth

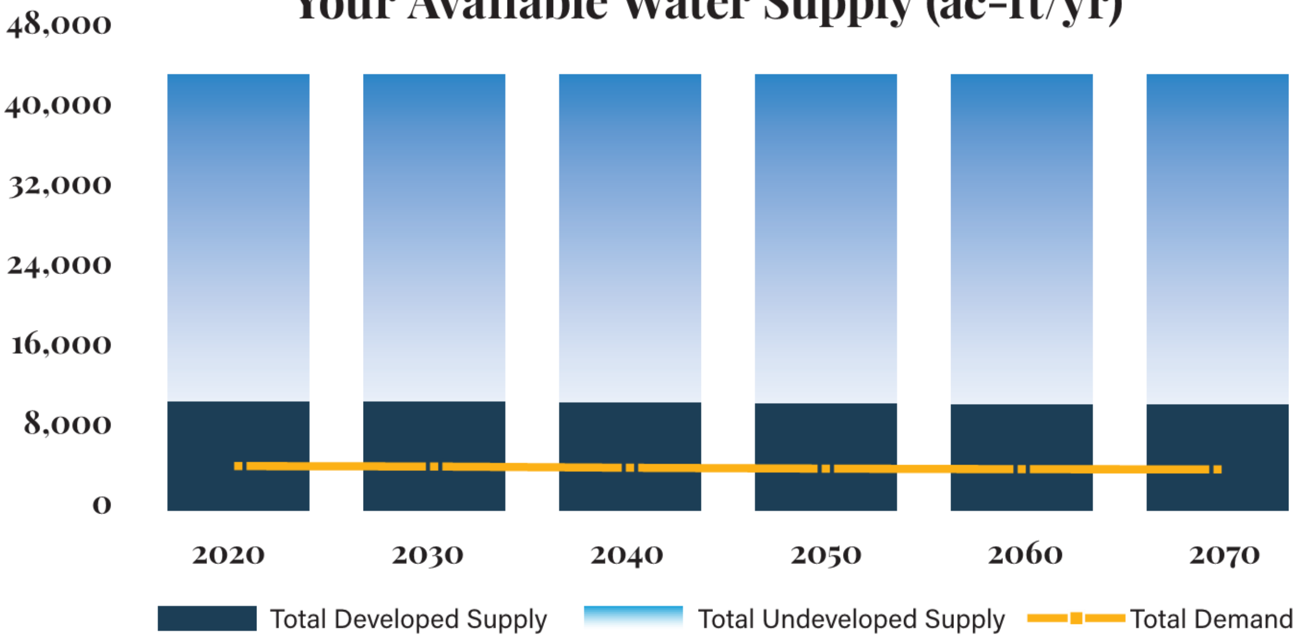
per TWDB Population Projections

2020	22,288
2030	22,396
2040	22,396
2050	22,396
2060	22,396
2070	22,396

Your County Water Demand (acre-feet)



Your Available Water Supply (ac-ft/yr)



Tyler County - Your Water User Groups with Identified Needs

Water User Group	Decade of Need	Water Management Strategy
Municipal	–	No Water Shortage Identified
Manufacturing	–	No Demand Projected
Irrigation	–	No Water Shortage Identified
Steam Electric Power	–	No Water Shortage Identified
Livestock	–	No Water Shortage Identified
Mining	–	No Water Shortage Identified

Chapter 1

Description of the Region

The East Texas Regional Water Planning Area (ETRWPA) is one of sixteen areas established by the 1997 Texas legislature Senate Bill 1 for the purpose of State water resource planning at a regional level on five-year planning cycles. The first regional water plan was adopted in 2001. Since that time, it was updated in 2006, 2011, and 2016. This plan, the 2021 Regional Water Plan (2021 Plan), is the result of the 5th cycle of regional water planning.

Pursuant to the formation of the ETRWPA, the East Texas Regional Water Planning Group (ETRWPG or RWPG), was formed and charged with the responsibility to evaluate the region's population projections, water demand projections, and existing water supplies for a 50-year planning horizon. The RWPG then identifies water shortages under drought of record conditions and recommends water management strategies. This planning is performed in accordance with regional and state water planning requirements of the Texas Water Development Board (TWDB).

This chapter provides details for the ETRWPA that are relevant to water resource planning, including: a physical description of the region, climatological details, population projections, economic activities, sources of water and water demand, and regional resources. A discussion of threats to the region's resources and water supply, a general discussion of water conservation and drought preparation in the region, and a listing of ongoing state and federal programs in the ETRWPA that impact water planning efforts in the region are also provided.

1.1 General Introduction

The ETRWPA consists of all or portions of 20 counties located in the Neches, Sabine, and Trinity River Basins, and the Neches-Trinity Coastal Basin. The region extends from the southeastern corner of the state for over 150 miles north and northwest as illustrated in Figure 1.1. The ETRWPA consists of approximately 10,329,800 acres of land and accounts roughly six percent of total area of the State of Texas.

By statute, the RWPG consists of members from at least 12 of the following statutorily required interests: public, counties, municipalities, industries, agriculture, environmental, small business, electric-generating utilities, river authorities, water districts, water utilities, and groundwater management areas. These voting, and several non-voting members, collectively represent the water supply interests of the entire region.

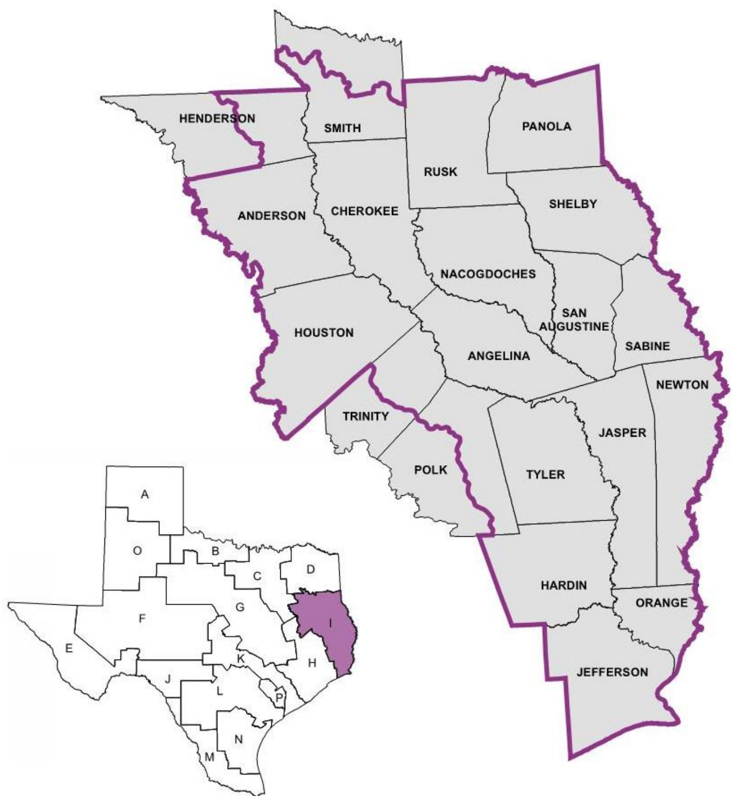


Figure 1.1 Location Map

SOURCE: TEXAS WATER DEVELOPMENT BOARD

The City of Nacogdoches is the administrative contracting agency for the RWPG. The RWPG has retained the services of a team of water-supply consulting engineering firms to prepare the 2021 Plan including Alan Plummer Associates, Inc. as the lead consultant, Freese & Nichols, Inc. as a subconsultant, and WSP USA as a subconsultant groundwater specialist. Table 1.1 provides a current list of the RWPG representatives involved in developing the 2021 Regional Water Plan.

Table 1.1 East Texas Regional Water Planning Group Members

Voting Members	
Category	**Name**
Agriculture	David Alders, *Carrizo Creek Corporation*
	Josh David, *Livestock*
Counties	Judge Chris Davis, *Cherokee County*
	Fred Jackson, *Jefferson County*
Electric Power	Randy Stanton, *Energy Services Inc.*
Environmental	Dr. Matthew McBroom, *Stephen F. Austin State University*
Groundwater Management Areas	John McFarland, *Rusk County GCD*
	John Martin, *Southeast Texas GCD*
Industries	Darla Smith, *BASF Corporation*
	David Gorsich, *Exxon Mobil Corporation*
Municipalities	David Brock, *City of Jacksonville*
	Gregory M. Morgan, *City of Tyler*
Public	Stevan Gelwicks
	Terry Stelly
River Authorities	David Montagne, *Sabine River Authority*
	Monty Shank, *Upper Neches River MWA*
	Kelley Holcomb, *Angelina-Neches River Authority*
	Scott Hall, *Lower Neches Valley Authority*
Small Business	Mark Dunn, *Dunn's Construction LLC*
	VACANT
Water Districts	Worth Whitehead*, *Rusk SWCD*
Water Utilities	Roger Fussell, *Lumberton MUD*
Non-Voting Members	
Lann Bookout, *Texas Water Development Board*	Stephan Lange, *Texas Parks & Wildlife Department*
Manuel Martinez, *Texas Department of Agriculture*	James Alford, *Trinity County*
Connie Standridge, *Region C RWPG*	Chip Kline, *Louisiana Governor's Office of Coastal Activities*
Honorable Joel Hale, *Rusk County Judge*	Ben A. Stephenson, *City of Dallas*
VACANT, Region H RWPG	Honorable Allison Harbison, *Shelby County Judge*
Walter Glenn, *Jasper County*	Terry McFall, *U.S. Department of Agriculture*
Rusty Ray, *Texas State Soil and Water Conservation Board*	

*Retired from the Regional Water Planning Group prior to final approval

Table 1.1 East Texas Regional Water Planning Group Members (Cont.)

Committees	
Executive Committee	
Chair – Kelley Holcomb 1st Vice Chair – David Brock 2nd Vice Chair – Josh David Secretary – John Martin	Assistant Secretary – David Montagne At-Large – Mark Dunn At-Large – David Alders
Nominations Committee	**By-Laws Committee**
Chair – Monty Shank Member – Chris Davis Member – Randy Stanton Ex-Officio – Kelley Holcomb	Chair – David Alders Member – Worth Whitehead Member – Darla Smith Member - Roger Fussell
Finance Committee	**Technical Committee**
Chair – Mark Dunn Member – Greg Morgan Member – Josh David Member – David Brock	Chair – Scott Hall Member – John Martin Member – Matthew McBroom

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

1.1.1 Physical Description

The ETRWPA is generally characterized by rolling to hilly surface features, except near the Gulf Coast. The elevation in the region varies from sea level at its southern boundary on the Gulf of Mexico to 763 ft mean sea level at Tater Hill Mountain in Henderson County at its far northwest corner. The region is further subdivided into natural geographic areas known as the Piney Woods, the Oak Woods and Prairies, and the Coastal Prairies, described as follows.

Piney Woods. The majority of the ETRWPA falls within the Piney Woods portion of the Texas Gulf Coastal Plain. Pine is the predominant timber of this region, although some hardwood timbers can be found as well, primarily in the valleys of rivers and creeks. Longleaf, shortleaf, and loblolly pine are native to the region and slash pine, an introduced species, is widely dispersed. Hardwoods include a variety of oaks, elm, hickory, magnolia, sweetgum, and blackgum. Lumber production is the principal industry of the area and practically all of Texas' commercial timber production comes from the Piney Woods region. The soils and climate are adaptable to the production of a variety of fruit and vegetable crops. Cattle ranching is widespread and generally accompanied by the development of pastures. Economic growth in the area has also been greatly influenced by the large oil field discovered in Rusk and Smith counties in 1931. This area has a variety of clays, lignite coal, and other minerals that have potential for development.

Oak Woods and Prairies. Most of the northwestern portion of the ETRWPA (parts of Smith, Henderson, Anderson, and Houston counties) fall within the Oak Woods and Prairies portion of the Texas Gulf Coastal Plains. Principal trees of this area are hardwoods, including post oak, blackjack oak, and elm. Riparian areas often have pecan, walnut, and other trees with high water demands. Upland soils are sandy and sandy loam, while the bottomlands are sandy loam and clay. The Oak Woods and Prairies are somewhat spotty in character, with some insular areas of blackland soil and others that closely resemble those of the Piney Woods. The principal industry of the area is diversified farming and livestock raising. The Oak Woods and Prairies region also has lignite, commercial clays, and other minerals.

Coastal Prairies. The southern portion of the ETRWPA (largely Jefferson and Orange counties) is located within the segment of the Texas Gulf Coastal Plains known as the Coastal Prairies. In general, this area is covered with a heavy growth of grass, and the line of demarcation between the prairies and the Pine Belt forests is very distinct. Soil of the Coastal Prairies is predominantly heavy clay. Cattle ranching is the principal agricultural industry, although significant rice production is also present. The Coastal Prairie has seen a large degree of industrial development that continues today. The chief concentration of this development has been from the city of Orange and the areas between the cities of Beaumont and Houston; much of the development has been in petrochemical manufacturing.

Figure 1.2 depicts the boundaries of these areas within the ETRWPA. Additional description of the region is provided later in this chapter.

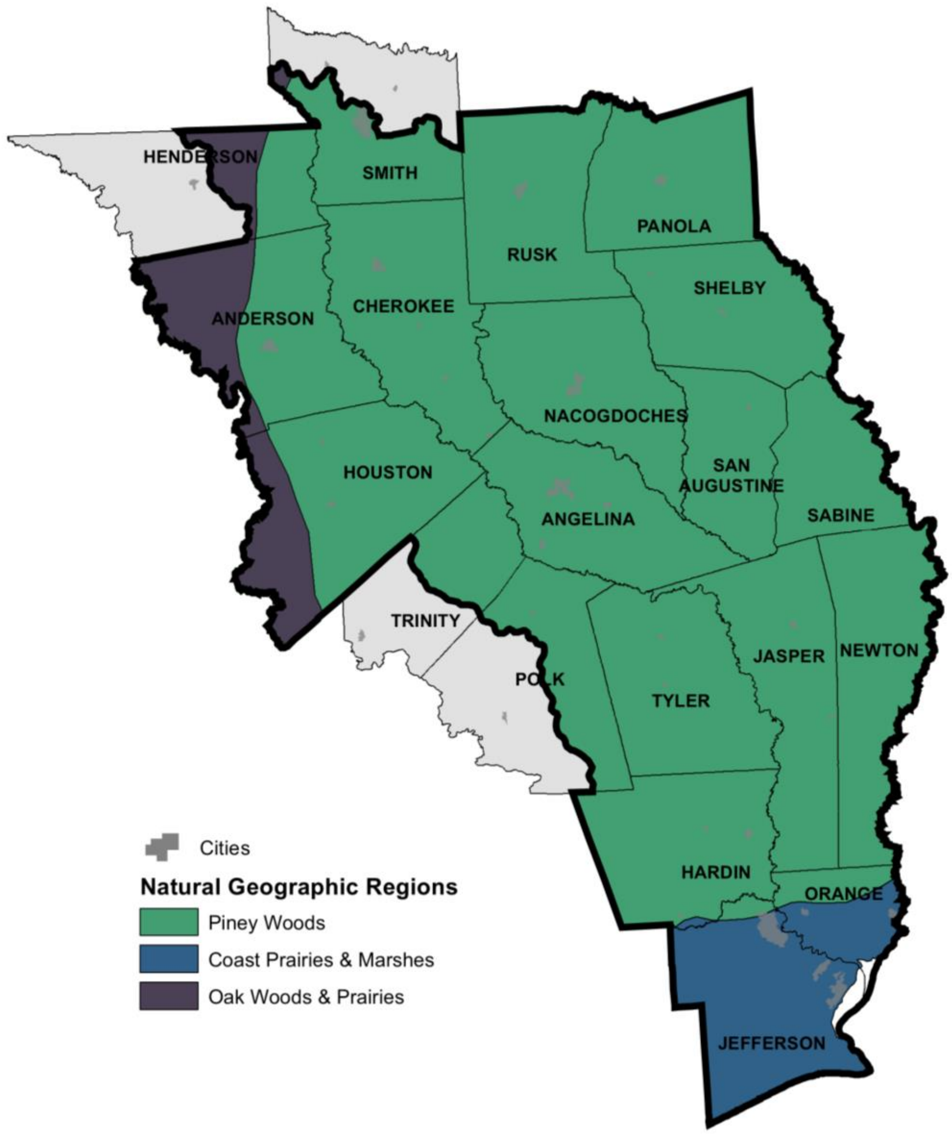


Figure 1.2 Natural Geographic Regions

SOURCE: TEXAS NATURAL RESOURCE INFORMATION SYSTEM

1.1.2 Climate

Data from National Weather Service Stations compiled by the Texas State Climatologist indicate that the mean temperatures for the entire region varied from a minimum January temperature of 35 °F in both Anderson and Henderson counties, to a maximum July temperature of 94 °F in Shelby County.[1] Similarly, the average growing season from 1981 to 2010 was 252 days in the ETRWPA.[2]

Precipitation generally increases from the northwest to southeast corners of the region, while evaporation increases in the opposite direction. Annual rainfall across the ETRWPA averaged 51.5 inches from 1981 through 2010, with the highest average rainfall (61.0 inches) being recorded in the southwest corner of Quadrant 714 and the lowest average rainfall (41.0 inches) being recorded in Quadrants 512 and 612. Average annual runoff ranges from approximately 10 inches in the northwest to 17 inches in the southeast. From 1954 to 2018 the average annual gross reservoir evaporation (the rate of evaporation from a reservoir) ranges from approximately 46 inches in the southeast to 57 inches in the northwest.[3]

Figures 1.3 through 1.5 depict mean annual temperature, mean annual precipitation, and gross reservoir evaporation, respectively for the ETRWPA.

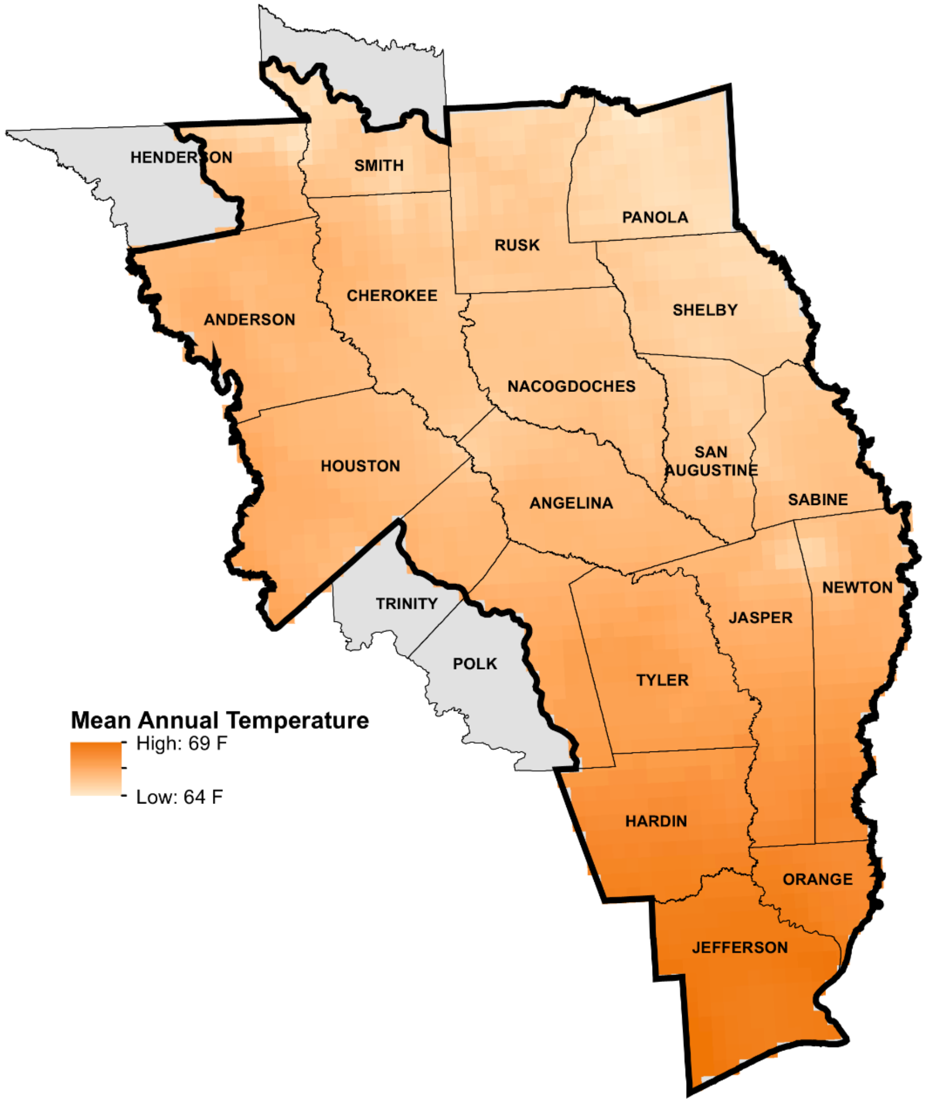


Figure 1.3 Mean Annual Temperature

SOURCE: PRISM CLIMATE GROUP

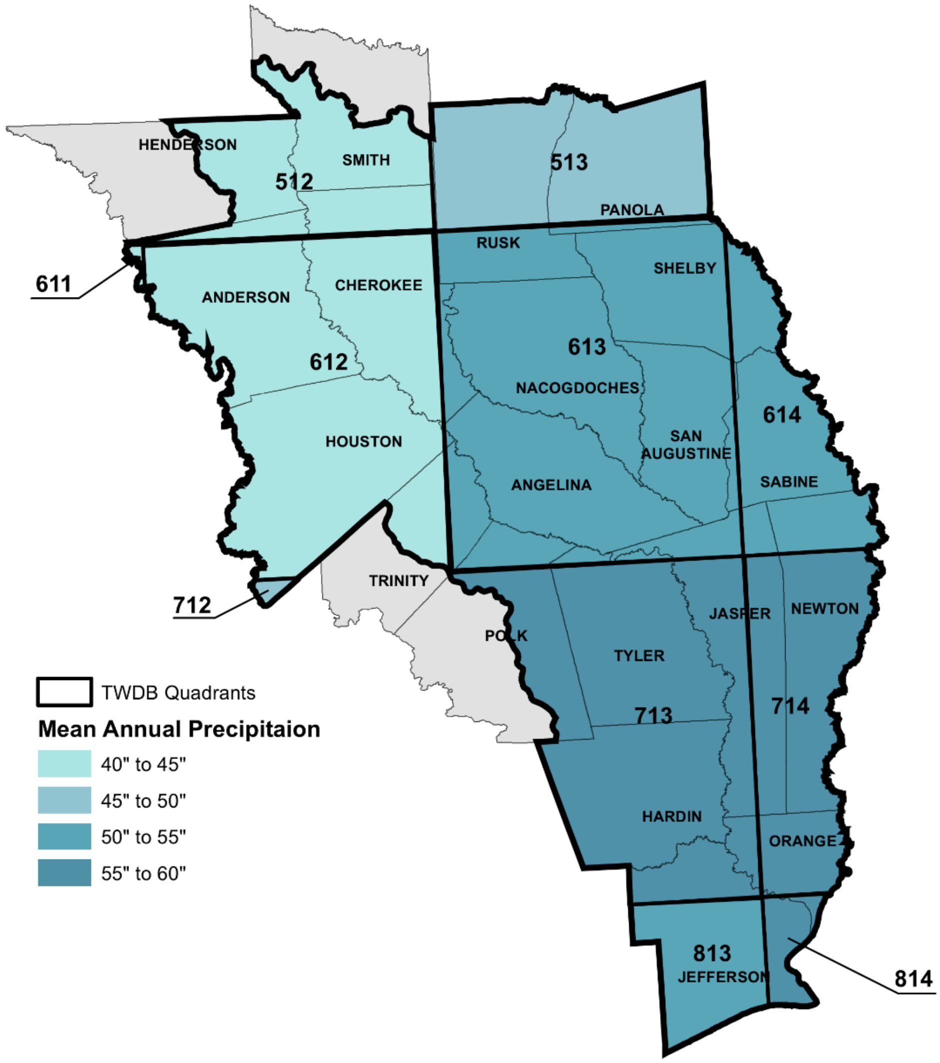


Figure 1.4 Mean Annual Precipitation

SOURCE: TEXAS WATER DEVELOPMENT BOARD

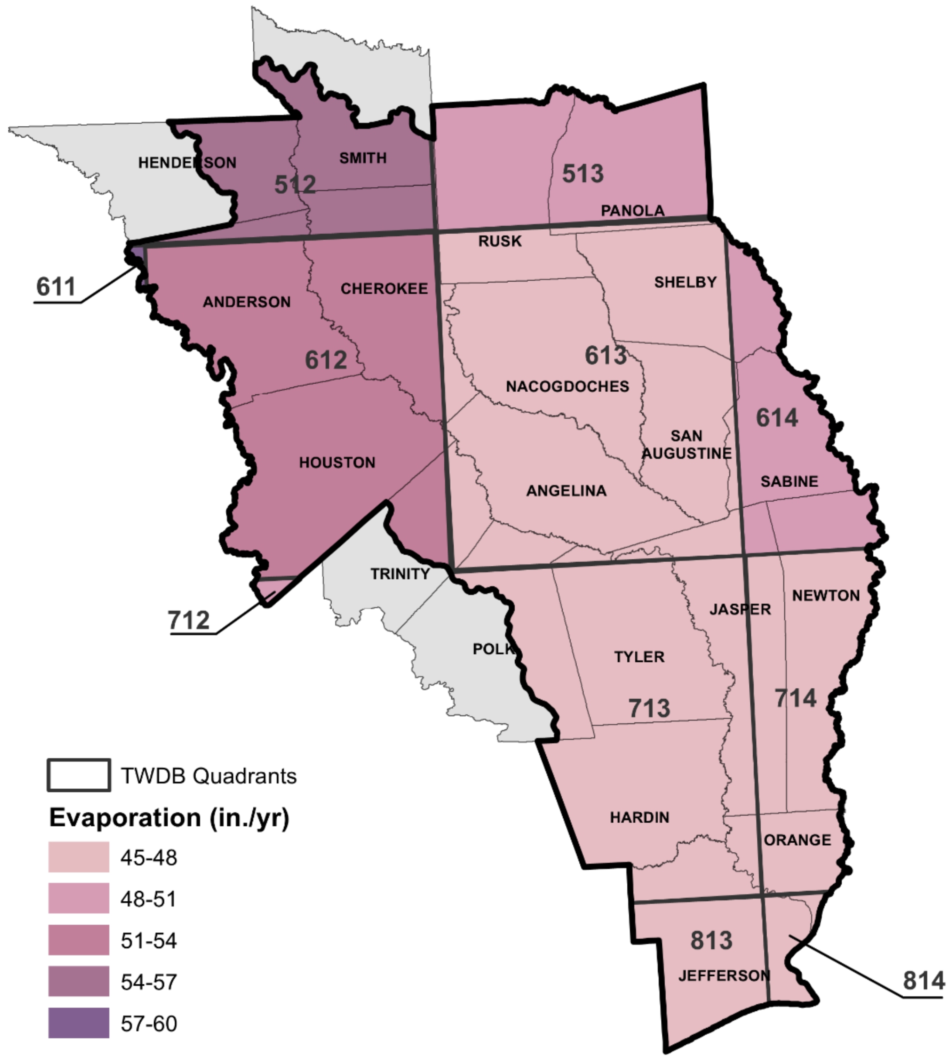


Figure 1.5 Gross Reservoir Evaporation

SOURCE: TEXAS WATER DEVELOPMENT BOARD

1.1.3 Population

The ETRWPA contains all or parts of three Metropolitan Statistical Areas (MSA) as defined by the Office of Management and Budget; an MSA is an urban area with a population of 50,000 or more.[4] The MSAs in the ETRWPA include:

- Beaumont-Port Arthur MSA (Jefferson, Orange, and Hardin counties).
- Part of the Longview MSA (Rusk County).
- Most of the Tyler MSA (portion of Smith County in Neches basin).

As of 2010, the combined population of these three MSAs is approximately 62% of the total ETRWPA population.

The population in the region increased approximately 6% from 2000 through 2010, to approximately 1.07 million people. Growth in the region is expected to continue at an average rate of approximately 6% per decade to approximately 1.61 million by 2080. The census data from 2000 and 2010 for the region's major cities are provided in Figure 1.6. Additional details on population projections developed by the TWDB are provided in Chapter 2 and Appendix ES-A, Report 01.

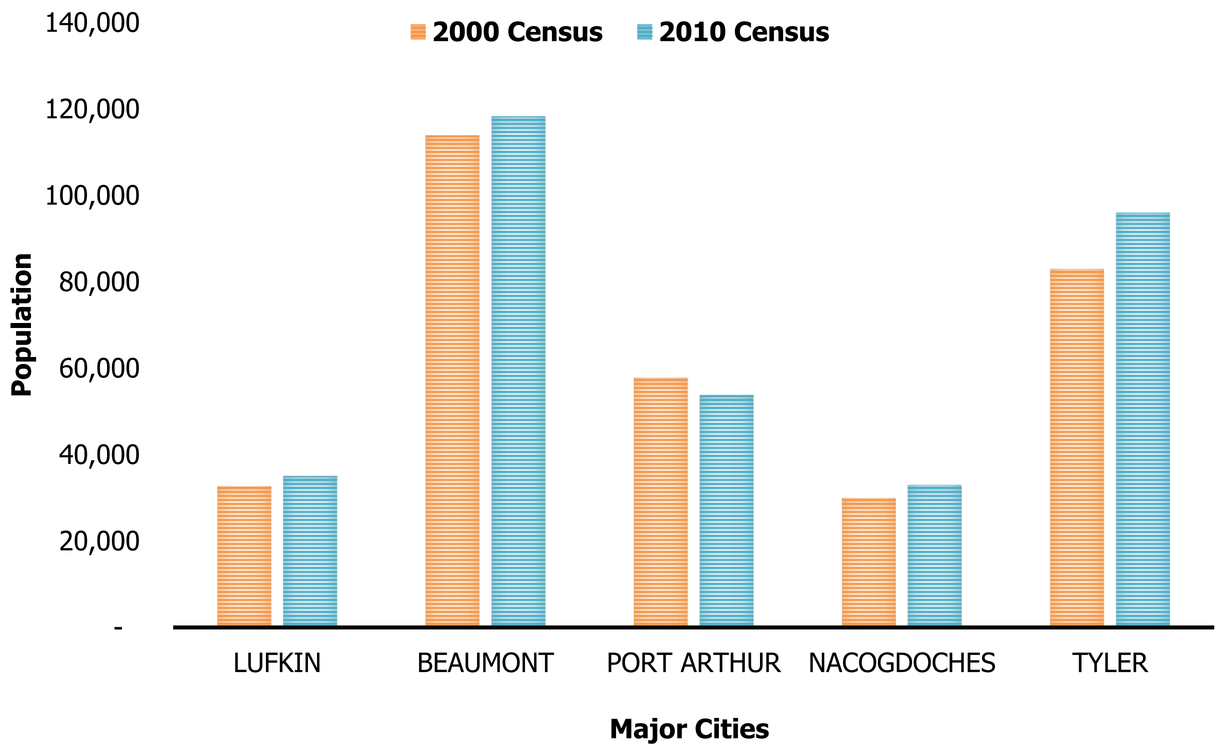


Figure 1.6 Historical Populations of Major Cities

SOURCE: U.S. CENSUS BUREAU

1.1.4 Economic Activity

The overall economy of the region consists primarily of agriculture, agribusiness, mineral production, wholesale and retail trade, and manufacturing. Manufacturing includes the timber and petrochemical industries. Major water-using industries and irrigated crops in the ETRWPA are listed in Table 1.2.

Table 1.2 Economic Sectors Heavily Dependent on Water Resources

Use Category	Detail
Irrigation	Hay
	Rice
	Soybeans
	Vegetables
Livestock	Poultry
	Cattle
Manufacturing	Timber, Pulpwood, and Forest Fiber
	Chemical and Allied Products
	Petroleum Refining
Mining	Oil and Gas Production

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

The Beaumont-Port Arthur MSA, at the southern end of the region, has an economy based primarily on petroleum refining and chemical plants including petrochemicals. Other industries include a steel mill and paper mills, correctional facilities, as well as other timber products industries in Hardin and Tyler counties.

Several seaports are located in the cities of Beaumont, Port Arthur, and Orange, plus several industrial docks, along with small amounts of shipyard activity. Agriculture in the area includes cattle, rice, and soybeans. Oil and gas production are significant.

Four campuses of the university system of the State of Texas are located in the area. Beaumont contains Lamar University and the adjacent Lamar Institute of Technology. Lamar State College-Port Arthur and Lamar State College-Orange are located in Port Arthur and Orange, respectively.

The majority of the Longview MSA is located just outside the region, north of Rusk County. It is centered in Longview in Gregg County. However, the area includes very diversified manufacturing located within the ETRWPA in Rusk County. Rusk County manufacturing includes brick manufacturing, power generation, steel fabrication, fiberglass specialties, and timber industry. Rusk County also has state correctional facilities. No major ETRWPA cities are located in this area.

The Tyler MSA, consisting of Smith County, lies partially within the northern end of the region. Tyler, the only major city in the area, lies almost entirely within the ETRWPA. Local manufacturing includes air conditioning/heating equipment, cast iron pipe, tires, and meatpacking, including poultry processing. Known as the "Rose Capital," Tyler has a thriving commercial rose industry as well. Tyler is home to Tyler Junior College and the University of Texas at Tyler, and the city is a growing hub for the health-care industry and retail in East Texas. Oil production is prevalent in the area.

Lufkin and Nacogdoches, the other major cities in the ETRWPA, do not presently classify as MSAs. However, Lufkin and Nacogdoches are both projected to become MSAs by 2050 according to the current TWDB population projections. These cities, located in adjacent counties, have many similarities including timber products industries, poultry processing, higher education, and health care service providers. Nacogdoches also has manufacturers of valves, transformers, sealing products, and motor homes. Stephen F. Austin State University is located in Nacogdoches.

Economic activity for the remainder of the region includes timber industry, including numerous timber processing mills. Natural gas and some oil production are scattered throughout the region, and beef cattle production is prominent, being found in all counties in the region. Plant nurseries are common in the north part of the region. Poultry production and/or processing are prevalent in Anderson, Shelby, Nacogdoches, Angelina, San Augustine, Houston, Cherokee, Smith, Rusk, and Panola counties. There is diverse manufacturing in addition to timber industries. Commercial fishing is an important economic characteristic of Sabine Lake. Tourism, fishing, and hunting are important in many areas, especially on the large reservoirs in the center of the region, further to the south near Sabine Lake and the Gulf of Mexico, and in many forested areas.

Information from the Texas Workforce Commission shows unemployment for the region varying from 3.1% in Anderson County to 8.1% in Sabine County in 2018. Of the three workforce areas overlapping the region, the average annual wages for 2018 were as follows: [5]

- East Texas (northern counties): $43,420
- Deep East Texas (middle counties): $38,792
- South East Texas (Beaumont-Port Arthur metropolitan area): $53,560

1.2 Current Water Demands

The demand for water in the ETRWPA is expected to grow from 738,081 acre-feet per year (ac-ft/yr) in the year 2020 to a total of 839,601 ac-ft per year in 2070. The water demands considered in the regional water planning process are categorized into six major user groups: municipal, manufacturing, irrigation, steam electric, livestock and mining. A more detailed description for each user group is found in Chapter 2.

Most demand in the region centers on larger cities or metropolitan areas. Over half of the current and projected water demand lies in Jefferson and Orange counties in southeast Texas. In that area, the two dominant water usages are manufacturing and irrigation, the latter occurring mainly in Jefferson County. However, large volumes of water use can occur away from large cities too, as in the case of outlying industries and steam-electric power generating plants.

For purposes of the 2021 Plan, major demand centers have been selected according to varying criteria. A county was selected if its total water usage (without depending on a single industry) exceeded 40,000 ac-ft per year. In counties that were not selected, a single industry was selected if it had 20,000 ac-ft per year or more in 2020 and represented the majority of usage in the county. As summarized in Table 1.3, there are currently five major demand centers in the ETRWPA located in Jasper, Jefferson, Orange, Rusk, and Smith counties.

Table 1.3 Major Demand Centers

County	Water User Group	2020 Demand (ac-ft/yr)
Jasper	Manufacturing	45,973
Jefferson	Irrigation	88,536
	Manufacturing	202,902
	Municipal	60,124
Orange	Manufacturing	44,335
Rusk	Steam Electric Power	45,304
Smith	Municipal	32,979

SOURCE: TEXAS WATER DEVELOPMENT BOARD

1.3 Sources of Water

The ETRWPA obtains its supplies from groundwater and surface water sources, primarily. Springs within the region can also be an important source of water for some uses. Following is a summary of groundwater, springs, and surface water sources within the ETRWPA. Historical average pumping values for aquifers were obtained from the Historical Groundwater Pumpage Estimates report developed by the TWDB.

1.3.1 Groundwater

The TWDB has identified two major aquifers and three minor aquifers in the region. The difference between the major and minor classification, as used by the TWDB, relates to the total quantity of water produced from an aquifer and not necessarily the total volume available.

The two major aquifers that underlie the region are known as the Carrizo-Wilcox and the Gulf Coast. The three minor aquifers, the Queen City, Sparta, and Yegua-Jackson, supply lesser amounts of water to the region. Figure 1.7 and Figure 1.8 show the locations of the major and minor aquifers, respectively.

The following generalized descriptions of the characteristics and quality of major and minor aquifers in the ETRWPA are based largely on the work of TWDB. Groundwater quality is affected by natural conditions as well as man-made contamination. According to the Texas Commission on Environmental Quality (TCEQ), "natural contamination probably affects the quality of more groundwater in the state than all other sources of contamination combined."[6] A more thorough discussion of groundwater availability is provided in Chapter 3.

Gulf Coast Aquifer. The Gulf Coast is a major aquifer that forms an irregularly shaped belt along the Gulf of Mexico from Florida to Mexico. In Texas, the aquifer provides water to all or parts of 54 counties, including 8 counties in the ETRWPA. It extends from the Rio Grande northeastward to the borders with Louisiana and Arkansas. The Gulf Coast aquifer provides the sole source of groundwater in the seven southern counties of the region.

The Gulf Coast aquifer contains various interconnected layers, some of which are aquicludes (impervious clay or rock layers). From bottom to top, the four main water-producing layers are the Catahoula, Jasper, Evangeline, and Chicot layers, with the Evangeline and Chicot being the main sources of groundwater in southeast Texas. Total pumpage from the Gulf Coast aquifer in the region averaged approximately 74,557 ac-ft per year in years 2013 through 2017.

Water quality in the Gulf Coast aquifer varies significantly, depending on location. Salt water intrusion is a significant source of natural contamination because of the proximity of the Gulf of Mexico. Under natural conditions, in the absence of pumping, a layer of salt water underlies the lighter fresh water layer with a well-defined interface between the two layers. At any given point, especially near the coast, deeper aquifers may be filled with salt water, very shallow aquifers may contain all fresh water, and an intermediate aquifer may be contained in the interface between the two. In areas near the coast, dissolved salts concentrations are generally in excess of 1,000 parts per million (ppm); sometimes more than 10,000 ppm. In areas of the aquifer further from the coast, dissolved salts concentrations can drop to less than 500 ppm.

Heavy pumpage has caused an updip migration, or saltwater intrusion, of poor quality water into the aquifer beyond its natural limits. A 1990 TWDB report indicated that salt water conditions are a problem in Orange County in the heavily pumped areas around the cities of Orange and Vidor. The previously referenced TCEQ report also indicates high chloride concentrations in most of Jefferson County. Much of the migration is lateral, but some localized vertical coning occurs in wells that draw from levels above the interface between salt and fresh water. In coning, some salt water is drawn up into the pumping well from below along with the fresh water at the intake level.

In some areas, natural contamination results from substances in the soil or in the aquifer media. Radioactivity is present in groundwater from natural causes, particularly in a belt across the ETRWPA including the area lacking major or minor aquifers designations. Some areas have nuisance substances in the groundwater such as iron, manganese, and sulfates affecting the taste or color of the water.

Man-made aquifer pollution may result from improper waste disposal, leaking underground tanks, wood preservation operations, pesticide use in agriculture, and improperly constructed wells.[6, 7] There is no current evidence indicating that water quality problems are directly associated with man-made pollution.

The Gulf Coast aquifer generally contains good quality water except in portions of Jefferson and Orange counties. The Carrizo-Wilcox aquifer generally has good water quality except for high dissolved solids in a band along its southern boundary. Iron is a widespread problem and sulfates and chlorides are found in scattered locations throughout the aquifer. [6, 7]

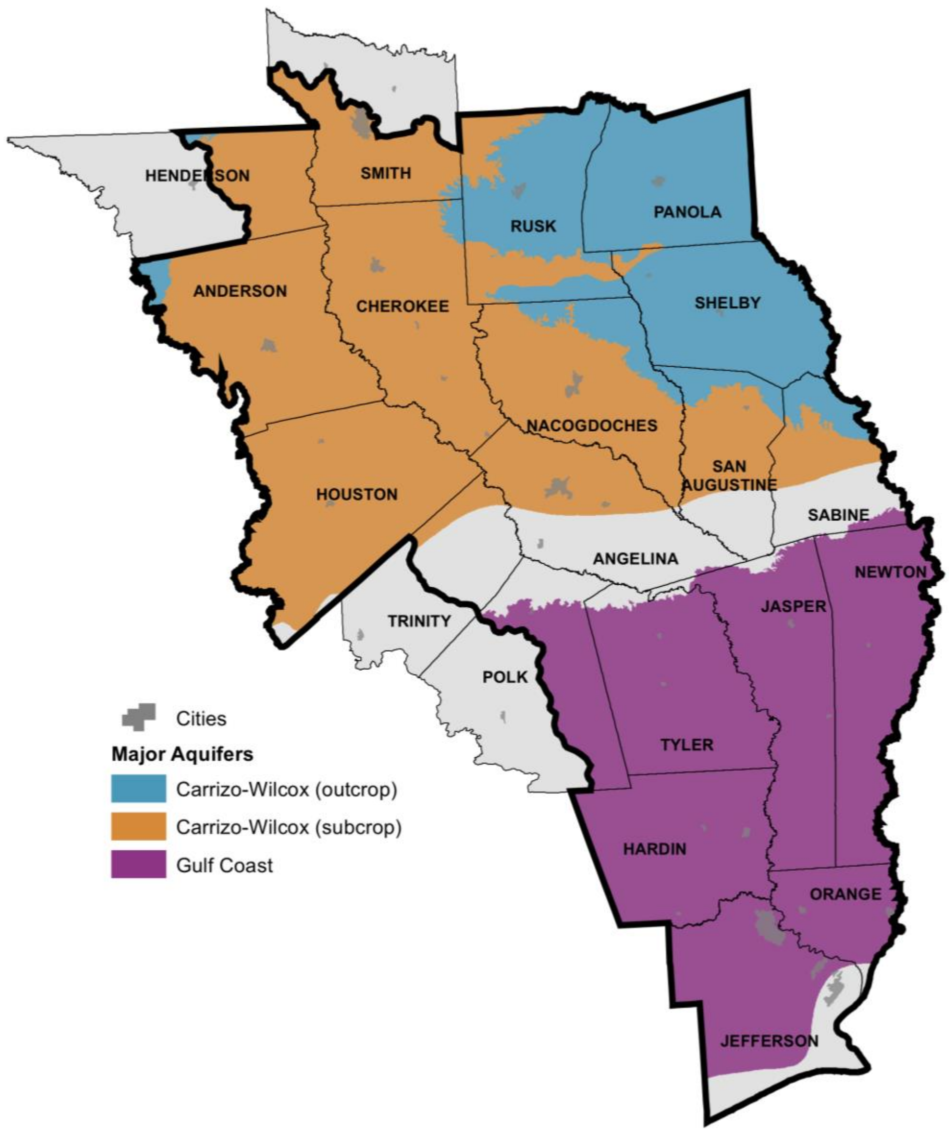


Figure 1.7 Major Aquifers

SOURCE: TEXAS WATER DEVELOPMENT BOARD

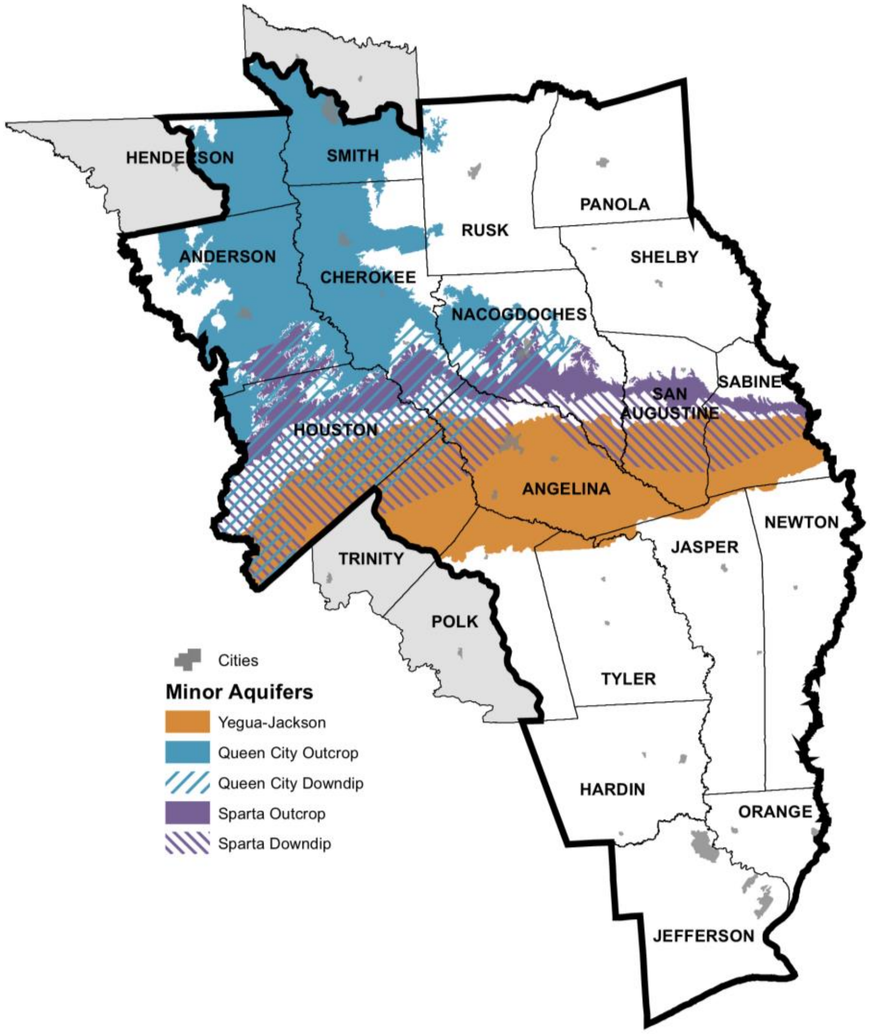


Figure 1.8 Minor Aquifers

SOURCE: TEXAS WATER DEVELOPMENT BOARD

Carrizo-Wilcox Aquifer. The Carrizo-Wilcox is a major aquifer that is formed by the hydraulically connected Wilcox Group and the overlying Carrizo Formation of the Claiborne Group. This aquifer extends from the Rio Grande in south Texas northeastward into Arkansas and Louisiana, providing water to all or parts of 60 counties in Texas, including 13 in the ETRWPA. The aquifer in the ETRWPA occurs as a major trough caused by the Sabine Uplift near the Texas-Louisiana border. It is a major source of water supply for the region.

Total groundwater pumpage from the Carrizo-Wilcox in the region averaged 71,612 ac-ft per year based on historical pumping for years 2013 through 2017. The largest urban areas dependent on groundwater from the Carrizo-Wilcox are located in central and northeast Texas and include the ETRWPA cities of Lufkin (Angelina County), Nacogdoches (Nacogdoches County), and Tyler (Smith County). Well yields of greater than 500 gallons per minute (gpm) are not uncommon.

In some wells, declines in the artesian portion of the Carrizo-Wilcox in this area have exceeded 300 feet. However, evaluation of 46 Carrizo-Wilcox wells scattered throughout the region that have been monitored since the 1960s indicates that the average water level decline from the 1960s to the 1990s is about 51 feet and ranges from 20 feet below ground level to 263 feet below ground level. Significant water-level declines have occurred in the region around Tyler and the Lufkin-Nacogdoches area.

Large water level declines have also occurred in Smith, Anderson, and Leon counties in the confined portions of the aquifer. Generally, wells located in the northern part of the aquifer have relatively stable groundwater levels. [8]

Much of this pumpage has been for municipal supply, but industrial pumpage is also significant. However, pumpage from industries has generally declined since the 1980s. Total pumpage from the Carrizo in Angelina and Nacogdoches counties has decreased since the 1980s and therefore, water levels have stabilized in these areas. In some wells, water levels have increased, although the wells are still being utilized.

Water quality in the Carrizo-Wilcox is generally good. Dissolved solids concentrations are typically less than 500 ppm in outcrop areas; but can be greater than 1,000 ppm in deeper zones. In addition, groundwater in deeper zones often contain iron and manganese at concentrations that exceed the secondary drinking water standards.

Sparta Aquifer. The Sparta is a minor aquifer that extends in a narrow band across the state from the Frio River in South Texas northeastward to the Louisiana border in Sabine County. The Sparta Formation is part of the Claiborne Group deposited during the Tertiary Period and consists of sand and interbedded clay with more massive sand beds in the basal section.

Yields of individual wells are generally low to moderate, although most high-capacity wells average 400 to 500 gpm. Because the Carrizo aquifer underlies the Sparta, most public water supply wells and other large production wells are completed in the Carrizo, thus limiting the total pumpage from the Sparta.

Relatively large amounts of usable quality groundwater are contained within the rocks of the Sparta aquifer. Historically, availability has been considered 5 percent of the average annual rainfall on the aquifer in the Neches and Sabine River basins.

The Sparta aquifer produces water of excellent quality throughout most of its extent in the region; however, water quality deteriorates with depth in the downdip direction. Water quality can deteriorate at depths greater than 2,000 feet below ground surface. Dissolved salts concentrations in shallower zones averages around 300 ppm; and can be around 800 ppm with depth. Iron concentrations are generally high.

Queen City Aquifer. Like the Sparta, the Queen City aquifer extends in a band across most of Texas from the Frio River in South Texas northeastward into Louisiana. The Queen City Formation is composed mainly of sand, loosely cemented sandstone, and interbedded clays. Although large amounts of usable quality groundwater are contained in the Queen City, yields are typically low. A few well yields exceed 400 gpm.

Total historical groundwater pumpage from the Queen City in the region averaged 3,376 ac-ft per year during 2013 through 2017. Groundwater levels in most Queen City wells have remained relatively stable, with variations less than 20 feet. However, the water level in a Wood County well declined approximately 100 feet between 1980 and 2016.

In the Neches, Sulphur, Sabine, and Cypress Creek basins, availability from the Queen City aquifer based on recharge has been estimated at 5 percent of average annual precipitation. Because of the relatively low well yields, overdrafting of the Queen City Aquifer is generally not a problem.

Throughout most of its extent, the chemical quality of the Queen City aquifer water is excellent; however, quality deteriorates with depth in the downdip direction. Dissolved salts concentrations in the Queen City aquifer are generally between 300 and 750 ppm. Dissolved iron concentrations can be high, particularly in northeastern areas of the aquifer.

Yegua-Jackson. The Yegua-Jackson aquifer extends in a narrow band from the Rio Grande to Louisiana. In the ETRWPA, the aquifer is located in the southern half of Sabine and San Augustine counties, the lower tip of Nacogdoches County, most of Angelina County, the southern portion of Houston County, those portions of Polk and Trinity counties located in the ETRWPA, and small northern portions of Tyler, Jasper, and Newton counties. The Yegua-Jackson aquifer is a complex association of sand, silt, and clay deposited during the Tertiary Period.

Total historical groundwater pumpage from the Yegua-Jackson in the region averaged 5,498 ac-ft per year during 2013 through 2017.

Water quality in the Yegua-Jackson aquifer varies, with dissolved salts concentrations ranging between 50 and 1,000 ppm in most cases. Iron is a problem, and the water from at least one location has been described as "sodium bicarbonate water."

Groundwater Conservation Districts. Groundwater conservation districts (GCDs) were created by the legislature for the purpose expressed in Chapter 36 of the Texas Water Code as follows:

Sec. 36.0015. PURPOSE. In order to provide for the conservation, preservation, protection, recharging, and prevention of waste of 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, GCDs may be created as provided by this chapter. Groundwater conservation districts created as provided by this chapter are the state's preferred method of groundwater management through rules developed, adopted, and promulgated by a district in accordance with the provisions of this chapter.

More specifically, these districts are granted authority to regulate the spacing and/or production rate from water wells. In some cases, districts may regulate or prohibit exportation of groundwater from the district, provided the exportation did not begin before June 1, 1997. Districts may impose a fee for water exported from the district.

Districts are required to develop five-year groundwater management plans and to provide the plan (and any amendments) to applicable regional planning groups. Districts must establish permitting systems for new or modified wells and must keep on file copies of drilling logs.

Most counties in the ETRWPA are covered by a GCD. Following is a brief description of the county breakdown among GCDs.

Anderson, Henderson, and Cherokee Counties. The Neches and Trinity Valleys GCD, created in 2001 and headquartered at Jacksonville, covers Cherokee County and almost all of Anderson County, both in the ETRWPA, as well as Henderson County (which overlaps Regions C and the ETRWPA). The remainder of Anderson County, in the Palestine-Montalba area, is covered by the Anderson County Underground Water Conservation District, created in 1987, and headquartered at Montalba.

Angelina and Nacogdoches Counties. Angelina and Nacogdoches counties are covered by the Pineywoods GCD, created in 2001 and headquartered in Lufkin. The GCD has regulations including a permitting system for water wells within its territory.

Jasper, Newton, Tyler, and Hardin Counties. The Southeast Texas GCD, headquartered in Kirbyville, regulates groundwater in these four counties and was created by the legislature in 2003.

Sabine, San Augustine, and Shelby Counties. The Deep East Texas GCD was created in the 83rd Legislature in 2013 and needs confirmation via voter approval to become official.

Polk County. Polk County is covered by the Lower Trinity GCD that was created by the 79th Legislature in 2005.

Panola County. The Panola County GCD was created by the 80th Legislature, has been confirmed by local election in 2007, and has a management plan in place.

Rusk County. The Rusk County GCD, was created by the 78th legislature in 2003, confirmed by local election in 2004, and is headquartered in Henderson. The District has a groundwater management plan in place.

Houston, Jefferson, Orange, Smith, and Trinity counties are not covered by any confirmed or pending GCD.

Groundwater Management Areas. The TWDB has divided the state into sixteen groundwater management areas (GMAs) as required by the legislature. These areas were established on the basis of political and aquifer boundaries for the purpose of planning and regulation. (A GMA is only a designated geographic area, not an entity with board members, staff, or governing power.) GCDs within each GMA are required to share planning information, develop Desired Future Conditions, and estimate Modeled Available Groundwater for permitting purposes.

The boundaries of the ETRWPA encompass portions of GMAs 11 and 14. GMA 11 lies north of the northern lines of Polk, Tyler, Jasper, and Newton counties in Region I and generally covers the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers. GMA 14 encompasses the Gulf Coast aquifer including Polk, Tyler, Jasper, and Newton counties and counties to the south toward the Texas coast.

The GCDs and GMAs in Region I are shown in Figure 1.9.

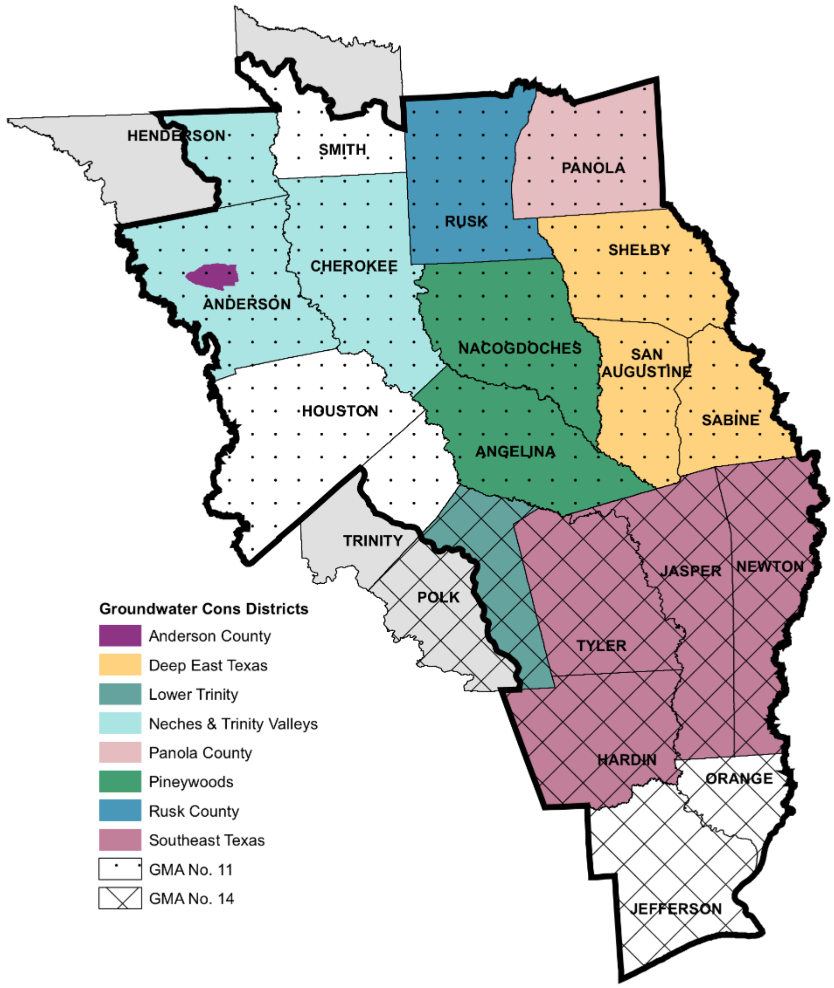


Figure 1.9 Groundwater Conservation Districts and Groundwater Management Areas

SOURCE: TEXAS WATER DEVELOPMENT BOARD

1.3.2 Springs

Over 250 springs of various sizes are documented in the ETRWPA according to the research of Gunnar M. Brune.[9] Most of the springs discharge less than 10 gpm and are inconsequential for most water supply planning purposes. However, springs are an important source of water for local supplies and provide crucial water for wildlife and, in some cases, livestock.

Based on discharge measurements collected mainly in the 1970s, 28 springs in the region discharge between 20 and 200 gpm, and there are seven springs that discharge between 200 and 2,000 gpm. It should be noted that Brune's research did not cover Anderson, Angelina, Henderson, Houston, or Trinity counties. In addition, Brune did not document any springs with flow greater than 20 gpm in Jefferson, Orange, or Panola County. U.S. Geological Survey (USGS) information was reviewed and only two springs with flows greater than 20 gpm, Black Ankle Springs in San Augustine and King's Spring in Polk County, were identified. Figure 1.10 shows the springs in the ETRWPA using USGS information.

Brune reported a flow of 5,700 gpm in the spring-fed Indian Creek in Jasper County, about five miles northwest of Jasper. This water was used at a Texas Parks and Wildlife Department (TPWD) fish hatchery.

Other notable springs are Spring Lake Springs in Smith County (570 gpm in 1979), Bailey Springs in Shelby County (620 gpm in 1976), Caney Creek Springs in Houston County (760 gpm in 1965), Hays Branch Springs in Houston County (810 gpm in 1965), and Elkhart Creek Springs in Houston County (1,500 gpm in 1965).

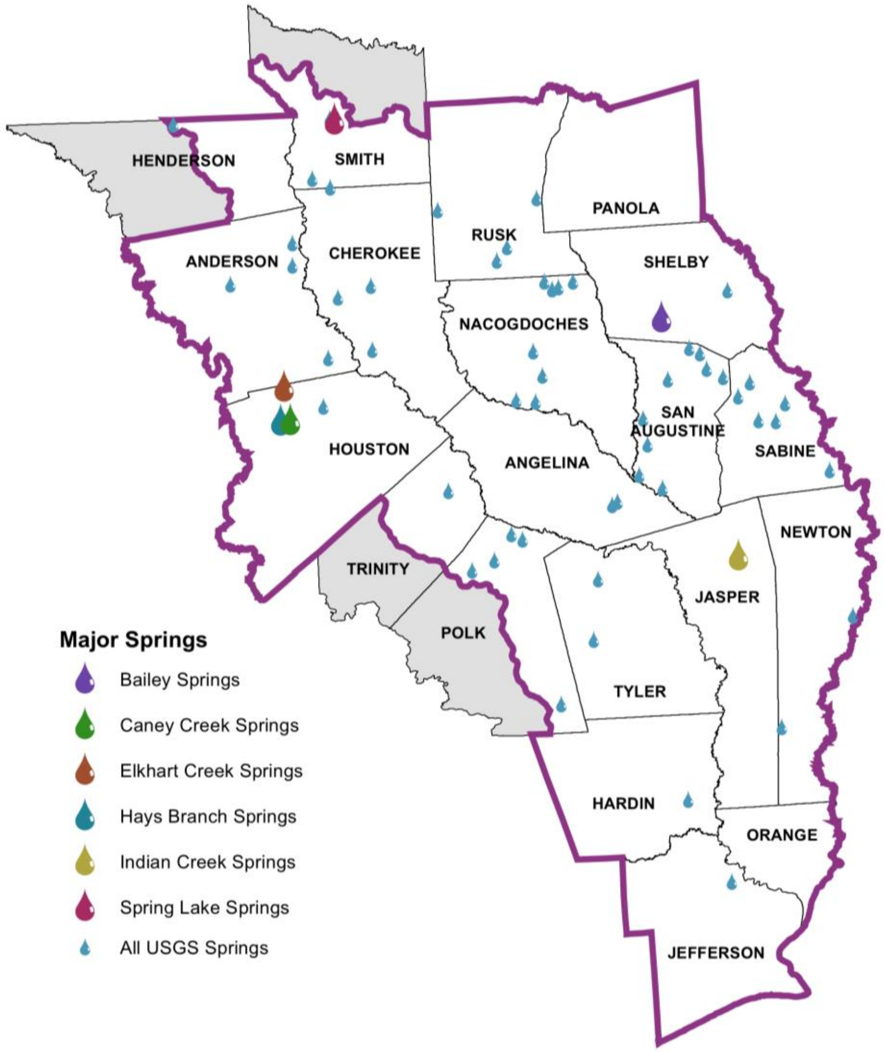


Figure 1.10 U.S. Geographical Survey Identified Springs

SOURCE: U.S. GEOGRAPHICAL SURVEY

1.3.3 Surface Water

Surface water includes water that may be obtained directly from streams, rivers, or reservoirs. Surface water sources within the ETRWPA include portions of three major river basins, and one coastal basin. Most of the region falls within the Neches River Basin. In fact, the majority of the Neches River Basin is located in the ETRWPA. The region also includes much of the Texas portion of the Sabine River Basin; portions of the Trinity River Basin in two counties; and a portion of the Neches-Trinity Coastal Basin in Jefferson County. Approximately one square mile of the Cypress Creek Basin lies in the northeastern portion of Panola County. Figure 1.11 indicates the locations of the major river basins within the ETRWPA. Additional descriptions of the Neches, Sabine, and Trinity River Basins follow. The current water supplies associated with each basin are described in detail in Chapter 3.

Neches River. The Neches River Basin originates in Van Zandt County, Texas, and flows for a distance of approximately 416 miles to Sabine Lake. In its course, the river passes through or forms a boundary for 14 counties in Texas. These include the ETRWPA counties of Smith, Henderson, Cherokee, Anderson, Houston, Angelina, Trinity, Polk, Tyler, Jasper, Hardin, Orange, and Jefferson.

The drainage area for the entire basin is approximately 10,000 square miles. Approximately 9,585 square miles of the basin are located within the ETRWPA. Approximately one-third of the basin area is comprised of the Angelina River Basin. Significant tributaries to the Neches River Basin include Pine Island Bayou and Village Creek. The Neches River Basin contributes nearly six million acre-feet of water to Sabine Lake annually.

Sabine River

The Sabine River originates in Hunt County, Texas, in Region C. It flows for a distance of approximately 550 miles in a generally southeast direction to Sabine Lake. The river passes through or forms a boundary for five counties in the ETRWPA: Panola, Shelby, Sabine, Newton, and Orange counties. Most of the river's course within the ETRWPA forms the boundary between Texas and Louisiana. The Sabine River Basin covers approximately 9,750 square miles, of which approximately 76% is in Texas. The remainder of the basin is located in Louisiana. Approximately 3,930 square miles of the basin are located within the ETRWPA. The Sabine River Basin contributes approximately 6.4 million acre-feet of water to Sabine Lake annually.

Neches-Trinity Basin. The coastal plain between the Neches River and Trinity River forms the Neches-Trinity Coastal Basin. The area is mostly located in Jefferson County (in the ETRWPA) and Chambers County (in Region H). Maximum elevation in the basin is approximately 50 feet, although most of the basin is less than 25 feet in elevation. Total basin drainage area is approximately 1,692 square miles. Approximately 858 square miles of the basin are located within the ETRWPA. In Jefferson County, the basin drains primarily to the Gulf Coast and to Sabine Lake.

Trinity River. The Trinity River is the longest river that flows entirely within Texas, and while a major water body in the State, only a small portion is located in the ETRWPA. The Trinity River has reaches that meet the legal definition of navigable waters, but it is not currently used for this purpose due to a cost-benefit analysis performed by the U.S. Army Corps of Engineers in the 1970s. The Trinity River basin falls almost entirely within the political boundary of the Trinity River Authority, a wholesale water provider in Regions C and H. In the ETRWPA, it forms a western boundary for Anderson and Houston counties. Approximately 1,420 square miles of the Trinity River basin are located within the ETRWPA.

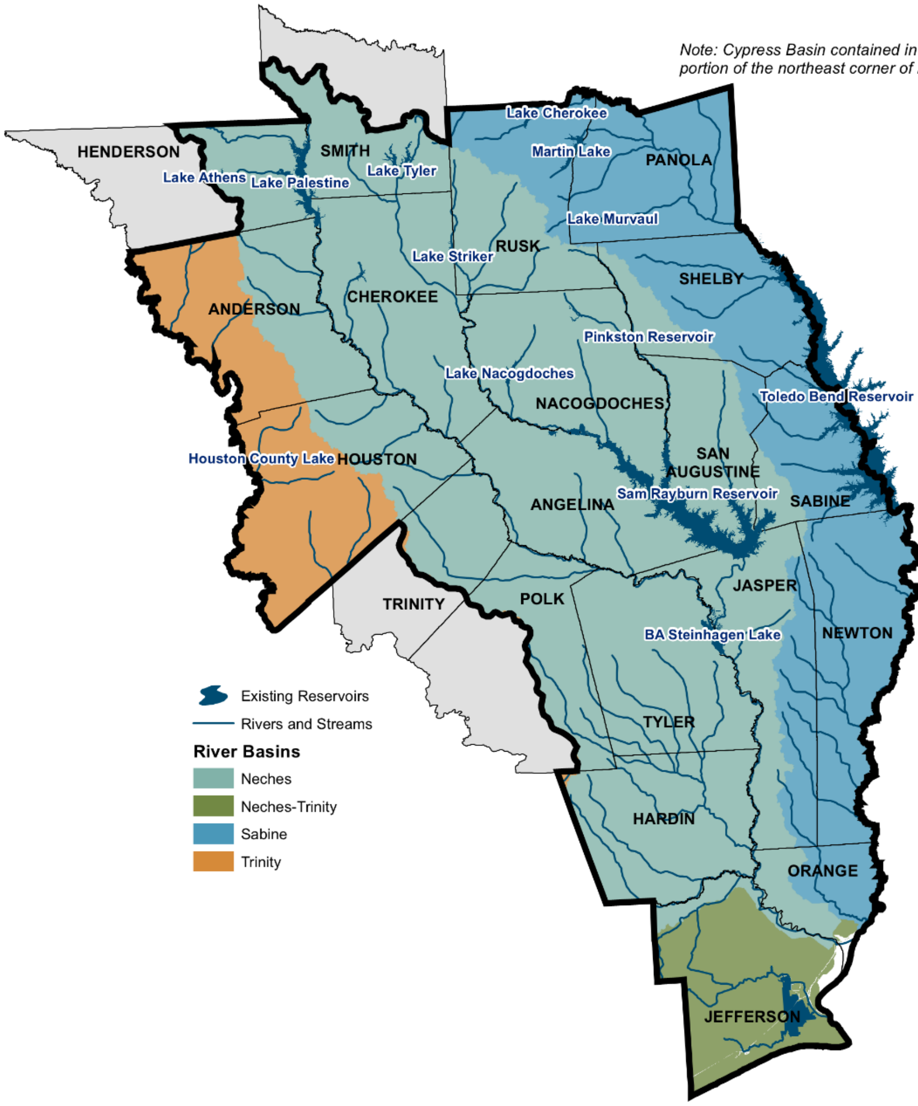


Figure 1.11 Surface Water Sources

SOURCE: TEXAS WATER DEVELOPMENT BOARD & U.S. CENSUS BUREAU

Reservoirs. In the ETRWPA, most surface water is provided by one of fourteen existing water supply reservoirs. Locations of major reservoirs in the region are shown on Figure 1.11. Details regarding these reservoirs are provided in Chapter 3.

Surface water quality in the region varies between water bodies but is generally considered to be very good for water supply purposes. Stream and lake segments with water quality impairments, as identified by the Texas Commission on Environmental Quality (TCEQ), are discussed in Section 1.10 of this chapter. While none of the segments in the region indicate problems as drinking water sources, aquatic life uses, fish consumption, and recreational uses are sometimes not supported in the water bodies.

Fish consumption is the subject of Texas Department of State Health Services advisories in a number of segments, mostly in reservoirs as a result of mercury found in certain species of fish.[10] The mercury concentration in the water is negligible and does not present problems for recreation or water supply.[11, 12]

Even though the water in the reservoirs and streams is usable as a drinking water source, surface water generally requires more extensive treatment than groundwater. This additional treatment for surface water generally includes sedimentation, filtration, and disinfection. Other more advanced treatment methods for surface water are uncommon in the ETRWPA.

Tidal Sources of Surface Water. Salt water intrusion can be a major concern in the tidal reaches of streams. Salt water, being denser than fresh water, tends to settle on the bottom of the channel. The horizontal and vertical extent of the salt water layer varies according to several factors including fresh water inflow and tidal influence.

In the ETRWPA, salt water has become a significant concern for Sabine Lake and the lower reaches of the Neches and Sabine Rivers, since a ship channel between the Gulf of Mexico and Sabine Lake (i.e., the Sabine-Neches Waterway) was dredged around the beginning of the twentieth century. Salt water intrusion, exacerbated by dredging of the Sabine-Neches Waterway, has disqualified the lower segments of the Sabine and Neches Rivers from use as drinking water supplies without addition of advanced treatment to remove salts. There are still some industrial uses, including cooling, that may be available.

At times of low flow in the rivers, the 0.5 parts per thousand (ppt) isohaline (the dividing line between "freshwater" and "saltwater") moves upstream; conversely, at times of high flow in the rivers, the 0.5 ppt isohaline moves downstream. Upstream saltwater encroachment can adversely affect freshwater habitat and the suitability of water quality for water supply purposes.

In line with the recommendations of the 1997 State Water Plan, the Neches River Salt Water Barrier has been constructed at a location north of Beaumont below the confluence of the Neches River and Pine Island Bayou. The project, completed in 2003, prevents saltwater from reaching the freshwater intakes of Lower Neches River cities, industries, and farms during periods of low flow. The project is a gated structure, allowing adjustment to prevent saltwater intrusion while maintaining flows. It is also equipped with a gated navigation channel to enable the passage of watercraft around the barrier.

Pollution from industrial discharges was historically a major concern in the tidal areas of the lower Neches and Sabine Rivers. However, largely due to strengthened environmental regulation and to increased environmental awareness, industries in the region have made significant improvements to the quality of their effluent discharges.

1.3.4 Reuse

Reuse of effluent from wastewater treatment plants (i.e., water reuse) is another water source for the region, but the current use of reuse supplies in the ETRWPA is small as compared to groundwater and surface water supplies. Water reuse supplies are assessed based on historical and current use and total approximately 14,000 ac-ft per year during the planning period. Currently, reuse is used only for non-potable applications by Manufacturing and Irrigation industries. Additional discussion of water reuse in the ETRWPA is found in Chapter 3.

1.3.5 Special Water Resources

Special water resources are defined by the Texas Administrative Code as surface water resources where the water rights are owned in whole or in part by an entity in another region, water supply contract, or existing water supply option agreement results in water from the surface water resource being supplied to an entity in another regional water planning area. Special water resources within the ETRWPA include Lake Athens, Lake Cherokee, and Lake Palestine.

Planning for these resources was coordinated with water rights holders and regions where the water is currently being used or planned to be used. Water plan development considered special water resources in the ETRWPA in order to protect the water rights, water supply contracts, and water supply option agreements associated with the special water resources to ensure that water supplies obligated to meet demands outside the ETRWPA are not adversely impacted.

1.3.6 Threats and Constraints on Water Supply

Water supplies in the ETRWPA may be threatened by conditions outside of the region. Some significant potential threats and constraints are discussed following. A more detailed discussion of potential threats to water supplies may be found in Chapter 3.

Interstate Allocation. The allocation of water in the Sabine River Basin between Texas and Louisiana is a vital factor in any water study involving the Texas portion of the basin. As noted earlier, the river forms the state line for the downstream half of its length after heading in Texas far from the state line. Almost the entire basin upstream from the state line is in Texas. However, Texas does not have completely unrestricted access to the water in the basin because of allocation restrictions with Louisiana.

The Sabine River Compact, executed in 1953, provides for allotment of the water between Texas and Louisiana.[13] This agreement was not only ratified by the two state legislatures but also approved by Congress.

Texas has unrestricted access to the water in the upper reach of the river except for the requirement of a minimum flow of 36 cfs at the junction between the river and the state line. Texas may construct reservoirs in the upper reach and use their water either there or in the downstream reach without loss of ownership.

Any reservoir constructed on the downstream reach must be approved by both states. The ownership, operating cost, and water yield are proportional to the portions of the construction cost paid by the two states. To date, Toledo Bend is the only reservoir constructed in the lower reach. In the case of Toledo Bend, the states split the cost equally and have equal ownership of the lake and its yield.

Any unappropriated water in the lower reach (not contained in or released from a reservoir) is divided equally between the two states. Since Toledo Bend extends to a point upstream from the junction of the river and the state line, the only water in that category is the water entering the river downstream from the dam.

The water in any reservoir on a tributary to the downstream reach can be used in the state where it is located, but that usage comes out of the state's share of the water in the river.

Inter-region Diversions. The City of Dallas (Region C) has contractual rights to 114,337 acre-feet of water from Lake Palestine in the Neches basin. The City does not presently have the facilities to transport and treat the water but anticipates the required construction to be complete by 2030. A long-range potential strategy to transfer water from Toledo Bend Reservoir to reservoirs located in Region C is under consideration.

Interception in Other Regions. It should be noted that large portions of the Sabine and Trinity basins are located upstream from the ETRWPA, as well as a small portion of the Neches basin. The upper Trinity basin includes the Dallas-Fort Worth area and falls within Region C and Region H to a large extent. The upper Sabine basin falls within both Region C and Region D and contains numerous medium sized cities as well as smaller communities east of the Dallas-Fort Worth area. Large amounts of surface water are already being used by the upstream communities, and this usage can be expected to increase dramatically in the future along with population growth. The Sabine River Authority of Texas (SRA) has contracts to provide over 300,000 ac-ft per year to the Dallas area from reservoirs in the upper Sabine basin.

1.4 Water User Groups and Major Water Providers

Water User Groups. Previous rounds of regional water planning have used city populations to calculate water usage in gallons per capita daily (GPCD); however, in this round of regional water planning, 31 TAC §357.30 includes a new utility-based definition for WUGs as follows that uses utility service area populations to calculate GPCD:

Water User Group (WUG) – Identified user or group of users for which Water Demands and Existing Water Supplies have been identified and analyzed and plans developed to meet Water Needs. These include:

> *(A) Privately-owned utilities that provide an average of more than 100 acre-feet per year for municipal use for all owned water systems;*
>
> *(B) Water systems serving institutions or facilities owned by the state or federal government that provide more than 100 acre-feet per year for municipal use;*
>
> *(C) All other Retail Public Utilities not covered in subparagraphs (A) and (B) of this paragraph that provide more than 100 acre-feet per year for municipal use;*
>
> *(D) Collective Reporting Units, or groups of Retail Public Utilities that have a common association and are requested for inclusion by the RWPG;*
>
> *(E) Municipal and domestic water use, referred to as County-Other, not included in subparagraphs (A) - (D) of this paragraph; and*
>
> *(F) Non-municipal water use including manufacturing, irrigation, steam electric power generation, mining, and livestock watering for each county or portion of a county in an RWPA.*

This change in definition resulted in 12 municipal WUG designations that were aggregated into County-Other and 64 municipal WUGs that were separated out of County-Other compared to the 2016 Regional Water Plan (2016 Plan).

WUGs in the 2021 Plan fall into one of six water use categories: Municipal; Manufacturing; Mining; Steam Electric Power; Livestock; and Irrigation. The ETRWPA has 194 municipal WUGs and 84 non-municipal WUGs. Water demands and supplies associated with each WUG are described in detail in Chapters 2 and 3, respectively.

Major Water Providers. WUGs either have direct access to water supplies or they purchase wholesale water from a Wholesale Water Provider (WWP). In this round of planning, the definition for a WWP was updated to the following:

Wholesale Water Provider (WWP) – Any person or entity, including river authorities and irrigation districts, that delivers or sells water wholesale (treated or raw) to WUGs or other WWPs or that the RWPG expects or recommends to deliver or sell water wholesale to WUGs or other WWPs during the period covered by the plan. The RWPGs shall identify the WWPs within each region to be evaluated for plan development.

In previous regional water plans, all demand and water supply data were presented in the plan summarized by WUGs and WWPs. However, in addition to the change in WWP designation outlined above, the designation of a Major Water Provider (MWP) was added to the regional water planning process intended to be a subset of WUGs and/or WWPs in the ETRWPA as identified by the RWPG to be of particular significance to the region's water supply. Throughout this plan, entities are discussed with data summarized by WUG, WWP, or MWP as required by recent rule changes.

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 RWPG discussed the designations for WWPs and MWPs in the ETRWPA and determined that all WWPs included in the 2016 Plan shall receive the designation of WWP and MWP in the 2021 Plan and include:

- Angelina and Neches River Authority
- Angelina-Nacogdoches Water Control & Improvement District No. 1
- Athens Municipal Water Authority
- City of Beaumont
- City of Carthage
- City of Center
- City of Jacksonville
- City of Lufkin
- City of Nacogdoches
- City of Port Arthur
- City of Tyler
- Houston County Water Control & Improvement District No. 1
- Lower Neches Valley Authority
- Panola County Freshwater Supply District No. 1
- Sabine River Authority of Texas
- Upper Neches River Municipal Water Authority

1.5 Agricultural and Natural Resources

For the purposes of this discussion, the ETRWPA's agricultural resources are defined as prime farmland. Natural resources within the ETRWPA include timber, wetlands, estuaries, endangered or threatened species, ecologically significant streams, springs, and state or federal parkland and preserves. Other natural resources include oil, natural gas, sand and gravel, lignite, salt, and clay. Various major natural resources are described in the following subsections.

1.5.1 Prime Farmland

Prime farmland is defined by the National Resources Conservation Service (NRCS) as "land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses."[14] As part of the National Resources Inventory, the NRCS has identified prime farmland throughout the country.

Figure 1.12 shows the distribution of prime farmland in the ETRWPA. Each color in this figure represents the percentage of prime farmland of any type. There are four categories of prime farmland in the NRCS State Soil Geographic Database for Texas: prime farmland, prime farmland if drained, prime farmland if protected from flooding or not frequently flooded during the growing season, and prime farmland where irrigated. Most counties in the region have significant prime farmland areas.

Table 1.4 shows the U.S. Department of Agriculture (USDA) 2017 agriculture statistics for the counties in the ETRWPA [15] (portions of Henderson, Smith, Polk, and Trinity counties are located in other Regions). The following general statements may be made regarding the region:[15]

- From 2012 to 2017, the total acres of farmland decreased by 6.3% while the total acres of crop land decreased by 5.9%.
- In any one year, approximately 20% of farmland is crop land.
- In any one year, approximately 63% of crop land is harvested.
- Excluding Jefferson County, approximately 3% of crop land is irrigated. In Jefferson County, approximately 18% of crop land is irrigated.
- Poultry production generates the largest agricultural product sales in Nacogdoches, Panola, San Augustine, and Shelby counties.
- Cattle and calf production generate the largest agricultural product sales in Henderson, Houston, and Smith counties.

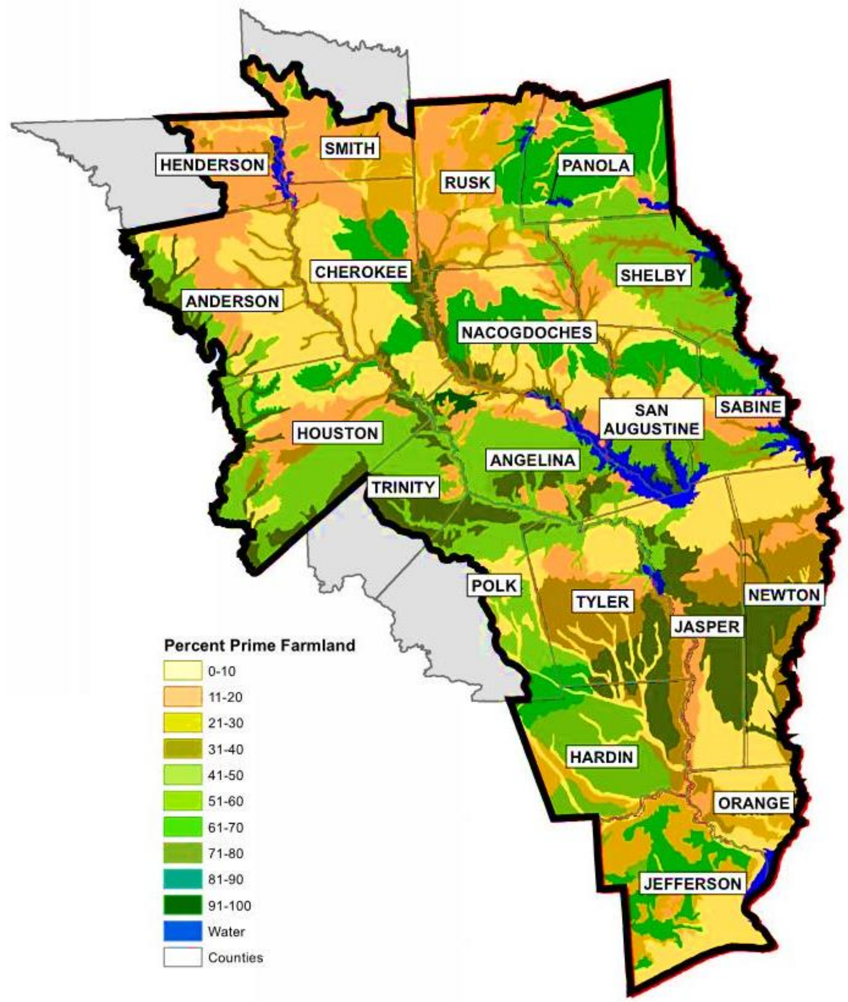


Figure 1.12 Percent Prime Farmland

SOURCE: TEXAS WATER DEVELOPMENT BOARD 2011 REGIONAL WATER PLAN

Table 1.4 U.S. Department of Agriculture 2017 Agricultural Statistics [15]

Category	Anderson	Angelina	Cherokee	Hardin	Henderson
Farms	1,754	1,028	1,587	661	1,988
Total Farmland (acres)	400,571	103,947	275,568	65,087	310,355
Crop Land (acres)	63,774	21,632	58,303	13,124	86,645
Harvested Crop Land (acres)	52,601	15,104	43,860	8,606	58,826
Irrigated Crop Land (acres)	3,089	453	978	1,081	1,614
Market Value Crops ($1,000)	15,551	2,594	66,491	2,366	11,645
Market Value Livestock ($1,000)	77,392	58,815	49,201	2,328	28,538
Total Market Value ($1,000)	92,943	61,409	115,692	4,694	40,183
Livestock and Poultry:					
Cattle and Calves Inventory	65,048	19,274	19,274	8,005	59,076
Hogs and Pigs Inventory	(D)	147	118	582	652
Sheep and Lambs Inventory	412	291	322	302	555
Layers and Pullets Inventory	3,494	2,597	2,992	3,446	6,051
Broilers and Meat-Type Chickens Sold	6,198,444	14,977,816	6,373,832	(D)	74
Crops Harvested (acres):					
Corn for Grain or Seed	2,416	0	0	5	18
Cotton	(D)	0	0	0	0
Rice	0	0	0	(D)	0
Sorghum for Grain or Seed	0	0	0	0	0
Soybeans for beans	0	0	0	(D)	(D)
Wheat for Grain	0	0	0	0	(D)

Category	Houston	Jasper	Jefferson	Nacogdoches	Newton
Farms	1,422	896	729	1,123	430
Total Farmland (acres)	394,543	91,437	358,934	264,750	58,793
Crop Land (acres)	70,772	13,375	137,267	29,502	5,484
Harvested Crop Land (acres)	44,044	10,743	38,047	20,450	4,105
Irrigated Crop Land (acres)	3,522	305	24,885	313	57
Market Value Crops ($1,000)	6,802	4,007	17,688	3,156	485
Market Value Livestock ($1,000)	57,716	5,132	14,629	367,586	1,102
Total Market Value ($1,000)	64,518	9,139	32,317	370,742	1,587
Livestock and Poultry:					
Cattle and Calves Inventory	68,987	14,268	37,189	34,172	4,212
Hogs and Pigs Inventory	4,762	259	511	48	177
Sheep and Lambs Inventory	1,781	372	340	198	266
Layers and Pullets Inventory	(D)	4,123	3,957	279,527	1,855
Broilers and Meat-Type Chickens Sold	7,160,115	(D)	66	84,656,731	51
Crops Harvested (acres):					
Corn for Grain or Seed	(D)	17	0	(D)	29
Cotton	(D)	0	0	0	0
Rice	0	0	20,698	0	0
Sorghum for Grain or Seed	0	0	(D)	0	0
Soybeans for beans	0	0	0	0	0
Wheat for Grain	0	0	(D)	(D)	0

Table 1.4 USDA 2017 Agricultural Statistics [15] (Cont.)

Category	Orange	Panola	Polk	Rusk	Sabine
Farms	663	978	742	1,441	200
Total Farmland (acres)	52,912	205,961	125,133	242,767	38,304
Crop Land (acres)	4,685	39,766	22,586	46,094	5,553
Harvested Crop Land (acres)	2,861	27,156	15,207	29,841	3,332
Irrigated Crop Land (acres)	342	781	281	530	56
Market Value Crops ($1,000)	1,489	4,626	2,291	5,956	450
Market Value Livestock ($1,000)	3,478	96,094	4,540	94,201	17,265
Total Market Value ($1,000)	4,967	100,720	6,831	100,157	17,715
Livestock and Poultry:					
Cattle and Calves Inventory	9,839	31,045	13,135	40,801	11,525
Hogs and Pigs Inventory	450	581	103	370	87
Sheep and Lambs Inventory	366	270	61	272	-
Layers and Pullets Inventory	8,630	1,388	1,885	25,945	359
Broilers and Meat-Type Chickens Sold	1,810	24,393,040	(D)	21,637,138	(D)
Crops Harvested (acres):					
Corn for Grain or Seed	6	(D)	14	26	(D)
Cotton	0	0	0	0	0
Rice	0	0	0	0	0
Sorghum for Grain or Seed	0	0	0	0	0
Soybeans for beans	0	(D)	0	0	0
Wheat for Grain	0	0	106	0	0
Category	**San Augustine**	**Shelby**	**Smith**	**Trinity**	**Tyler**
Farms	293	995	2,928	601	778
Total Farmland (acres)	61,806	179,084	271,765	98,887	91,143
Crop Land (acres)	9,196	28,551	64,308	20,051	18,847
Harvested Crop Land (acres)	7,177	20,457	49,260	13,138	13,398
Irrigated Crop Land (acres)	40	383	1,932	266	794
Market Value Crops ($1,000)	1,296	2,837	36,759	2,108	9,643
Market Value Livestock ($1,000)	55,380	464,720	16,846	6,120	5,243
Total Market Value ($1,000)	56,676	467,557	53,605	8,228	14,886
Livestock and Poultry:					
Cattle and Calves Inventory	9,853	43,354	43,874	19,464	14,052
Hogs and Pigs Inventory	153	193	559	627	351
Sheep and Lambs Inventory	39	329	1,255	27	381
Layers and Pullets Inventory	125,933	1,238,783	12,602	2,372	4,061
Broilers and Meat-Type Chickens Sold	13,552,362	103,631,416	959	(D)	295
Crops Harvested (acres):					
Corn for Grain or Seed	13	(D)	18	(D)	0
Cotton	0	0	0	0	0
Rice	0	0	0	0	0
Sorghum for Grain or Seed	0	(D)	0	0	0
Soybeans for beans	0	(D)	0	0	0
Wheat for Grain	(D)	0	(D)	0	0

Table 1.4 USDA 2017 Agricultural Statistics [15] (Cont.)

TOTALS FOR ALL COUNTIES:		**SPECIAL FOR JEFFERSON COUNTY:**	
Total Farmland (acres)	3,691,747	Irrigated / Total Crop Land (%)	18.13%
Crop Land (acres)	759,515		
Crop Land / Total Farmland (%)	20.57%	**COUNTIES OTHER THAN JEFFERSON:**	
Harvested Crop Land (acres)	478,213	Irrigated Crop Land (acres)	16,817
Harvested / Total Crop Land (%)	62.96%	Irrigated / Total Crop Land (%)	2.70%
Irrigated Crop Land (acres)	41,702	(D) – Withheld to avoid disclosing data for individual farms	
Irrigated / Total Crop Land (%)	5.49%		

SOURCE: U.S. DEPARTMENT OF AGRICULTURE, NATIONAL AGRICULTURAL STATISTICS SERVICE

1.5.2 Forest Products and Timberland Ecosystem Services

Some of the primary wood products produced from the timberlands in the ETRWPA include solid wood (sawtimber and chip-n-saw), engineered products (plywood, oriented strandboard, particleboard, and cross-laminated panels and timbers), fiber products (paper and fiberboard), and woody biomass (wood pellets, bioenergy, and mulch). According to the Texas A&M Forest Service, there are over 60 million acres of forestland in Texas but only about 23% of that is productive timberland. About 85% of this productive timberland is in East Texas.[16] In spite of rapid urbanization particularly in southeast Texas, overall forest acreage has slightly increased in the region due to conversion of marginal agricultural lands to forest over the past couple of decades. In terms of economic value, timber is the ninth most valuable agricultural commodity in Texas. In 2015, the forest industry contributed $18.3 billion to the Texas economy employing over 66,000 people with a payroll of $3.7 billion.[17] This resource is being sustainably managed, with overall growth rates exceeding removals since the 1980s and pine growth in particular being about 30% above removals. The total volumes of timber harvests declined by 15% from 2007 to 2015 due to lower economic activity in the housing market. This indicates that there is good potential for additional development of this resource through future wood processing facilities in the region. Other economic and environmental benefits to the ETRWPA provided by timberlands and forests include water quality protection, fish and wildlife management, carbon sequestration, and recreational opportunities. For water quality protection, Texas has a nationally recognized forestry best management practices (BMP) program for water quality management from forest operations. These voluntary forestry water quality BMPs have about a 94% compliance rate and have been shown to be very effective in minimizing potential water quality degradation from forest management activities like clearcutting and forest regeneration.[18] About 92% of the forestland in East Texas is privately owned but numerous national and state parks and forests exist including the Angelina National Forest, Big Thicket National Preserve, Davy Crockett National Forest, and Sabine National Forest among others. These areas have an abundance of scenic pine and hardwood forests with numerous public hiking trails, paddling trails, and campgrounds. Figure 1.13 shows the ETRWPA compared to the Texas A&M Forest Service's East Texas region.

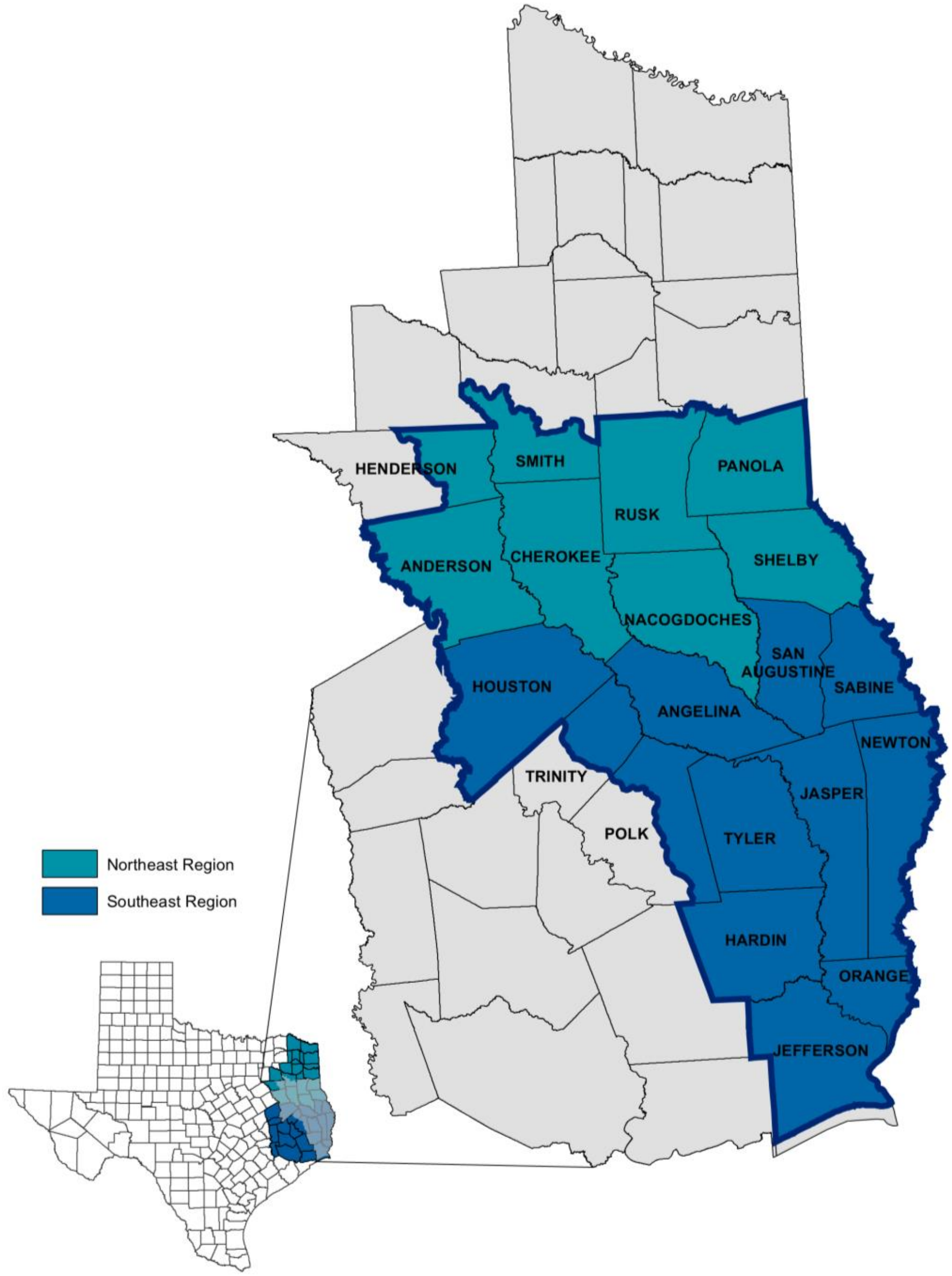


Figure 1.13 Texas A&M Forest Service Northeast and Southeast Regions

SOURCE: TEXAS A&M FOREST SERVICE, 2015

1.5.3 Wetlands

Wetlands are areas characterized by a degree of flooding or soil saturation, hydric soils, and plants adapted to growing in water or hydric soils.[19] Wetlands are beneficial in several ways; they provide flood attenuation, bank stabilization, water-quality maintenance, fish and wildlife habitat, and opportunities for hunting, fishing, and other recreational activities.[19] There are significant wetland resources in the region, especially near rivers, lakes, and reservoirs.

Texas wetlands types and characteristics are summarized in Table 1.5. Most Texas wetlands are palustrine bottomland hardwood forests and swamps, and most of the State's palustrine wetlands are located in the flood plains of East Texas rivers.[19] Table 1.6 shows the bottomland hardwood acreage associated with the four major rivers in the region.

The TPWD, in a study of natural resources in Smith, Cherokee, Rusk, Nacogdoches, and Angelina counties,[20] found the most extensive wetlands in the study area were water oak-willow and oak-blackgum forests along the Neches, Angelina, and Sabine Rivers. In the same study, TPWD noted the presence of a significant bald cypress-water tupelo swamp along the Neches River in Angelina County.[20] The TPWD identified specific stream segments in the region that they classify as being priority bottomland hardwood habitat.[10]

Table 1.5 Texas Wetland Types and Characteristics

Wetland Classifications	Definition	Vegetation / Habitat Types
Palustrine	Freshwater vegetated wetlands and intermittently or permanently flooded open-water bodies of less than 20 acres in which water is less than 6.6 feet deep, and salinity due to ocean-derived salts always is always less than 0.5 parts per thousand (ppt).	Predominantly trees; shrubs; emergent, rooted herbaceous plants; or submersed/floating plants.
Estuarine	Deep-water tidal habitats and adjacent tidal wetlands in low-wave-energy environments where the salinity of the water is greater than 0.5 ppt and is variable due to evaporation and mixing of freshwater and seawater.	Emergent plants; intertidal unvegetated mud or sand flats and bars; estuarine shrubs; subtidal open water bays (deep water habitat).
Lacustrine	Wetlands and deep-water habitats with all of the following characteristics: situated in a topographical depression or in a dammed river channel; lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30% areal coverage; total area exceeds 20 acres unless water depth at the deepest point exceeds 6.6 feet or active wave-formed or bedrock shoreline makes up all or part of the boundary; ocean-derived salinity is always less than 0.5 ppt.	Nonpersistent emergent plants, submersed plants, and floating plants.
Riverine	All freshwater wetlands and deep water habitats contained within a channel, with two exceptions: wetlands dominated by trees, shrubs, persistent, emergent mosses, or lichens, and habitats with salinity greater than 0.5 ppt.	Nonpersistent emergent plants, submersed plants, and floating plants.
Marine	Tidal wetlands that are exposed to waves and currents of the Gulf of Mexico and to water having salinity greater than 30 ppt.	Intertidal beaches, subtidal open water (deep water habitat).

SOURCE: U.S. GEOLOGICAL SURVEY [21]

Table 1.6 1980 Geographical Distribution of Bottomland Hardwood Associated with Selected Rivers

River	Area (acres)	Amount Located in ETRWPA
Trinity River	305,000	Small portion
Neches River	257,000	Almost all
Sabine River	255,000	Approximately half of the Texas portion of the Sabine River Basin is in ETRWPA.
Angelina River	88,000	All

SOURCE: TEXAS PARKS AND WILDLIFE DEPARTMENT

Section 404 of the Clean Water Act (CWA) mandates that, when impacts to wetlands are unavoidable, the impacts to wetlands must be mitigated by replacing the impacted wetland with a similar type of wetland. Mitigation banking, as defined by the National Mitigation Banking Association, is the restoration, creation, enhancement, or preservation of a wetland, stream, or other habitat area undertaken expressly for the purpose of compensating for unavoidable resource losses in advance of development actions, when such compensation cannot be achieved at the development site or not be as environmentally beneficial. The United States Army Corps of Engineers (USACE) districts and mitigation banks located within the ETRWPA are presented in Figure 1.14. The Blue Elbow Swamp Mitigation Bank, near the mouth of the Sabine River, was established by the Texas Department of Transportation to compensate for future impacts to wetlands.[23]

In the coastal part of the region, palustrine wetlands such as swamps and fresh marshes occupy flood plains and line the shores of tidal freshwater reaches of sluggish coastal rivers.[19] Much of the palustrine wetland area in Jefferson County is farmed for rice growing. Figure 1.15 shows the density of palustrine wetlands in the coastal part of the region. In the U.S. Fish and Wildlife Service (USFWS) study area, palustrine emergent wetlands were most prevalent in Jefferson County, palustrine forested wetlands were most prevalent in Newton, Jasper, Orange, and Hardin counties, and palustrine scrub-shrub was most prevalent in Newton, Jasper, Orange, and Hardin counties. Some concentrations of palustrine shrub wetlands were also found in Jefferson County. Ponds, Freshwater Lakes, Freshwater Forested/Shrub Wetlands, and Freshwater Emergent Wetlands also appear in other counties of the ETRWPA; however, only the coastal area of the ETRWPA is presented in Figure 1.15 because the wetlands in this area are more concentrated and diverse.

Estuarine wetlands such as salt marshes and tidal flats are the next most prevalent type of wetland areas. Estuarine wetlands are very common in the area around Sabine Lake,[22] particularly those dominated by emergent vegetation.

Three other kinds of wetlands cover a smaller area in the region but are ecologically significant:[22] lacustrine, riverine, and marine wetlands. See Table 1.5 above for a detailed description of these types of wetlands.

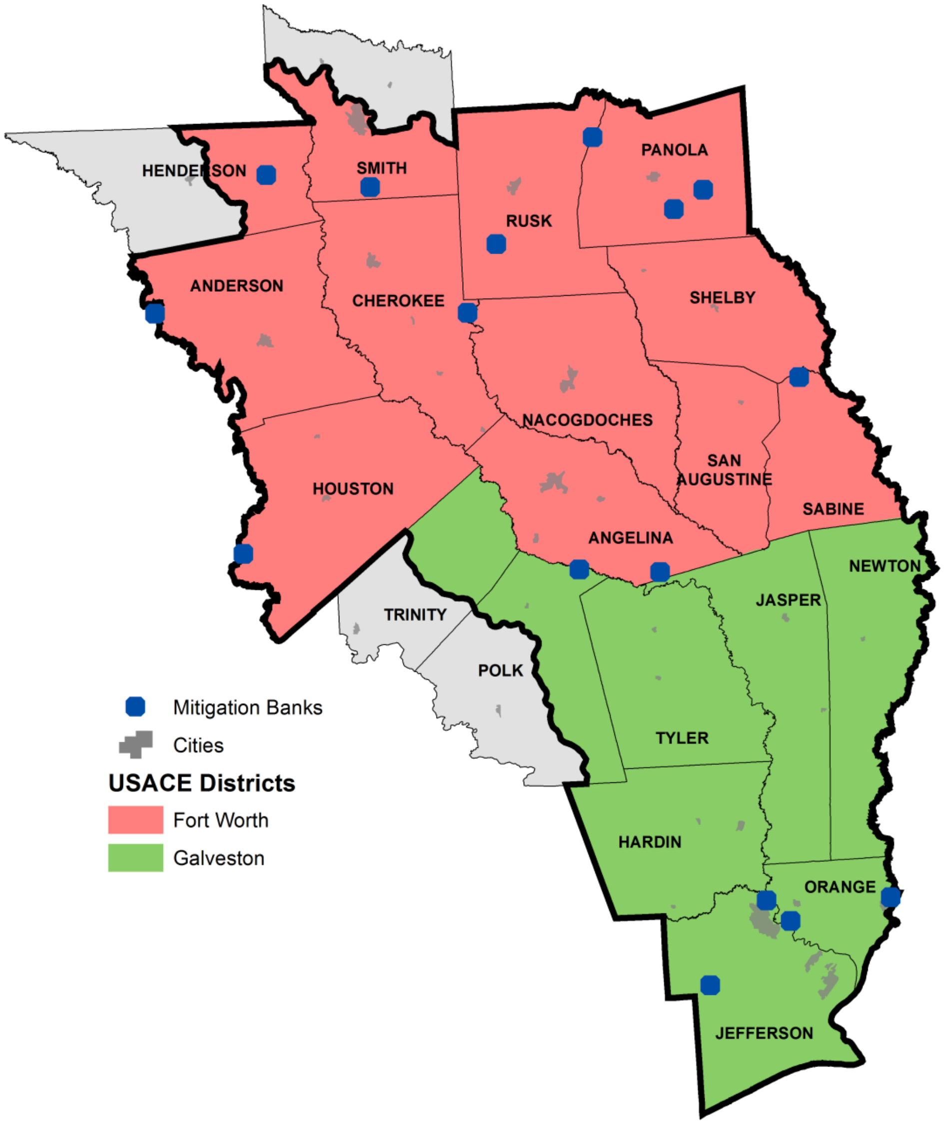


Figure 1.14 Mitigation Banks

SOURCE: U.S. ARMY CORPS OF ENGINEERS

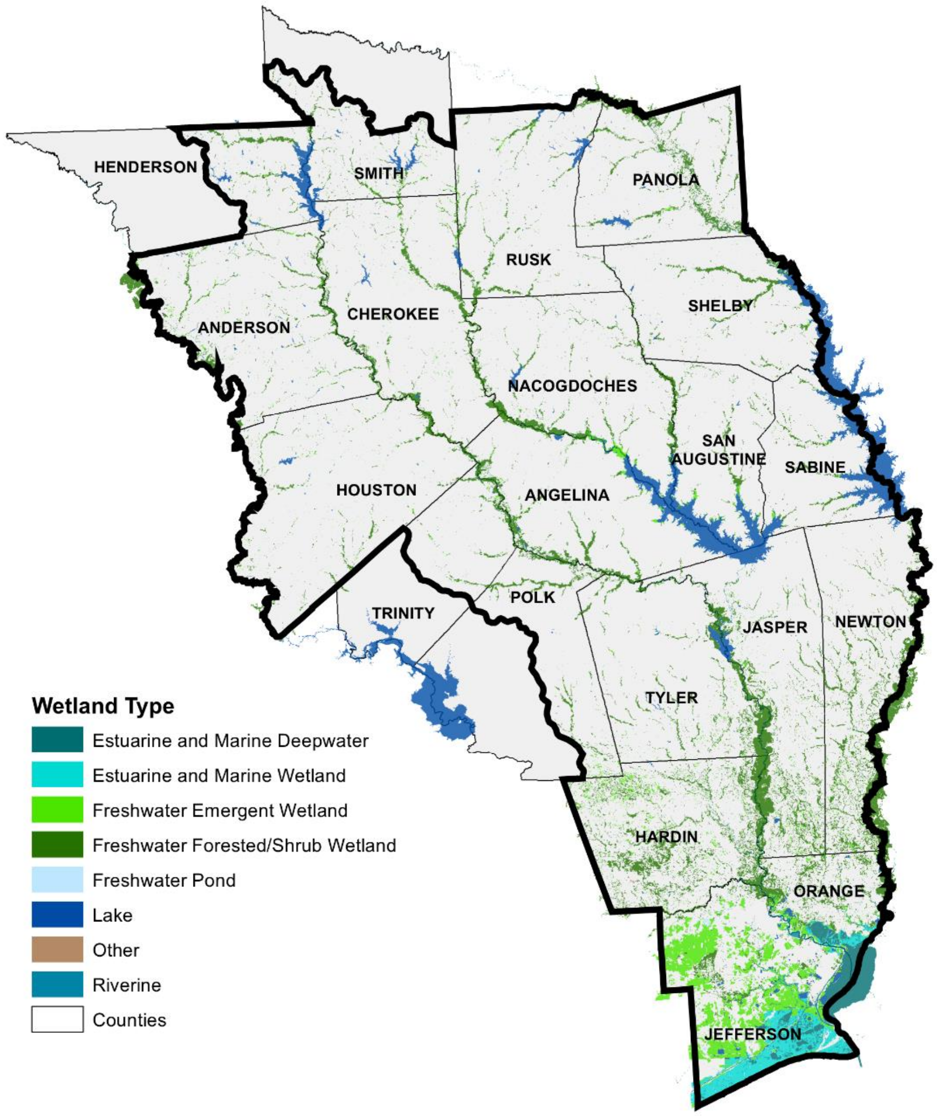


Figure 1.15 Wetland Area

SOURCE: U.S. FISH & WILDLIFE SERVICE

1.5.4 Estuaries

The Sabine-Neches Estuary includes Sabine Lake, the Sabine-Neches and Port Arthur Canals, and Sabine Pass. The Sabine-Neches Estuary covers about 100 square miles. The Neches and Sabine River Basins and part of the Neches-Trinity Coastal Basin contribute freshwater flow to the estuary.[24] The Sabine-Neches Estuary within the ETRWPA is depicted on Figure 1.16.

In the estuary, freshwater from the Sabine and the Neches Rivers meets saltwater from the Gulf of Mexico. Although the estuary is influenced by the tide, it is protected from the full force of Gulf wave action and storms due to its inland location. The Sabine-Neches Estuary is important for fish, shellfish, and wildlife habitat and for sport and commercial fishing.

Sabine Lake is a natural water body located on the Texas-Louisiana border in southeast Texas, approximately seven miles from the Gulf of Mexico. According to SRA, the surface area for the main body of the lake is approximately 54,300 acres. The lake supports an extensive coastal wetland (i.e., salt marsh) system around much of the perimeter. The lake's small volume coupled with large freshwater inflows from the Sabine and Neches Rivers result in a turnover rate of around 50 times per year.

Sabine Lake is hydraulically connected to the Gulf of Mexico via Sabine Pass, a seven-mile long tidal inlet between the Gulf and the southern end of the lake. Historically, Sabine Pass was a narrow, shallow waterway. However, in the latter part of the 19th century, a ship channel (generally known today as the Sabine-Neches Waterway) was dredged in the pass and lake to enable deep-water navigation to inland ports. Over ensuing years, the Sabine-Neches Waterway has been expanded in length, depth, and width, and extended up into the Neches and Sabine Rivers.

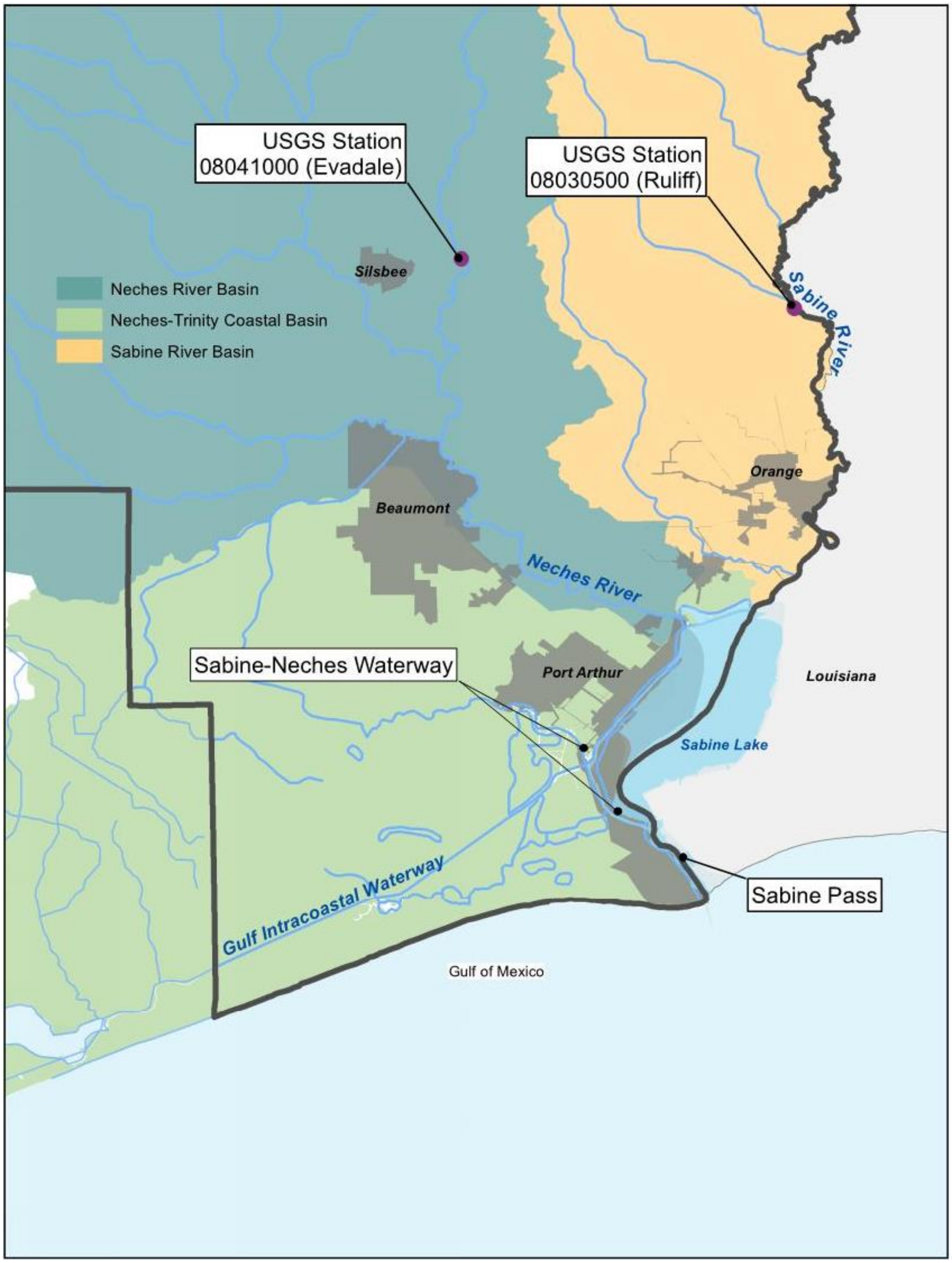


Figure 1.16 Sabine Lake Estuary and Vicinity

SOURCE: TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Today, the Sabine-Neches Waterway extends from the Gulf of Mexico to Port Arthur on the western shore of Sabine Lake; to Beaumont upstream on the Neches River; and to Orange, upstream on the Sabine River. The waterway is some 400 feet wide and 40 feet deep. In 2014, the U.S. House of Representatives passed the Water Resources Reform and Development Act, H.R. 3080, authorizing 34 water projects including the widening of the Sabine-Neches Waterway. The expansion could deepen the channel to 48 feet and widen it to as much as 700 feet.

1.5.5 Rare, Threatened and Endangered Species

In 2019, the TPWD identified rare, threatened, and endangered species of the region (See Appendix 1-A). Included are 14 species of birds, 11 insects, 22 mammals, 24 reptiles/amphibians, 16 fish, six mollusks, 55 vascular plants, and three crustaceans. These species are listed as rare, threatened, or endangered at the state level or have limited range within the state. The TPWD maintains a list of species of special concern in the Texas Natural Diversity Database.

1.5.6 Ecologically Significant River and Stream Segments

In each river basin in Texas, the TPWD has identified stream segments that it classifies as being ecologically unique.[25] Stream segments have been placed on this list because they have met criteria based on factors related to biological function, hydrologic function, presence of riparian conservation areas, high water quality/exceptional aquatic life/high aesthetic value, and threatened or endangered species/unique communities. Table 1.7 lists stream segments within the ETRWPA, meeting one or more of the criteria. Figure 1.17 shows geographically where the stream segments are located. Additional discussion of ecological significant stream segments in the ETRWPA is found in Chapter 8.

1.5.7 State and Federal Parks, Management Areas, and Preserves

The state and federal governments own and operate a number of parks, management areas, and preserves in the Region. Table 1.8 summarizes these facilities.

Table 1.7 Texas Parks and Wildlife Department Ecologically Significant Segments in East Texas

River or Stream Segment	Biological Function	Hydrologic Function	Riparian Conservation Area	High Water Quality/ Aesthetic Value	Endangered Species/ Unique Communities	Total Number of Criteria Met
Alabama Creek			•			1
Alazan Bayou	•		•		•	3
Upper Angelina River	•		•		•	3
Lower Angelina River	•		•		•	3
Attoyac Bayou					•	1
Austin Branch			•			1
Beech Creek			•	•		2
Big Cypress Creek				•		1
Big Hill Bayou	•		•			2
Big Sandy Creek	•		•	•	•	4
Bowles Creek			•			1
Camp Creek			•		•	2
Catfish Creek			•	•	•	3
Cochino Bayou			•			1
Hackberry Creek			•		•	2
Hager Creek			•			1
Hickory Creek			•			1
Hillebrandt Bayou			•			1
Irons Bayou				•		1
Little Pine Island Bayou			•			1
Lynch Creek			•		•	2
Menard Creek			•			1
Mud Creek	•				•	2
Upper Neches River	•		•	•	•	4
Lower Neches River	•		•	•	•	4
Pine Island Bayou			•			1
Piney Creek			•	•	•	3
Upper Sabine River	•			•	•	3
Middle Sabine River	•			•		2
Lower Sabine River	•		•			2
Salt Bayou	•		•			2
San Pedro Creek			•			1
Sandy Creek (Trinity Co.)			•		•	2
Sandy Creek (Shelby Co.)					•	1
Taylor Bayou			•			2
Texas Bayou			•			1
Trinity River	•		•		•	3
Trout Creek			•			1
Turkey Creek			•			1
Village Creek	•		•	•	•	4
White Oak Creek				•		1

SOURCE: TEXAS PARKS AND WILDLIFE DEPARTMENT

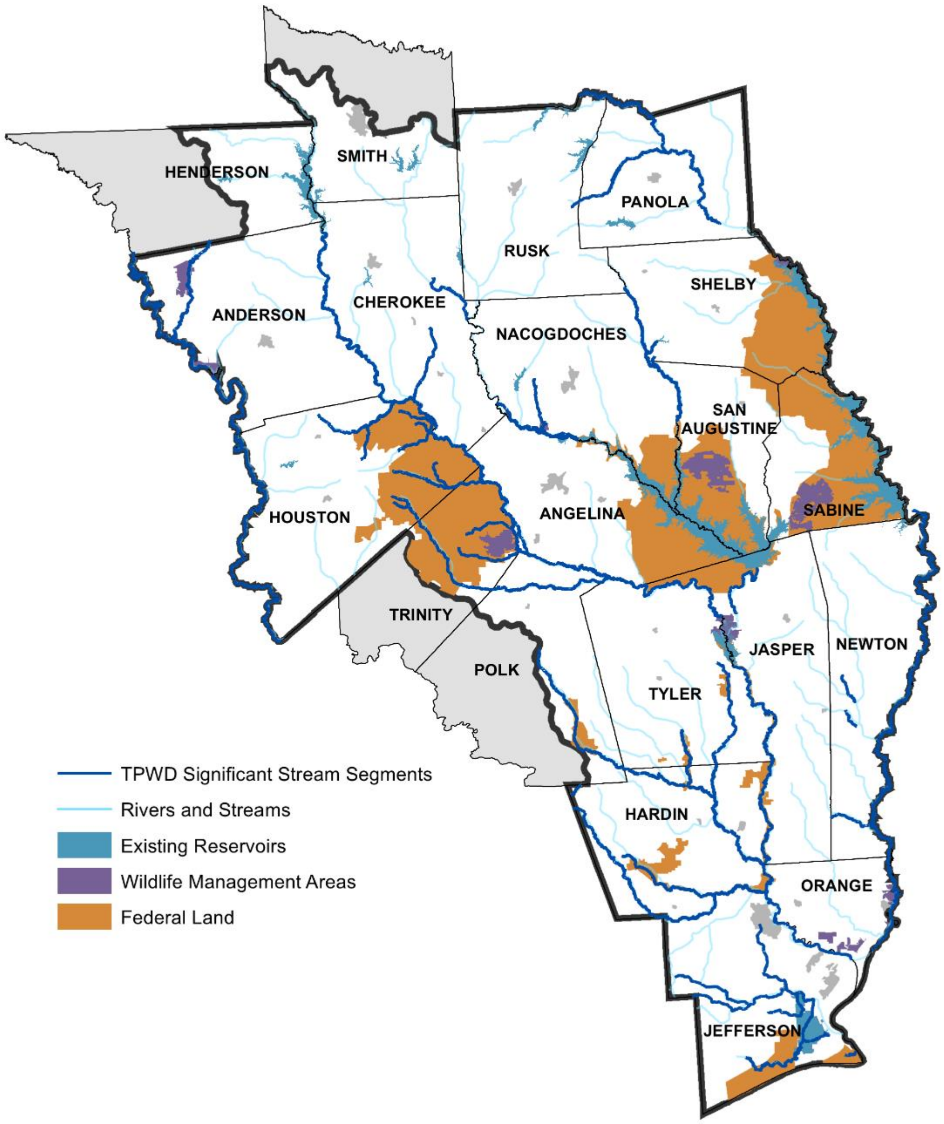


Figure 1.17 Ecologically Significant Stream Segments

SOURCE: TEXAS PARKS AND WILDLIFE DEPARTMENT

Table 1.8 State and Federal Parks, Management Areas, and Preserves

Owner/Operator	Name	County
Texas Parks and Wildlife Department	Martin Creek Lake State Park	Rusk
	Rusk/Palestine State Park	Cherokee and Anderson
	Mission Tejas State Park	Houston
	Martin Dies Jr. State Park	Jasper and Tyler
	Village Creek State Park	Hardin
	Sea Rim State Park	Jefferson
	Gus Engeling Wildlife Management Area	Anderson
	Big Lake Bottom Wildlife Management Area	Anderson
	North Toledo Bend Wildlife Management Area	Shelby
	Bannister Wildlife Management Area	San Augustine
	Moore Plantation Wildlife Management Area	Sabine and Jasper
	Angelina Neches/Dam B. Wildlife Management Area	Jasper and Tyler
	Lower Neches Wildlife Management Area	Orange
	Tony Houseman Wildlife Management Area	Orange
	J.D. Murphree Wildlife Management Area	Jefferson
	Alabama Creek Wildlife Management Area	Trinity
	Alazan Bayou Wildlife Management Area	Nacogdoches
	East Texas Conservation Center	Jasper
Texas Forest Service	E.O. Siecke State Forest	Newton
	Masterson State Forest	Jasper
	John Henry Kirby Memorial State Forest	Tyler
	I.D. Fairchild State Forest	Cherokee
Texas State Historical Commission	Caddoan Mounds State Historical Park	Cherokee
	Mission Dolores State Historic Site	San Augustine
	Sabine Pass Battleground State Historical Site	Jefferson
U.S. Army Corps of Engineers	Sam Rayburn Reservoir	
	Town Bluff Dam, B.A. Steinhagen Lake	
U.S. Fish and Wildlife Service	Neches National Wildlife Refuge	Anderson, Cherokee
	Texas Point National Wildlife Refuge	Jefferson
	McFaddin National Wildlife Refuge	Jefferson
National Forest Service	Angelina National Forest	San Augustine, Angelina, Jasper, and Nacogdoches
	Davy Crockett National Forest	Houston and Trinity
	Sabine National Forest	Sabine, Shelby, San Augustine, Newton, and Jasper
National Park Service	Big Thicket National Preserve	Polk, Tyler, Jasper, Hardin, Jefferson, and Orange

SOURCE: TEXAS PARKS AND WILDLIFE DEPARTMENT, TEXAS A&M FOREST SERVICE, TEXAS HISTORICAL COMMISSION, U.S. ARMY CORPS OF ENGINEERS, U.S. FISH AND WILDLIFE SERVICE, U.S. FOREST SERVICE, AND NATIONAL PARK SERVICE

1.5.8 Archeological Resources

The east Texas area, including the ETRWPA, is rich in cultural, historical, and archeological resources. Its abundant water, timber, and other natural resources made it ideal for native American settlement. The eastern portion of Texas was explored and settled early by European cultures. The ETRWPA, from Sabine Pass to the northern extent of the region has been a significant center of Texas historical development over the past two centuries.

Texas Historical Commission maintains the Texas Historic Sites Atlas, a database containing historic county courthouses, National Register properties, historical markers, museums, sawmills, and neighborhood surveys.[26] This database contains a very large amount of data. The Texas Historical Commission does not release information on archeological sites to the general public.

The most prominent archeological site in the ETRWPA is Caddo Mounds State Historic Site, a 94-acre park in Cherokee County west of Alto. This area was the home of Mound Builders of Caddo origin who lived in the region for 500 years beginning about 800 A.D. The site offers exhibits and interpretive trails through its reconstructed sites of Caddo dwellings and ceremonial areas, including two temple mounds, a burial mound, and a village area.[27]

1.5.9 Mineral Resources

Mineral resources include petroleum production and coal mining operations. Various types of mineral resources in the ETRWPA are described below.

Petroleum Production. Oil and natural gas fields are significant natural resources in portions of the region. With the exception of Angelina County, producing oil wells may be found in each county in the region. A portion of the region is located within the Haynesville/Bossier Shale Formation. The Haynesville/Bossier Shale Formation is a hydrocarbon-producing geological formation capable of producing large amounts of gas. There are high densities of producing oil wells in Anderson, Hardin, and Rusk counties and high densities of natural gas wells in Nacogdoches, Panola, and Rusk, counties, with lesser densities in the other counties in the region. The Region I counties which are impacted by the Haynesville/Bossier Shale Formation include Angelina, Nacogdoches, Panola, Rusk, Sabine, San Augustine, and Shelby.

Figure 1.18 and Figure 1.19 depict oil and gas resources in the ETRWPA.[28]

Starting around 2008, the East Texas petroleum industry was revitalized when multi-stage hydraulic fracturing (fracking) and horizontal drilling of the Haynesville/Bossier Shale became technologically and economically feasible. According to the USGS's 2016 assessment, this natural gas field is estimated contain in excess of 304 trillion cubic feet (TCF) of natural gas making it among the largest gas reserves in the lower 48 states.[29] This is an increase of 240 TCF over USGS's 2011 estimate of 61 TCF. An additional 4 billion barrels of oil are estimated to be in the strata associated with this formation.[29] In Region I, Angelina, Nacogdoches, Panola, Rusk, Sabine, San Augustine, and Shelby counties overlie the Haynesville/Bossier Shale. Conventional oil and gas reserves underlie the other counties in the region, with significant well densities in Nacogdoches, Anderson, Cherokee, and Rusk counties. With recent increases in pipelines, refinery capacity, and liquefied natural gas (LNG) export terminals along the Gulf Coast, demands for East Texas oil and gas are predicted to continue to increase over the coming decades.

Concerns have arisen about the large volumes of water used by the petroleum industry, especially during fracking, and the potential degradation of surface and ground water quality in Region I from oil and gas drilling and production. In terms of water use, the total volume of water used during fracking is less than 1% of the total water used in Texas.[30] Furthermore, due to the great depths separating drinking water aquifers and shales undergoing fracking and the improvements in drilling technology, it is unlikely that fracking will degrade Region I's groundwater resources. The movement of fracking fluids into drinking water aquifers has not been observed in Texas.[31] Surface spills and nonpoint stormwater discharges can result in impacts to surface waters when appropriate best management practices are not implemented.[32] However, effective stormwater and spill management practices have been shown to significantly reduce potential impacts from oil and gas development to water resources (McBroom et al., 2012).[33]

Lignite Coal Fields. Figure 1.20 shows lignite coal resources located in the region.[34] The Wilcox Group of potential deep basin lignite (200-2,000 feet in depth) underlies significant portions of Henderson, Smith, Cherokee, Rusk, and Nacogdoches counties. The Jackson-Yegua Group of potential deep basin lignite underlies significant portions of Houston, Trinity, Polk, Angelina, Nacogdoches, San Augustine, and Sabine counties. Finally, bituminous coal underlies a small portion of Polk County in the region.

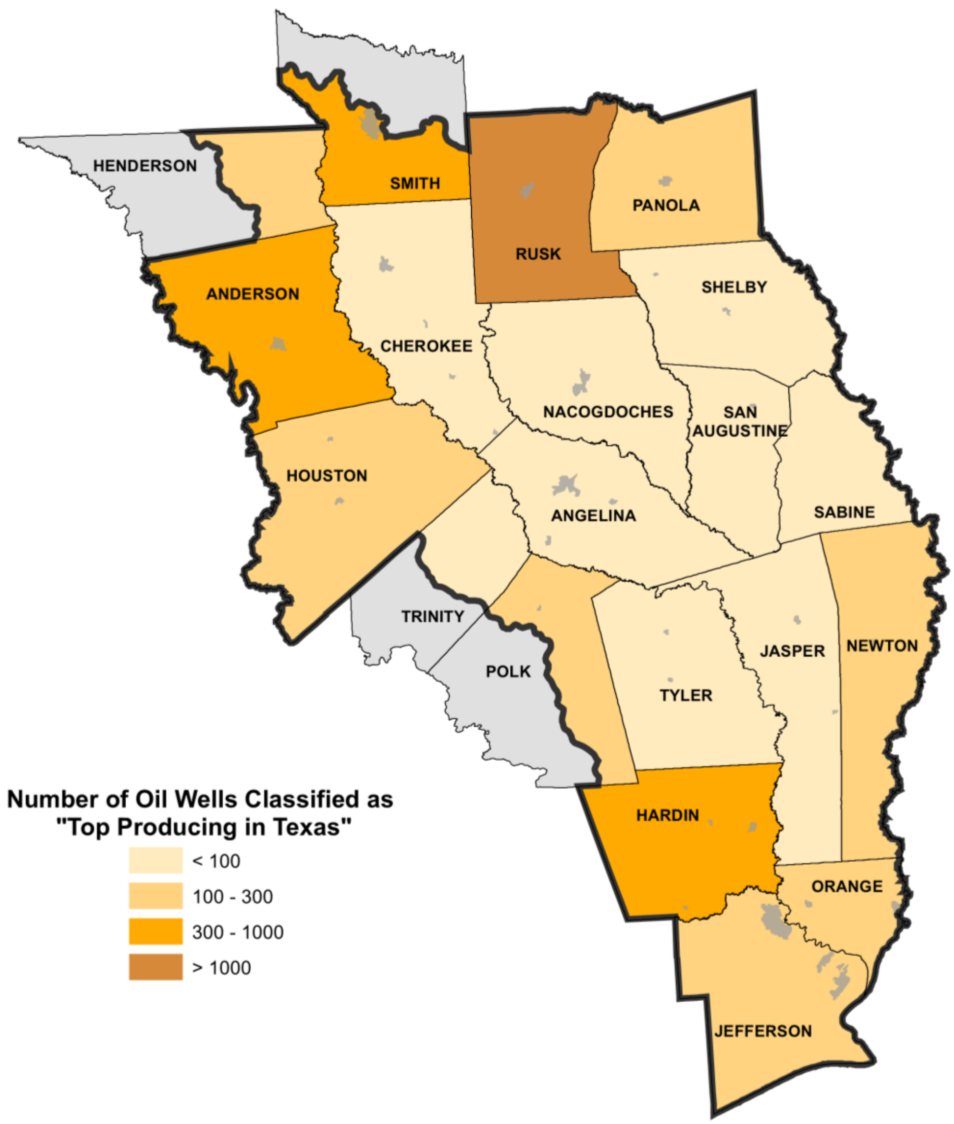


Figure 1.18 Top Producing Oil Wells

SOURCE: RAILROAD COMISSION OF TEXAS, SEPTEMBER 2018

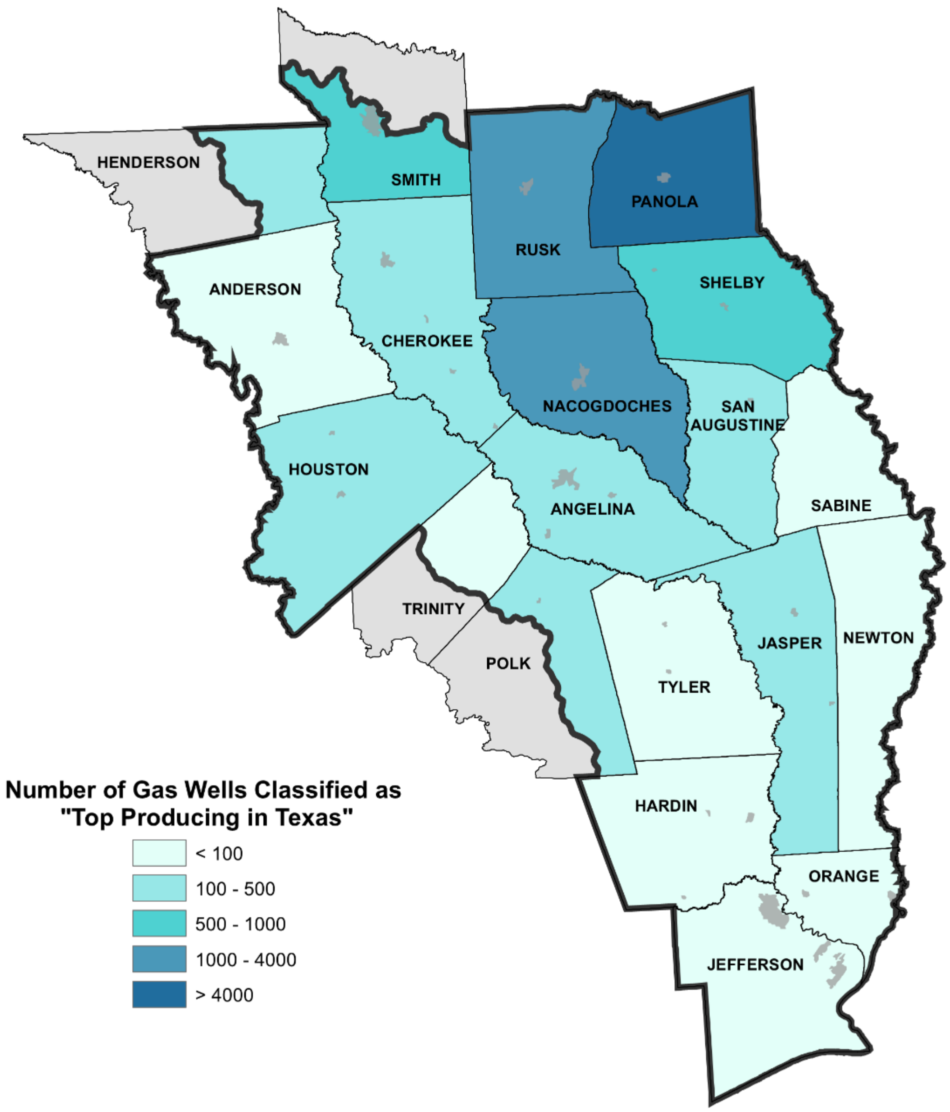


Figure 1.19 Top Producing Gas Wells

SOURCE: RAILROAD COMISSION OF TEXAS, SEPTEMBER 2018

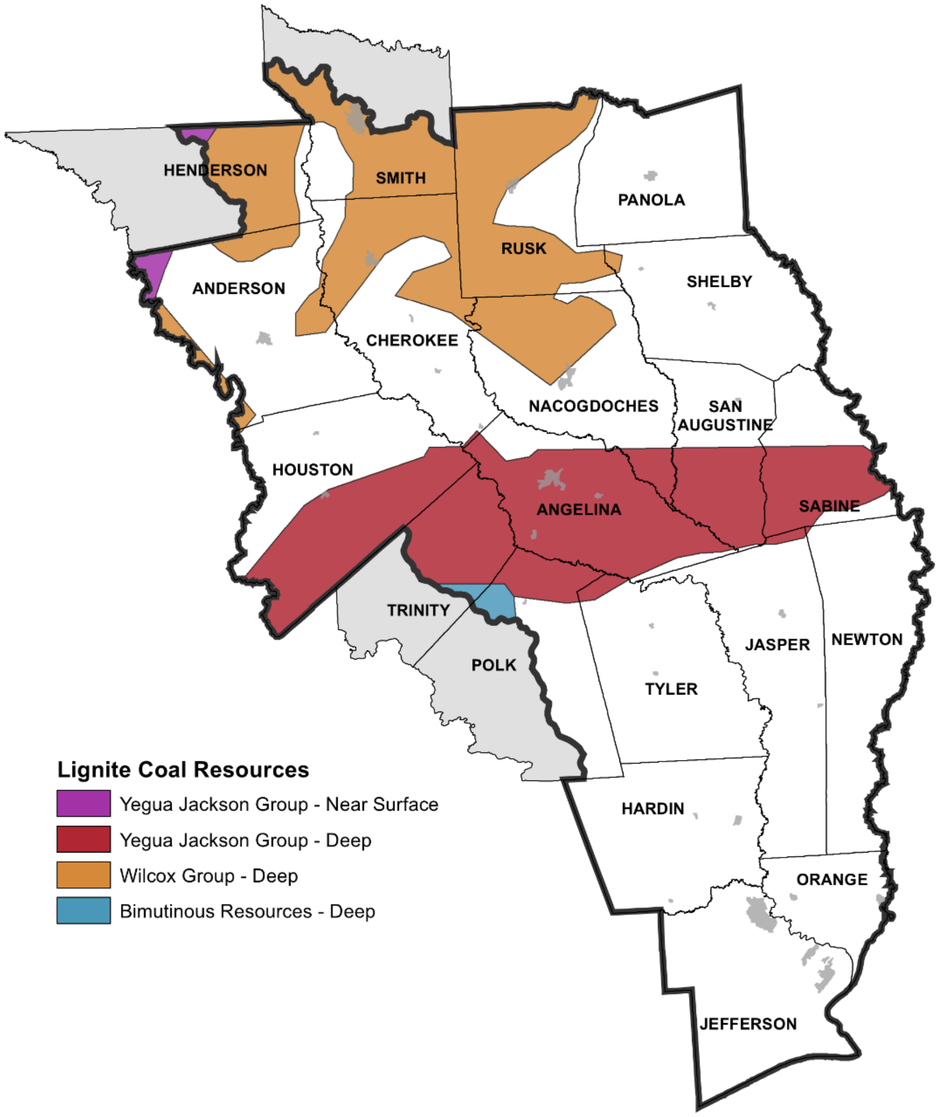


Figure 1.20 Lignite Coal Resources

SOURCE: TEXAS ALMANAC

1.6 Threats to Water Quality

1.6.1 Surface Water Quality

The first major U.S. Law to address water pollution was the Federal Water Pollution Control Act of 1948. This law was amended in 1972, in what became known as the Clean Water Act (CWA). The preamble of the CWA states that the objective of the Act is to "restore and maintain the chemical, physical, and biological integrity of the Nations waters." The 1972 amendments to the act included the following sweeping new changes to the approach to water pollution control:

- Established the structure for the regulation of pollutant discharges to Waters of the United States.

- Gave authority to the United States Environmental Protection Agency to implement control programs (i.e., permitting requirements) for discharges of pollutants from point sources.
- Funded construction of wastewater treatment facilities.
- Recognized the need for planning to address concerns about pollution from non-point sources.
- Established a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands.

The CWA is a cornerstone of the water planning process in the United States and central to the regional planning process.

Water quality in the region is generally very good. The TCEQ monitors surface water quality and documents quality through its water quality inventory. Concerns about water quality impacts to aquatic life, contact recreation, or fish consumption are documented by the TCEQ.[10]

Texas Clean Rivers Program was created in 1991 by the Texas Legislature to provide a network for monitoring water quality in the State's surface water bodies. The program is administered by the TCEQ; and the TCEQ partners with river authorities to improve the quality of surface water within each river basin in the State. The TCEQ and river authorities conduct water quality monitoring and assessment of streams, rivers, and lakes within their jurisdiction, and coordinate stakeholder participation in the process. The regional water authorities within the ETRWPA that have contracts with the TCEQ to participate as a Texas Clean Rivers Program partner include the Angelina Neches River Authority, Lower Neches Valley Authority, and Sabine River Authority of Texas.

1.7 Threats to Agricultural and Natural Resources

Water is essential to the ETRWPA's natural resources. A lack of water of adequate quality can present a significant threat to such resources. Some of the most significant potential threats in the ETRWPA are described below.

1.7.1 Drawdown of Aquifers

Overpumping of aquifers can pose a risk to household water use and livestock watering in localized rural areas. If water levels decline, the cost of pumping water increases, and water quality may change. In some cases, wells that are completed in the outcrop may go dry or wells constructed in a way that restricts the lowering of pumps may not be usable. These wells may need to be redrilled to deeper portions of the aquifer or abandoned altogether. Significant water level declines have been reported in localized areas in both the Carrizo-Wilcox and Gulf Coast aquifers,[35] the major aquifers in the region. Groundwater conservation districts work to ensure that the risk of excessive drawdown is minimized.

Overpumping of aquifers also poses a threat to estuarine wetlands. Between 1955 and 1992, approximately 19,900 acres of estuarine intertidal emergent wetlands were lost in Texas as a result of submergence (drowning) and erosion, probably due to faulting and land subsidence resulting from the withdrawal of underground water and oil and gas.[22] These losses occurred primarily between Freeport and Port Arthur. The risk of land subsidence is smaller for inland areas than for coastal areas due to the difference in compaction characteristics of the aquifers. In addition, groundwater conservation districts work to ensure that subsidence risks are minimized.

Overpumping of aquifers in coastal regions can lead to saltwater intrusion, where saltwater is drawn updip into the aquifer or moves vertically into fresh water portions of the aquifer and degrades the aquifer water quality. Saltwater intrusion into the Gulf Coast aquifer has occurred previously in central and southern Orange County [35] and Jefferson County.

1.7.2 Insufficient Instream/Environmental Flows

Flow quantities and frequencies in rivers and streams are necessary to maintain the fish and wildlife habitat in the region. Insufficient flow quantities and patterns could pose a threat to fish and wildlife habitat. Additional discussion of environmental flows is provided in Chapter 3.

1.7.3 Inundation Due to Reservoir Development

Reservoir development causes unavoidable losses to wildlife resources. In 1990, the TPWD and USFWS developed preliminary data on the acreage of land and species impacted by 44 proposed reservoirs in Texas that appeared to be the most likely to be constructed. The four projects included in this report that affect the ETRWPA include Columbia (formerly called Eastex), Rockland, Bon Wier, and Tennessee Colony reservoir projects. Table 1.9 shows the impacts of new reservoir development on the surrounding land and on protected species. For a complete list of potential reservoirs, refer to Chapter 8.

The USFWS has defined the following site priorities used to preserve bottomland hardwood forests and forested riparian vegetation:

- Priority 1 - excellent quality bottomlands of high value to waterfowl;
- Priority 2 - good quality bottomlands with moderate waterfowl benefits;
- Priority 3 - excellent quality bottomlands with minor waterfowl benefits because of small size, lack of management potential, or other factors;
- Priority 4 - moderate quality bottomlands with minor waterfowl benefits;
- Priority 5 - sites proposed for elimination from further study because of low quality and/or no waterfowl benefits; and Priority 6- sites recommended for future study.

The proposed Rockland Reservoir would impact the bottomland hardwood site known as the "Middle Neches River," which USFWS has identified as a Priority 1 preservation area. In addition, three USFWS Priority 2 bottomland hardwood preservation areas would be impacted: Neches River South, Piney Creek, and Russell Creek.

The USFWS has identified two preservation areas that would be affected by construction of the Tennessee Colony Reservoir. The first is an area known as "Boone Fields," located adjacent to the Trinity River between Saline Branch Creek and Catfish Creek, which contains upland forest and some bottomlands. The USFWS has classified this site as a Priority 5 preservation site. The reservoir would also affect a hardwood bottom in Region C known as "Tehuacana Creek." The USFWS has also classified this site as a Priority 5 preservation site. The USFWS defines Priority 5 as "sites proposed for elimination from further study because of low quality and/or no waterfowl benefits." [36]

**Table 1.9 Potential Impacts of Development on Land
Reservoir Area and Protected Species**

Potential Impacts		Potential Reservoir Site			
		Columbia [37]	Rockland	Bon Wier	Tennessee Colony
Inundated Land (acres)	Mixed bottomland hardwood forest (2)	5,351	27,300	14,600	34,800
	Swamp/Flooded Hardwood Forest (2)	NA	NA	2,300	NA
	Pine-hardwood forest (3)	2,247	50,800	10,400	NA
	Post Oak-Water Oak-Elm Forest (3)	NA	NA	NA	19,200
	Grassland (4)	2,616	NA	NA	9,600
	Other	409	21,400	7,800	21,500
	TOTAL	**10,623**	**99,500**	**35,100**	**85,100**
Endangered Species Potentially Impacted	Interior least tern		•		
	Red-cockaded woodpecker	•	•	•	•
	Whooping crane				•
Threatened Species Potentially Impacted	Alligator snapping turtle	•	•	•	•
	American swallow-tailed kite	•	•	•	•
	Bachman's sparrow	•	•	•	•
	Bald Eagle	•	•	•	•
	Black bear	•	•	•	•
	Blue sucker		•	•	
	Creek chubsucker	•	•	•	
	Louisiana pigtoe	•	•	•	•
	Louisiana pine snake	•	•	•	•
	Northern scarlet snake	•	•	•	•
	Paddlefish	•	•	•	•
	Rafinesque's big-eared bat	•	•	•	
	Reddish egret		•	•	
	Sandbank pocketbook	•	•	•	•
	Southern hickorynut	•	•	•	•
	Texas heelsplitter	•	•	•	•
	Texas horned lizard	•	•	•	•
	Texas pigtoe	•	•	•	•
	Timber rattlesnake	•	•	•	•
	White-faced ibis	•	•	•	•
	Wood stork	•	•	•	•

SOURCE: U.S. ARMY CORPS OF ENGINEERS, U.S. FISH AND WILDLIFE SERVICE, TEXAS PARKS AND WILDLIFE DEPARTMENT

Construction of the Tennessee Colony Reservoir would inundate approximately 13,800 acres of bottomland, which comprise the Richland Creek Wildlife Management Area in Region C. The TPWD acquired this area as mitigation for wildlife losses associated with the construction of Richland-Chambers Dam and Reservoir in Region C.[38] The Wildlife Management Area is located in Freestone County on the west side of the Trinity River within the boundaries of the proposed Tennessee Colony Reservoir.

The U.S. Army Corps of Engineers designed the Tennessee Colony Reservoir in 1979, but the project encountered numerous concerns about conflicts with development of lignite in the area and with existing communities and water supply lakes. The project has been deferred pending removal of the lignite.

1.8 Consideration of Existing Water Planning Efforts

The ETRWPA published its first round of regional water planning in 2001. This plan was updated according to legislative and TWDB requirements in 2006, 2011, and again in 2016. The 2021 Plan makes up the 4th update to the regional water plan during this 5th cycle of regional water planning. Over the course of these planning efforts, other ongoing planning efforts, as well as existing water resource programs, have been an integral part of the process. Coordination efforts with TWDB Regions C, D, and H (all adjacent to the ETRWPA) have occurred for consistency across plans. In addition, water plans specific to WUGs and WWPs were considered in the evaluation of WMSs included in Chapter 5B. Following is a summary of planning efforts and existing programs that have been considered and utilized by the RWPG.

1.8.1 State, Regional, and Local Water Management Planning

Water planning in the ETRWPA incorporates a combination of published plans summarizing water planning efforts, past and present. The 1990 Texas Water Plan, a state-level planning effort, determined that there was a geographic disparity in water availability. As a result of that finding, the Trans-Texas Water Program (TTWP) was created. The TTWP developed sound regional WMSs for areas of southeast, south-central, and west-central Texas. It considered issues associated with the rapid growth of the Houston, San Antonio, Austin, and Corpus Christi areas and the possibility of moving water from the water-rich areas of southeast Texas (essentially the ETRWPA now) to these more urbanized demand centers. In 1998, the Phase II Report of the TTWP determined that southeast Texas could play an important role in meeting expected regional demands by exporting water to central Texas. The report looked at a 50-year planning horizon and identified 13 WMSs that could be implemented to satisfy long-range demands in the study area. Among the conclusions of the TTWP were the following:

- Southeast Texas (essentially the ETRWPA) possessed adequate surface and groundwater resources to supply its own demands and support meeting demands of other areas of south-central and west-central Texas.
- Water conservation, wastewater reclamation, and systems operations can extend the period of adequate supply and delay the need for new resources development in the Houston metropolitan area.
- The Neches Salt Water Barrier would create additional supply from existing resources.
- Contractual transfers of existing supplies can result in additional reduced conveyance requirements.
- Interbasin transfer of water will be needed to meet future water requirements of both the southeast and central Texas areas.
- Desalination is not an appropriate economic or environmental strategy for use in the southeast area.

The TTWP was a turning point in regional water planning in Texas. The TTWP resulted in the adoption of Texas legislature Senate Bill 1 in 1997, which mandated regional water planning for the entire state and was the inception of Region I, or the ETRWPA.

Since 1997, the area known as the ETRWPA has relied largely on the regional water planning process for development of long-range water plans. However, there are a number of ongoing efforts within the region aimed at planning for future water needs. These efforts have been recognized by the RWPG and their results incorporated into the regional planning process.

Local planning efforts within the region have included water conservation plans developed by water user groups and wholesale water providers. Chapter 6 includes further discussion of these plans. Groundwater conservation districts within the region have prepared groundwater management plans and water conservation plans aimed at providing a degree of long-range planning for groundwater resources under their jurisdiction. Groundwater conservation districts are identified in Section 1.10.4 of Chapter 1.

1.8.2 Comprehensive Sabine Watershed Management Plan

This report was completed in December 1999. It was prepared for the SRA of Texas in conjunction with the TWDB, Contract # 97-483-214; Freese and Nichols, Inc., Brown and Root, Inc., and LBG-Guyton Associates (now WSP USA). This plan was developed over a period from 1996 through 1999 as an update to a 1985 master plan for the basin. The plan points out the two distinct geographic regions of the basin, upstream and downstream from the upstream end of Toledo Bend Reservoir in Panola County.

TWDB consensus planning population and water use projections showed water use in the Upper Basin to increase from 197,000 to 457,000 ac-ft per year from 1990 to 2050. Lower Basin use was shown to increase from 79,000 to 164,000 ac-ft per year from 1990 to 2050. No new water supplies for the Lower Basin were recommended. A total of 93,000 ac-ft per year of new supplies were recommended for the Upper Basin, including a proposed Prairie Creek Reservoir.

1.8.3 Trinity River Basin Master Plan

This study was originally adopted by the Trinity River Authority of Texas in 1958 and has been updated various times since then, most recently in 2016. This most recent plan revisions added new sections on Reuse of Reclaimed Water and on Regional Water Planning in Regions C and H. Nearly 81% of the Trinity River Basin falls into Regions C or H while less than 8% of this basin is located within the ETRWPA.

In 2010, the sum of the firm yield of existing reservoirs and the currently permitted inter-basin water transfer amounts within the Trinity River Basin was 2,994 mgd, or 3,354,000 ac-ft per year. Several new reservoirs were recommended in this master plan, including Tennessee Colony, a reservoir needed for flood control. The construction of the Tennessee Colony reservoir (located partially within the ETRWPA) has been deferred due to costs, environmental conflicts, lack of local sponsor commitments, and other factors. The Texas Instream Flow Program established by Senate Bill 2 in 2001 by the 77th Texas Legislature and the Trinity River Authority of Texas are currently in the process of undergoing the Middle Trinity River Instream Flow Study in order to develop flow recommendations that will support the ecological environment around the proposed reservoir site.

A number of other recommended reservoirs are included in the plan as needed for water supplies, including four smaller reservoirs within the ETRWPA in Houston County:

- Big Elkhart Reservoir
- Hurricane Reservoir

- Gail Reservoir
- Mustang Reservoir

1.8.4 Consideration of Other Publicly Available Plans

The RWPG provided significant outreach to various municipal, agricultural, and manufacturing water users in the current round of planning to ensure that existing plans for water conservation, water resource planning, drought contingency, and other planning tools were appropriately considered in the 2021 Plan. Municipal WUGs and wholesale water providers were specifically queried regarding the existence of planning documents. Existing Plans have been requested of industries as well.

1.9 Drought of Record

In regional water planning, the availability of water supplies is determined for drought of record conditions. The drought of the 1950s is widely considered to be the drought of record, but on regional or sub-regional bases, other periods of time may have been more severe. Chapter 7 presents the current drought of record for each major reservoir in the ETRWPA and evaluates more recent droughts of record in the region. The discussion suggests that the 2010-2012 period was one of significant drought for the ETRWPA. However, more localized hydrologic information is necessary to evaluate whether accounting for a more recent drought would change the estimates of available water supplies.

1.10 Current Drought Preparations

Drought contingency and water conservation planning represent important components of the water planning process. Water conservation includes measures that may be taken to reduce water consumption under all conditions and at all times. While water conservation does not generally eliminate the need for future water supply sources, it can result in the ability to delay development of costly strategies. Water conservation improves the effective use of existing sources. Drought management is designed to preserve existing water supplies during extreme dry periods. Drought management strategies are, therefore, temporary measures intended to result in significantly reduced water use in a short period of time. Drought contingency and water conservation are discussed further in Chapters 7 and 5C, respectively.

1.11 Water Loss and Water Audits

The 78th Texas Legislature passed legislation in 2005 requiring retail public utilities that provide potable water to perform a water audit, computing the utility's most recent annual water loss every five years. Since then, the TWDB established new requirements for water audit reporting; these requirements are summarized as follows:

- Retail water suppliers with an active financial obligation with the TWDB are required to submit a water loss audit annually.
- Retail water suppliers with more than 3,300 connections are required to submit a water loss audit annually.
- All public utilities are required to submit a water loss audit once every five years.

Statewide water loss audit summaries for public utility audits submitted for 2017 were performed. Appendix 1-B contains the 2017 water loss audit data reported by ETRWPA utilities and a summary of 2017 water loss audit data by planning region. Based on data from responding utilities, the ETRWPA demonstrates an average non-revenue water percentage at 27.7% (the state average for non-revenue water is 16.6%). Of this percentage, 5.2% is attributed to unbilled authorized consumption, 3.4% to apparent losses, and . Unbilled authorized consumption includes both unbilled metered and unbilled unmetered water use, and apparent loss includes unauthorized consumption, meter inaccuracies, and data discrepancies.

The RWPG used the water loss audits to determine what type of water management strategy was needed for each entity with a calculated water need. In addition, conservation WMSs were recommended for the 57 entities that have a base gallon per capita per day water usage greater than the state recommended consumption rate of 140 gallons per capita day. More detail regarding these strategies and their development is provided in Chapters 5A, 5B, and 5C.

1.12 Threats Addressed or Affected by Water Management Strategies

Water management strategies (WMS) were evaluated for impacts as addressed in Chapter 5B of this Plan. The evaluation was based on a numeric evaluation from most desirable (1) to least desirable (5). The major potential impact was determined to be the crossing of wetlands during the construction process. The long-term impact after construction was expected to be minimal. The results of this study were considered and incorporated as appropriate into the development of WMSs in Chapter 5B. For discussion on drawdown on aquifers, insufficient instream/environmental flows, and inundation due to reservoir development, see Section 1.7 of this chapter.

Chapter 2
Current and Projected Population and Water Demand

An understanding of the demand for water in the region is a basic requirement of water planning. The municipal demand for water is based, in part, on population projections for the region. In this chapter, projected population growth for the East Texas Regional Water Planning Area (ETRWPA) is examined. Water demand projections have also been developed for the various non-municipal categories of water use (manufacturing, irrigation, steam electric power, livestock, and mining) and for Major Water Providers (MWPs).

2.1 Methodology for Updating Demands

For the 2021 Regional Water Plan (2021 Plan), the Texas Water Development Board (TWDB) provided initial population and demand projections for water users in the region. The East Texas Regional Water Planning Group (ETRWPG) forwarded the population projections to the respective entities within the ETRWPA for review. Considering the comments received, the projections were revised and adopted by the ETRWPG and the TWDB.

Municipal water demands were calculated based on projections of the Texas State Data Centers (TSDC) population and the 2011 gallons per capita per day (gpcd). Projection water usage rates also incorporate anticipated reduction in demands associated with water conservation achieved through eventual compliance with plumbing codes.

The ETRWPA includes 194 municipal water user groups (WUGs) and 84 non-municipal WUGs for a total of 278. Since developing the 2016 Regional Water Plan (2016 Plan), the TWDB has moved from WUGs designated using political boundaries, such as city limits, to utility-based designations using water utility service areas. Due to these changes, 12 entities lost the designation of a WUG, 64 new WUGs were identified in the region, 2 WUGs are now split into more than one county, and 13 WUGs have new names compared to the 2016 Plan. New population and demand projections were developed by the TWDB and the TSDC for these new entities.

Demands for non-municipal use categories were developed with input from representatives of these areas. The TWDB provided initial projections of demand for the non-municipal use categories. These draft projections were reviewed by the ETRWPG and the group made a number of requested changes to projections, based primarily on local knowledge.

The following changes were made to the TWDB's initial demand projections and are included in the 2021 Plan:

- Increased population and demand projections for Lumberton MUD.
- Decreased population and demand projections for Hardin County-Other.
- Increased population and demand projections for the City of Woodville.
- Decreased population projections for Tyler County-Other.
- Increased manufacturing demand in Jefferson County.

- Increased steam electric power demand in Tyler County.
- Increased livestock demand in Jasper County.

Correspondence related to these changes is provided in Appendix 2-A. A summary of historical population, net water use estimates, and historical gpcd estimates by county are presented in Appendix 2-B. A summary of population projections and water demands by county and basin are presented as TWDB DB22 reports in Appendix ES-A, Report 01.

Following this section is a discussion of population growth and municipal water demand presented by county. In addition, discussion of anticipated water demands for the various non-municipal categories of water use is provided.

2.2 Population Growth Projections

The population in the ETRWPA is projected to increase from 1,151,556 in 2020 to 1,553,652 in 2070. The major centers of population – Angelina, Jefferson, and Smith counties – comprise nearly 50% of the population throughout the entire planning period. The projection of population growth from 2020 to 2070 by county is presented on Figure 2.1. The expected annual change in population for each county, using average annual growth during the planning period, is presented on Figure 2.2. The largest change in percentage growth is expected in Cherokee, Nacogdoches, Rusk, and Smith counties. The distribution of population by county and individual entity is provided in Table 2.1. A municipal WUG is defined as a privately-owned utility, state or federal water system, or retail public utility that provides more than 100 acre-feet per year; municipal water use not meeting this criterion is aggregated into county-other by county. The WUGs identified in Table 2.1 meet these definitions; however, where a lesser population is shown, the WUG is split between counties within the region or split between regions within the State.

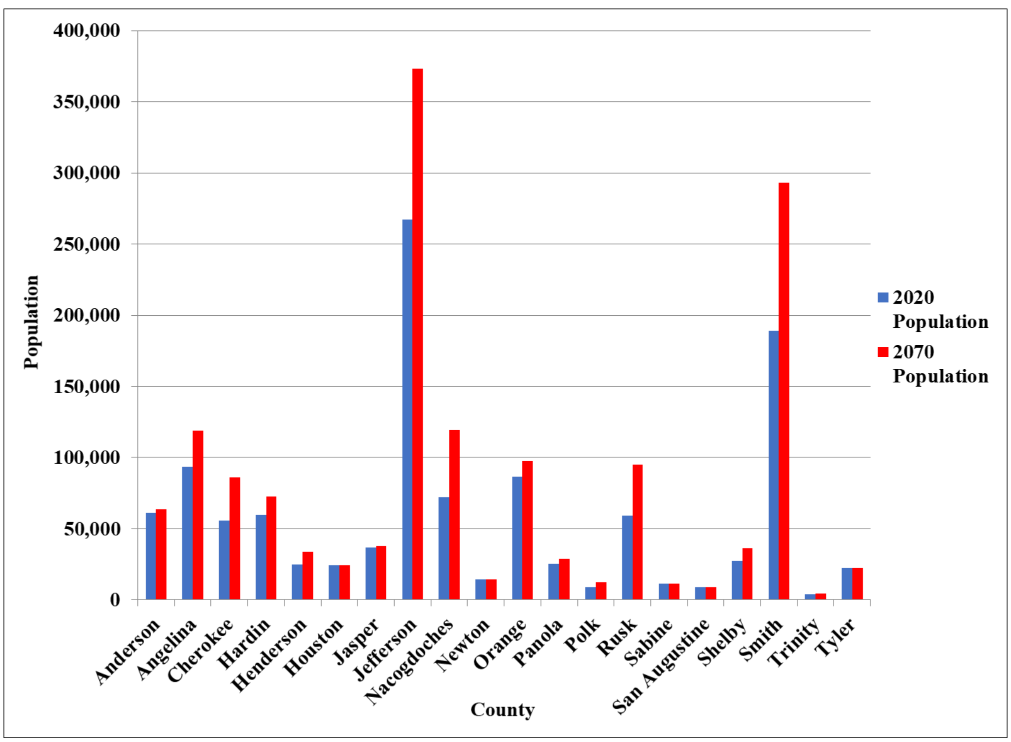


Figure 2.1 Population Projections for the East Texas Regional Water Planning Area by County (2020-2070)

SOURCE: TEXAS WATER DEVELOPMENT BOARD

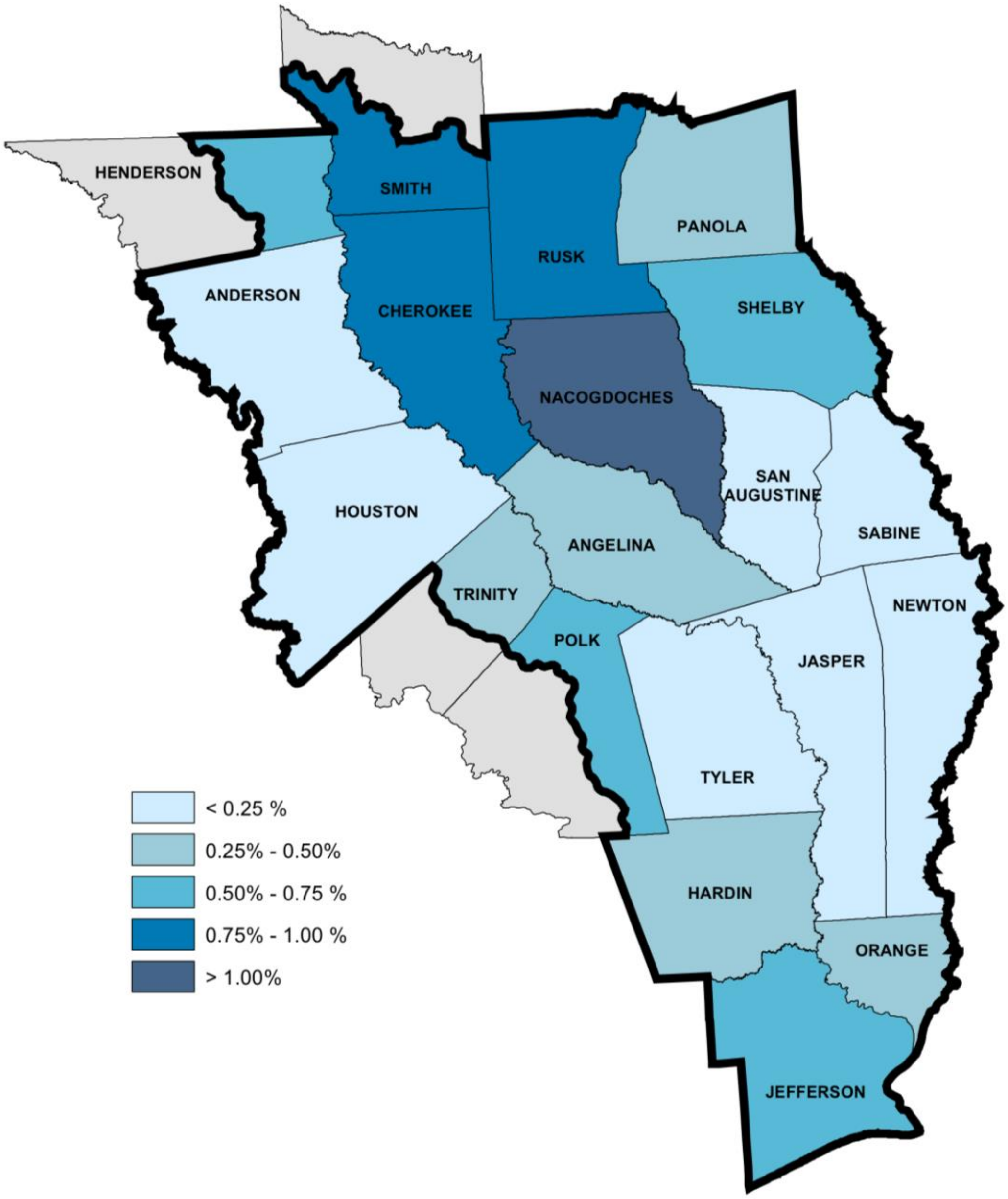


Figure 2.2 Population Annual Growth Rate

SOURCE: TEXAS WATER DEVELOPMENT BOARD

Table 2.1 Population Projections for the East Texas Regional Water Planning Area by County

County/WUG	Est.[a]	Projections					
Anderson County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Anderson County Cedar Creek WSC	1,018	1,015	1,049	1,060	1,060	1,060	1,060
B B S WSC	1,068	1,345	1,388	1,405	1,405	1,405	1,405
B C Y WSC	2,449	1,901	1,901	1,901	1,901	1,901	1,901
Brushy Creek WSC[c]	3,297	3,361	3,470	3,511	3,511	3,511	3,511
County-Other	5,351	6,434	6,730	6,830	6,830	6,830	6,830
Elkhart	1,846	1,431	1,478	1,496	1,496	1,496	1,496
Four Pines WSC	3,507	3,596	3,713	3,756	3,756	3,756	3,756
Frankston[c]	799	1,263	1,305	1,320	1,320	1,320	1,320
Frankston Rural WSC	1,274	1,295	1,338	1,354	1,354	1,354	1,354
Neches WSC	2,244	1,515	1,564	1,582	1,582	1,582	1,582
Norwood WSC	922	874	880	890	890	890	890
Palestine	17,233	18,954	19,576	19,803	19,803	19,803	19,803
Pleasant Springs WSC	929	974	1,007	1,018	1,018	1,018	1,018
Slocum WSC	2,090	2,417	2,496	2,524	2,524	2,524	2,524
TDCJ Beto Gurney & Powledge Units	5,017	3,598	3,716	3,759	3,759	3,759	3,759
TDCJ Coffield Michael	4,002	5,132	5,300	5,361	5,361	5,361	5,361
The Consolidated WSC[c]	1,148	1,140	1,178	1,191	1,191	1,191	1,191
Tucker WSC	1,147	1,160	1,198	1,211	1,211	1,211	1,211
Walston Springs WSC	3,565	3,611	3,730	3,774	3,774	3,774	3,774
Anderson County Total	***58,906***	***61,016***	***63,017***	***63,746***	***63,746***	***63,746***	***63,746***
Angelina County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Angelina WSC	2,938	3,000	3,210	3,386	3,547	3,690	3,818
Central WCID of Angelina County	6,551	7,323	7,835	8,265	8,658	9,009	9,320
County-Other	2,732	5,672	6,072	6,406	6,705	6,972	7,205
Diboll	5,209	5,646	6,041	6,372	6,675	6,946	7,186
Four Way SUD	5,490	5,596	5,987	6,316	6,616	6,885	7,122
Hudson WSC	8,817	9,588	10,259	10,823	11,337	11,797	12,204
Huntington	2,384	2,504	2,680	2,826	2,961	3,081	3,188
Lufkin	45,944	43,626	46,679	49,241	51,580	53,673	55,526
M & M WSC	3,892	3,325	3,558	3,753	3,932	4,091	4,232
Pollok-Redtown WSC[c]	1,651	1,658	1,778	1,880	1,977	2,066	2,148
Redland WSC	2,103	2,624	2,808	2,961	3,102	3,228	3,340
Upper Jasper County Water Authority[c]	107	91	92	93	93	93	93
Woodlawn WSC	1,700	1,828	1,956	2,064	2,162	2,249	2,327
Zavalla	855	835	893	943	987	1,028	1,063
Angelina County Total	***90,373***	***93,316***	***99,848***	***105,329***	***110,332***	***114,808***	***118,772***
Cherokee County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Afton Grove WSC	1,416	1,237	1,357	1,474	1,614	1,761	1,919
Alto	1,297	1,275	1,398	1,519	1,663	1,814	1,977
Alto Rural WSC	3,385	3,272	3,588	3,898	4,267	4,655	5,074
Blackjack WSC	644	778	853	927	1,014	1,107	1,206

Table 2.1 Population Projections for the East Texas Regional Water Planning Area by County

County/WUG	Est.[a]	Projections					
Bullard	37	58	63	69	76	82	89
County-Other	2,897	2,039	2,308	2,551	2,869	3,183	3,511
Craft Turney WSC	4,948	5,215	5,717	6,211	6,800	7,417	8,086
Gum Creek WSC	1,268	1,311	1,437	1,561	1,709	1,865	2,033
Jacksonville	14,544	18,083	19,830	21,543	23,585	25,726	28,041
New Summerfield	1,580	1,238	1,358	1,475	1,614	1,761	1,919
North Cherokee WSC	5,046	4,900	5,375	5,839	6,391	6,973	7,599
Pollok-Redtown WSC[c]	143	144	154	163	171	179	186
Rusk	5,966	6,204	6,804	7,391	8,091	8,826	9,620
Rusk Rural WSC	2,807	2,969	3,255	3,537	3,872	4,223	4,603
South Rusk County WSC[c]	54	63	70	77	85	92	100
Southern Utilities[c]	3,558	4,165	4,497	4,847	5,240	5,670	6,148
Troup[c]	72	77	85	92	101	109	119
Wells	802	879	963	1,046	1,146	1,249	1,362
West Jacksonville WSC	1,338	1,126	1,234	1,341	1,468	1,601	1,745
Wright City WSC[c]	514	601	659	716	784	855	932
Cherokee County Total	***52,316***	***55,634***	***61,005***	***66,277***	***72,560***	***79,148***	***86,269***
Hardin County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
County-Other	13,001	5,989	6,136	6,241	6,301	6,343	6,397
Hardin County WCID 1	1,344	1,421	1,528	1,605	1,661	1,706	1,739
Kountze	1,955	2,135	2,141	2,145	2,148	2,151	2,153
Lake Livingston WSC[c]	92	100	112	125	138	152	166
Lumberton MUD	21,645	28,586	31,985	34,397	36,192	37,592	38,619
North Hardin WSC	7,353	7,821	8,344	8,716	8,991	9,206	9,367
Silsbee	6,959	7,162	7,320	7,434	7,517	7,583	7,633
Sour Lake	1,867	1,920	2,021	2,093	2,147	2,189	2,219
West Hardin WSC	2,738	3,537	3,556	3,569	3,578	3,586	3,592
Wildwood POA[c]	687	806	843	869	887	902	913
Hardin County Total	***57,641***	***59,477***	***63,986***	***67,194***	***69,560***	***71,410***	***72,798***
Henderson County[b]	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Athens	234	274	294	311	333	352	371
Berryville	1,078	1,097	1,201	1,287	1,401	1,500	1,596
Bethel Ash WSC	3,394	3,154	3,565	3,908	4,362	4,753	5,133
Brownsboro	910	1,368	1,665	1,915	2,243	2,527	2,803
Brushy Creek WSC[c]	900	917	985	1,041	1,116	1,181	1,243
Chandler	4,015	3,704	4,510	5,181	6,067	6,833	7,574
County-Other	5,076	7,634	7,117	6,583	5,924	4,535	2,798
Edom WSC	191	204	223	238	254	274	296
Frankston[c]	28	44	67	86	111	133	154
Leagueville WSC	1,817	2,023	2,159	2,330	2,533	3,184	4,044
Moore Station WSC	3,052	1,430	1,526	1,647	1,789	2,250	2,858
Murchison	875	603	604	606	608	611	612
R P M WSC[c]	556	630	752	854	988	1,104	1,216
Virginia Hill WSC	1,495	1,722	1,976	2,190	2,470	2,711	2,946
Henderson County Total	***23,621***	***24,804***	***26,644***	***28,177***	***30,199***	***31,948***	***33,644***

Table 2.1 Population Projections for the East Texas Regional Water Planning Area by County

County/WUG	Est.[a]	Projections					
Houston County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
County-Other	516	864	844	842	842	842	842
Crockett	6,713	7,073	7,105	7,105	7,105	7,105	7,105
Grapeland	1,280	1,519	1,527	1,528	1,528	1,528	1,528
Lovelady	652	684	693	693	693	693	693
Pennington WSC[c]	878	868	872	872	872	872	872
TDCJ Eastham Unit	2,360	2,460	2,460	2,460	2,460	2,460	2,460
The Consolidated WSC[c]	10,763	10,683	10,759	10,760	10,760	10,760	10,760
Houston County Total	***23,162***	***24,151***	***24,260***	***24,260***	***24,260***	***24,260***	***24,260***
Jasper County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brookeland FWSD[c]	268	335	337	338	338	338	338
County-Other	11,311	16,111	16,467	16,531	16,527	16,521	16,518
Jasper	11,048	9,059	9,259	9,297	9,297	9,297	9,297
Jasper County WCID 1	2,461	2,730	2,791	2,802	2,802	2,802	2,802
Kirbyville	2,147	2,218	2,267	2,276	2,276	2,276	2,276
Mauriceville MUD[c]	420	429	439	440	440	440	440
Rayburn County MUD	2,559	1,703	1,741	1,748	1,748	1,748	1,748
Rural WSC	982	1,029	1,052	1,056	1,056	1,056	1,056
South Jasper County WSC	1,655	1,591	1,626	1,633	1,633	1,633	1,633
Upper Jasper County Water Authority[c]	2,002	1,673	1,716	1,728	1,732	1,738	1,741
Jasper County Total	***34,853***	***36,878***	***37,695***	***37,849***	***37,849***	***37,849***	***37,849***
Jefferson County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Beaumont	129,574	130,024	138,409	147,221	157,462	168,758	181,406
Bevil Oaks	1,493	1,345	1,431	1,522	1,628	1,745	1,875
China	809	1,230	1,309	1,393	1,489	1,596	1,716
County-Other	6,427	13,126	17,880	23,611	30,269	37,612	45,833
Groves	17,550	16,007	16,007	16,007	16,007	16,007	16,007
Jefferson County WCID 10	5,334	5,654	6,018	6,402	6,847	7,338	7,889
Meeker MWD	3,363	3,333	3,548	3,774	4,036	4,325	4,650
Nederland	17,787	18,855	20,071	21,348	22,833	24,471	26,306
Port Arthur[c]	46,877	55,393	56,090	56,090	56,090	56,090	56,090
Port Neches	12,536	13,858	14,752	15,691	16,782	17,986	19,335
West Jefferson County MWD	9,309	8,554	9,105	9,685	10,359	11,102	11,934
Jefferson County Total	***251,059***	***267,379***	***284,620***	***302,744***	***323,802***	***347,030***	***373,041***
Nacogdoches County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Appleby WSC	3,602	3,656	4,108	4,553	5,026	5,527	6,050
Caro WSC	2,098	2,593	2,913	3,228	3,564	3,919	4,290
County-Other	6,049	6,750	7,582	8,404	9,281	10,204	11,173
Cushing	967	924	1,037	1,150	1,270	1,396	1,528
D & M WSC	5,958	6,238	7,009	7,767	8,574	9,430	10,322
Etoile WSC	1,070	2,238	2,514	2,786	3,075	3,382	3,702

Table 2.1 Population Projections for the East Texas Regional Water Planning Area by County

County/WUG	Est.[a]	Projections					
Garrison	1,034	1,124	1,263	1,399	1,545	1,698	1,859
Lilly Grove SUD	2,585	2,649	2,975	3,298	3,641	4,004	4,383
Melrose WSC	2,670	2,828	3,178	3,521	3,887	4,275	4,680
Nacogdoches	35,107	37,580	42,218	46,790	51,655	56,802	62,183
Swift WSC	2,481	2,773	3,116	3,453	3,812	4,192	4,589
Woden WSC	2,028	2,783	3,127	3,466	3,825	4,206	4,605
Nacogdoches County Total	***65,649***	***72,136***	***81,040***	***89,815***	***99,155***	***109,035***	***119,364***
Newton County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brookeland FWSD[c]	716	896	901	902	902	902	902
County-Other	7,930	8,196	8,191	8,190	8,190	8,190	8,190
Mauriceville MUD[c]	382	390	390	390	390	390	390
Newton	2,708	2,478	2,478	2,478	2,478	2,478	2,478
South Newton WSC[c]	2,438	2,485	2,485	2,485	2,485	2,485	2,485
Newton County Total	***14,174***	***14,445***	***14,445***	***14,445***	***14,445***	***14,445***	***14,445***
Orange County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Bridge City	9,047	8,991	9,397	9,683	9,877	10,026	10,134
County-Other	16,606	23,395	24,458	25,202	25,708	26,092	26,370
Kelly G Brewer	765	499	521	538	548	557	562
Mauriceville MUD[c]	8,909	9,108	9,520	9,811	10,007	10,157	10,266
Orange	18,500	19,667	20,556	21,183	21,608	21,931	22,166
Orange County WCID 1	17,699	12,541	13,108	13,507	13,778	13,985	14,134
Orange County WCID 2	3,445	3,632	3,797	3,912	3,991	4,051	4,094
Orangefield WSC	4,722	4,865	5,084	5,240	5,345	5,425	5,482
Pinehurst	2,000	2,226	2,326	2,397	2,445	2,481	2,509
Port Arthur[c]	4	5	5	5	5	5	5
South Newton WSC[c]	1,372	1,398	1,461	1,506	1,536	1,559	1,576
Orange County Total	***83,069***	***86,327***	***90,233***	***92,984***	***94,848***	***96,269***	***97,298***
Panola County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Beckville	1,016	994	1,113	1,186	1,254	1,305	1,345
Carthage	6,864	6,925	7,066	7,152	7,232	7,292	7,339
County-Other	15,245	15,901	16,795	17,329	17,809	18,169	18,446
Gill WSC	780	817	841	857	871	882	891
Minden Brachfield WSC[c]	75	58	65	71	78	85	93
Panola-Bethany WSC	82	92	111	134	169	192	211
Tatum[c]	304	324	387	425	460	487	507
Panola County Total	***24,366***	***25,111***	***26,378***	***27,154***	***27,873***	***28,412***	***28,832***
Polk County[b]	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Chester WSC[c]	186	224	230	235	239	242	245
Corrigan	1,535	1,871	2,091	2,263	2,410	2,530	2,627
County-Other	3,181	3,820	4,280	4,618	4,877	5,060	5,173
Damascus Stryker WSC	1,395	1,557	1,739	1,883	2,005	2,105	2,185
Lake Livingston WSC[c]	920	1,000	1,124	1,246	1,378	1,515	1,660
Moscow WSC[c]	923	356	398	430	459	482	500

Table 2.1 Population Projections for the East Texas Regional Water Planning Area by County

County/WUG	Est.[a]	Projections					
Soda WSC	110	131	146	159	169	178	184
Polk County Total	***8,250***	***8,959***	***10,008***	***10,834***	***11,537***	***12,112***	***12,574***
Rusk County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Chalk Hill SUD	4,317	3,807	4,243	4,668	5,123	5,597	6,088
County-Other	6,209	9,606	10,747	11,834	12,992	14,175	15,381
Cross Roads SUD	3,346	3,134	3,494	3,844	4,218	4,609	5,013
Crystal Farms WSC	1,126	1,043	1,163	1,279	1,404	1,534	1,668
Ebenezer WSC	601	838	934	1,027	1,127	1,231	1,339
Elderville WSC	1,780	1,902	2,094	2,301	2,534	2,790	3,073
Gaston WSC	1,389	1,661	1,851	2,036	2,235	2,442	2,656
Goodsprings WSC	2,871	2,869	3,198	3,518	3,861	4,218	4,588
Henderson	13,430	14,928	16,640	18,302	20,089	21,946	23,871
Jacobs WSC	632	2,347	2,616	2,878	3,159	3,451	3,754
Kilgore	3,412	3,323	3,705	4,075	4,472	4,887	5,314
Minden Brachfield WSC[c]	1,925	1,488	1,659	1,825	2,002	2,188	2,380
Mt Enterprise WSC	1,512	1,864	2,078	2,285	2,508	2,740	2,981
New London	2,300	2,491	2,775	3,051	3,349	3,659	3,980
New Prospect WSC	3,180	1,156	1,289	1,418	1,557	1,700	1,850
Overton[c]	2,302	2,611	2,910	3,200	3,513	3,837	4,174
South Rusk County WSC[c]	1,632	1,888	2,104	2,314	2,541	2,775	3,019
Southern Utilities[c]	358	419	452	487	527	570	618
Tatum[c]	1,135	1,212	1,351	1,486	1,630	1,781	1,937
West Gregg SUD	179	188	210	231	253	277	301
Wright City WSC[c]	340	497	554	610	669	731	795
Rusk County Total	***53,976***	***59,272***	***66,067***	***72,669***	***79,763***	***87,138***	***94,780***
Sabine County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brookeland FWSD[c]	608	651	656	657	657	657	657
County-Other	3,318	1,554	1,564	1,562	1,562	1,562	1,562
G M WSC[c]	5,203	6,750	6,755	6,756	6,756	6,756	6,756
Hemphill	1,198	1,294	1,304	1,304	1,304	1,304	1,304
Pineland	934	968	970	970	970	970	970
Sabine County Total	***11,261***	***11,217***	***11,249***	***11,249***	***11,249***	***11,249***	***11,249***
San Augustine County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
County-Other	5,093	4,968	4,968	4,968	4,968	4,968	4,968
G M WSC[c]	507	563	563	563	563	563	563
San Augustine	1,795	2,121	2,121	2,121	2,121	2,121	2,121
San Augustine Rural WSC	1,169	1,265	1,265	1,265	1,265	1,265	1,265
San Augustine County Total	***8,564***	***8,917***	***8,917***	***8,917***	***8,917***	***8,917***	***8,917***
Shelby County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Center	6,220	5,589	6,011	6,383	6,736	7,066	7,370

Table 2.1 Population Projections for the East Texas Regional Water Planning Area by County

County/WUG	Est.[a]	Projections					
Choice WSC	945	1,143	1,228	1,305	1,377	1,444	1,506
County-Other	6,588	8,212	8,832	9,380	9,900	10,384	10,838
East Lamar WSC	774	853	918	975	1,029	1,079	1,125
Five Way WSC	1,288	1,512	1,627	1,727	1,822	1,912	1,994
Flat Fork WSC	1,183	1,161	1,248	1,326	1,399	1,467	1,530
Huxley	1,419	2,210	2,376	2,522	2,662	2,793	2,912
Joaquin	982	1,176	1,264	1,343	1,416	1,487	1,550
McClelland WSC	1,430	1,383	1,487	1,579	1,666	1,747	1,823
Sand Hills WSC	1,475	1,725	1,855	1,970	2,079	2,180	2,273
Tenaha	1,880	1,252	1,347	1,430	1,509	1,583	1,651
Timpson	1,088	1,245	1,339	1,422	1,500	1,573	1,641
Shelby County Total	***25,272***	***27,461***	***29,532***	***31,362***	***33,095***	***34,715***	***36,213***
Smith County[b]	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Algonquin Water Resources of Texas	623	859	954	1,052	1,161	1,276	1,400
ARP	995	1,084	1,136	1,189	1,245	1,303	1,362
Ben Wheeler WSC	14	17	19	20	21	22	23
Bullard	2,314	3,674	4,714	5,757	6,881	8,024	9,197
Carroll WSC	701	855	950	1,048	1,156	1,270	1,394
County-Other	6,001	4,034	5,356	6,686	8,100	9,538	10,998
Crystal Systems Texas	418	1,317	1,657	2,000	2,372	2,758	3,166
Dean WSC	6,924	4,725	4,905	5,087	5,281	5,480	5,683
Emerald Bay MUD	1,100	1,133	1,133	1,133	1,133	1,133	1,133
Jackson WSC	2,305	2,322	2,561	2,802	3,062	3,325	3,595
Lindale	1,962	2,099	2,704	3,311	3,964	4,629	5,311
Lindale Rural WSC	3,519	3,815	4,149	4,484	4,846	5,212	5,591
Overton[c]	132	149	189	229	271	315	359
R P M WSC[c]	231	262	297	332	369	408	447
Southern Utilities[c]	33,148	35,552	37,774	39,984	42,376	44,796	47,271
Troup[c]	1,978	2,101	2,317	2,536	2,770	3,009	3,254
Tyler	99,702	104,698	113,960	123,250	133,249	143,427	153,872
Walnut Grove WSC	7,770	8,728	10,281	11,839	13,516	15,222	16,973
Whitehouse	7,527	9,215	10,854	12,499	14,270	16,071	17,920
Wright City WSC[c]	1,631	2,381	2,669	2,958	3,269	3,585	3,910
Smith County Total	***178,995***	***189,020***	***208,579***	***228,196***	***249,312***	***270,803***	***292,859***
Trinity County[b]	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Centerville WSC	784	855	925	932	905	937	981
County-Other	1,490	1,826	1,974	1,988	1,933	2,045	2,140
Groveton	479	518	561	565	550	569	596
Pennington WSC[c]	515	549	594	599	581	602	629
Trinity County Total	***3,268***	***3,748***	***4,054***	***4,084***	***3,969***	***4,153***	***4,346***
Tyler County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Chester WSC[c]	724	872	899	917	932	944	954
Colmesneil	1,045	1,045	1,045	1,045	1,045	1,045	1,045
County-Other	10,541	6,273	6,269	6,227	6,194	6,166	6,141

Table 2.1 Population Projections for the East Texas Regional Water Planning Area by County

County/WUG	Est.[a]	Projections					
Cypress Creek WSC	582	592	595	595	595	595	595
Lake Livingston WSC[c]	27	29	33	36	40	44	49
Moscow WSC[c]	38	15	16	18	19	20	21
Tyler County WSC	4,379	5,684	5,711	5,711	5,711	5,711	5,711
Warren WSC	1,339	1,371	1,377	1,377	1,377	1,377	1,377
Wildwood POA[c]	509	598	626	645	658	669	678
Woodville	3,003	5,809	5,825	5,825	5,825	5,825	5,825
Tyler County Total	***22,187***	***22,288***	***22,396***	***22,396***	***22,396***	***22,396***	***22,396***
Total For ETRWPA	**1,090,962**	**1,151,556**	**1,233,973**	**1,309,681**	**1,388,867**	**1,469,843**	**1,553,652**

[a] Historical WUG population data was retrieved from municipal supporting data on the TWDB's website in a spreadsheet titled "Historical Population & GPCD for WUGs." County-Other population data was also retrieved from the same location in a spreadsheet titled "Historical Population & GPCD for County-Other Rural Areas."

[b] These counties are split between more than one TWDB regional water planning area. The populations shown represent the portion that fall within the East Texas Regional Water Planning Area (ETRWPA).

[c] These WUGS are split between more than one county. The population shown represents the portion that falls within the county indicated.

SOURCE: TEXAS WATER DEVELOPMENT BOARD

2.3 Water Demands

In the current round of planning, water demand in the ETRWPA is expected to increase from 738,081 ac-ft per year in 2020 to 839,601 ac-ft per year in 2070. This is a 33% decrease in projected demand in 2020 and 48% decrease in projected demand in 2070 compared to the same planning horizon presented in the 2016 Plan which had a demand of 1,108,800 ac-ft per year in 2020 and 1,607,250 ac-ft per year in 2070. The decrease is due to a new requirement from the TWDB for contracts to be in place for non-municipal projected demands. This adjustment greatly decreased all non-municipal demands in this round of planning, with exception to mining, with manufacturing representing approximately 81% of the decrease. Table 2.2 shows a summary of the water usage by water use category for each decade of the planning period and Table 2.3 shows the projected change within each category and each category's contribution to the total demand. Details of each water use category are provided in subsequent sections. Figure 2.3 presents the water usage in the east Texas regional water planning area by use category.

Table 2.2 Summary of Water Usage Projections for the East Texas Regional Water Planning Area by Use Category and Decade (ac-ft/yr)

Water Use Category	2020	2030	2040	2050	2060	2070
Municipal	192,049	199,870	207,822	218,266	230,468	243,611
Manufacturing	305,973	353,415	353,415	353,415	353,415	353,415
Mining	27,523	24,547	18,169	15,488	12,986	12,093
Steam Electric Power	67,011	67,011	67,011	67,011	67,011	67,011
Livestock	47,157	50,284	54,029	58,524	63,890	65,103
Irrigation	98,368	98,368	98,368	98,368	98,368	98,368
Total for ETRWPA	**738,081**	**793,495**	**798,814**	**811,072**	**826,138**	**839,601**

SOURCE: TEXAS WATER DEVELOPMENT BOARD

Table 2.3 Demand Projection Percentages for the East Texas Regional Water Planning Area by Category

Water User Category	Percent Change in Demand 2020 to 2070	Percent of Total ETRWPA Demand	
		2020	2070
Municipal	26.8%	26.0%	29.0%
Manufacturing	15.5%	41.5%	42.1%
Mining	-56.1%	3.7%	1.4%
Steam Electric Power	0.0%	9.1%	8.0%
Livestock	38.1%	6.4%	7.8%
Irrigation	0.0%	13.3%	11.7%

SOURCE: TEXAS WATER DEVELOPMENT BOARD

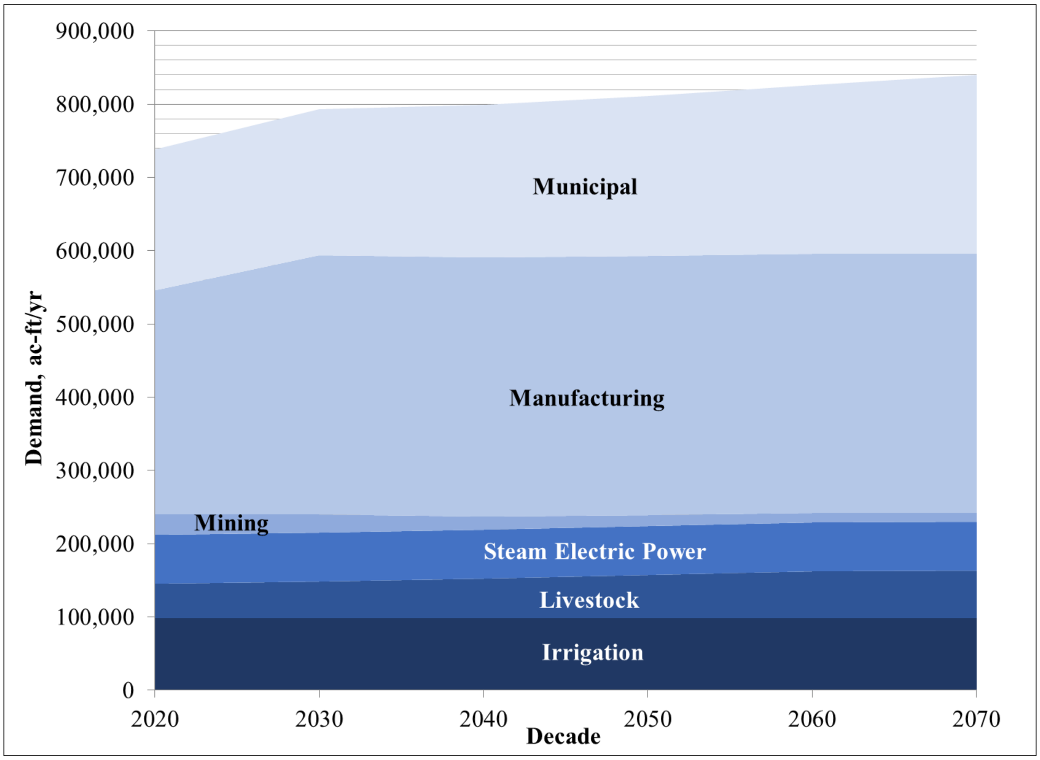


Figure 2.3 Water Usage in the East Texas Regional Water Planning Area by Use Category

SOURCE: TEXAS WATER DEVELOPMENT BOARD

2.3.1 Municipal Demands

Municipal water use includes both residential and commercial use. Residential use includes single and multi-family housing. Commercial use is composed of water used by small businesses, institutions, and public offices. It does not include water used by industry. Municipal water demand projections are estimated by multiplying the projected population of an entity by the entity's 2011 gpcd less water efficiency savings. The 2011 gpcd was collected using the TWDB Water Use Surveys and was used because it is a recent drought of record for entities within the ETRWPA. Table 2.4 provides a summary of the calculated municipal use by entities in the ETRWPA. A summary of net water use estimates and historical gpcd estimates by county are presented in Appendix 2-B. The projected changes in municipal water demands are presented in Table 2.5.

Municipal water use is expected to grow from 192,049 ac-ft per year to 243,611 ac-ft per year during the planning period. This represents an approximate 27% increase in municipal water demand over the planning horizon. The average annual percent increase in each county for municipal demand over the planning period is represented on Table 2.5. Counties with the most growth in municipal demand include Cherokee, Nacogdoches, Rusk, and Smith counties.

Compared to the last round of planning, the projections in this round are less than 2% greater than the projected municipal water demands for the same planning horizon with a projected demand of 188,646 ac-ft per year in 2020 and 239,607 ac-ft per year in 2070 presented in the 2016 Plan.

Figure 2.4 presents the projected demand by decade for Jefferson and Smith counties compared to the remaining 18 counties in the ETRWPA labeled as "Other" because these two counties account for nearly 50% of the total population in the region. The remaining 18 counties are presented in Figure 2.5. The average annual projected growth for municipal water use is shown on Figure 2.6. Additional details on WUG demand projections by county and river basin are provided in Appendix ES-A, Report 02.

Table 2.4 Historical Water Use and Projected Municipal Water Demand in the East Texas Regional Water Planning Area by County (ac-ft/yr)

County/WUG	Est.[a]	Projections					
Anderson County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Anderson County Cedar Creek WSC	110	101	100	98	96	96	96
B B S WSC	118	131	130	127	124	124	124
B C Y WSC	172	220	212	206	202	202	202
Brushy Creek WSC[c]	291	288	281	272	265	264	264
County-Other	561	907	920	912	900	897	897
Elkhart	205	249	251	249	246	246	246
Four Pines WSC	295	336	335	331	326	325	325
Frankston[c]	179	238	240	238	235	235	235
Frankston Rural WSC	221	171	171	168	166	166	166
Neches WSC	145	199	199	196	193	192	192
Norwood WSC	117	138	135	133	132	132	132
Palestine	3,028	4,896	4,966	4,953	4,915	4,909	4,909
Pleasant Springs WSC	77	169	171	169	167	167	167
Slocum WSC	224	285	284	279	275	274	274
TDCJ Beto Gurney & Powledge Units	1,790	1,129	1,150	1,152	1,145	1,144	1,144
TDCJ Coffield Michael	2,265	3,116	3,195	3,214	3,205	3,203	3,203
The Consolidated WSC[c]	156	129	129	126	124	124	123
Tucker WSC	110	127	126	124	122	121	121
Walston Springs WSC	354	368	364	357	350	349	349
Anderson County Total	***10,418***	***13,197***	***13,359***	***13,304***	***13,188***	***13,170***	***13,169***
Angelina County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Angelina WSC	240	251	251	254	265	274	284
Central WCID of Angelina County	641	510	527	555	582	605	626
County-Other	188	641	653	668	697	722	746
Diboll	745	738	758	776	811	841	870
Four Way SUD	552	484	502	520	538	558	577
Hudson WSC	839	644	689	727	762	793	820
Huntington	263	254	259	264	271	281	291
Lufkin	6,144	7,253	7,545	7,792	8,073	8,382	8,668
M & M WSC	261	283	286	290	300	310	321
Pollok-Redtown WSC[c]	149	162	166	170	176	184	191
Redland WSC	190	203	201	210	219	227	235
Upper Jasper County Water Authority[c]	11	11	11	10	10	10	10
Woodlawn WSC	251	163	165	168	173	180	186
Zavalla	97	85	87	89	91	95	98
Angelina County Total	***10,571***	***11,682***	***12,100***	***12,493***	***12,968***	***13,462***	***13,923***

Table 2.4 Historical Water Use and Projected Municipal Water Demand in the East Texas Regional Water Planning Area by County (ac-ft/yr)

County/WUG	Est.[a]	Projections					
Cherokee County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Afton Grove WSC	149	189	202	215	234	254	277
Alto	248	236	253	270	293	319	347
Alto Rural WSC	546	637	677	734	801	873	951
Blackjack WSC	108	138	147	158	171	186	203
Bullard	9	11	12	13	15	16	17
County-Other	576	238	260	281	311	344	380
Craft Turney WSC	487	485	503	524	562	610	665
Gum Creek WSC	99	129	134	142	153	167	181
Jacksonville	2,429	3,045	3,247	3,457	3,745	4,076	4,440
New Summerfield	136	158	169	180	195	212	231
North Cherokee WSC	471	601	640	680	736	801	872
Pollok-Redtown WSC[c]	13	14	14	15	15	16	17
Rusk	815	1,041	1,112	1,186	1,286	1,400	1,525
Rusk Rural WSC	284	301	316	332	358	388	423
South Rusk County WSC[c]	9	6	7	7	8	8	9
Southern Utilities[c]	625	712	749	791	847	914	991
Troup[c]	12	15	16	17	19	20	22
Wells	89	141	150	159	172	187	204
West Jacksonville WSC	141	165	175	187	203	221	241
Wright City WSC[c]	45	69	73	77	83	91	99
Cherokee County Total	***7,291***	***8,331***	***8,856***	***9,425***	***10,207***	***11,103***	***12,095***
Hardin County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
County-Other	1,531	710	696	684	688	691	697
Hardin County WCID 1	136	131	134	136	138	141	143
Kountze	261	255	246	238	234	234	234
Lake Livingston WSC[c]	10	7	8	8	9	10	11
Lumberton MUD	2,107	2,610	2,805	2,929	3,032	3,137	3,222
North Hardin WSC	464	543	561	586	604	619	630
Silsbee	896	944	931	918	913	919	925
Sour Lake	280	279	285	288	292	297	301
West Hardin WSC	290	238	239	240	240	241	241
Wildwood POA[c]	84	156	160	162	164	166	168
Hardin County Total	***6,059***	***5,873***	***6,065***	***6,189***	***6,314***	***6,455***	***6,572***
Henderson County[b]	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Athens	44	56	59	61	65	68	72
Berryville	95	118	124	129	138	147	157
Bethel Ash WSC	237	321	350	376	414	450	486
Brownsboro	146	218	259	295	343	386	428
Brushy Creek WSC[c]	79	79	80	81	84	89	93
Chandler	443	627	746	846	984	1,107	1,226
County-Other	820	700	613	538	482	367	226
Edom WSC	16	22	23	24	26	27	30
Frankston[c]	6	8	12	16	20	24	27

Table 2.4 Historical Water Use and Projected Municipal Water Demand in the East Texas Regional Water Planning Area by County (ac-ft/yr)

County/WUG	Est.[a]	Projections					
Leagueville WSC	173	215	221	233	250	313	397
Moore Station WSC	146	183	189	200	215	269	342
Murchison	95	94	91	89	88	88	89
R P M WSC[c]	83	69	79	88	101	112	123
Virginia Hill WSC	165	166	182	195	217	237	257
Henderson County Total	***2,548***	***2,876***	***3,028***	***3,171***	***3,427***	***3,684***	***3,953***
Houston County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
County-Other	89	151	144	141	141	141	141
Crockett	1,171	1,280	1,253	1,225	1,211	1,208	1,208
Grapeland	184	211	205	200	197	196	196
Lovelady	91	132	130	128	127	126	126
Pennington WSC[c]	76	82	79	77	76	75	75
TDCJ Eastham Unit	1,032	1,098	1,088	1,079	1,075	1,074	1,074
The Consolidated WSC[c]	1,460	1,210	1,174	1,139	1,120	1,116	1,116
Houston County Total	***4,103***	***4,164***	***4,073***	***3,989***	***3,947***	***3,936***	***3,936***
Jasper County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brookeland FWSD[c]	30	39	38	37	36	36	36
County-Other	1,213	1,698	1,667	1,620	1,590	1,583	1,583
Jasper	1,667	1,963	1,963	1,937	1,918	1,915	1,915
Jasper County WCID 1	238	204	192	188	188	188	188
Kirbyville	302	402	401	395	391	390	390
Mauriceville MUD[C]	30	30	30	30	30	30	30
Rayburn County MUD	222	178	174	170	167	167	167
Rural WSC	113	107	105	102	101	100	100
South Jasper County WSC	122	119	114	110	110	110	110
Upper Jasper County Water Authority[C]	200	200	198	194	192	192	192
Jasper County Total	***4,137***	***4,940***	***4,882***	***4,783***	***4,723***	***4,711***	***4,711***
Jefferson County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Beaumont	23,441	30,788	32,110	33,623	35,671	38,168	41,012
Bevil Oaks	105	134	135	138	146	156	167
China	179	142	145	150	157	168	180
County-Other	659	2,076	2,733	3,541	4,503	5,586	6,802
Groves	2,160	2,218	2,141	2,076	2,051	2,045	2,045
Jefferson County WCID 10	659	493	499	510	534	570	612
Meeker MWD	372	431	444	462	488	521	560
Nederland	2,138	2,436	2,498	2,580	2,718	2,904	3,119
Port Arthur[c]	14,669	19,234	19,205	18,984	18,939	18,920	18,919
Port Neches	1,662	1,431	1,450	1,484	1,557	1,662	1,785
West Jefferson County MWD	678	741	752	771	809	863	926

Table 2.4 Historical Water Use and Projected Municipal Water Demand in the East Texas Regional Water Planning Area by County (ac-ft/yr)

County/WUG	Est.[a]	Projections					
Jefferson County Total	***46,722***	***60,124***	***62,112***	***64,319***	***67,573***	***71,563***	***76,127***
Nacogdoches County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Appleby WSC	786	658	722	787	862	946	1,035
Caro WSC	358	254	272	292	317	347	380
County-Other	657	686	749	827	909	996	1,090
Cushing	92	166	181	197	216	237	259
D & M WSC	586	904	993	1,086	1,189	1,305	1,428
Etoile WSC	260	255	275	297	323	354	387
Garrison	191	252	277	302	331	363	397
Lilly Grove SUD	360	369	404	440	481	528	577
Melrose WSC	639	410	447	485	529	581	635
Nacogdoches	6,187	6,868	7,514	8,177	8,945	9,818	10,742
Swift WSC	334	424	461	499	545	598	654
Woden WSC	218	340	368	396	432	473	518
Nacogdoches County Total	***10,668***	***11,586***	***12,663***	***13,785***	***15,079***	***16,546***	***18,102***
Newton County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brookeland FWSD[c]	81	104	101	99	97	97	97
County-Other	893	886	846	811	803	800	800
Mauriceville MUD[c]	27	27	26	26	26	26	26
Newton	341	443	433	425	421	420	420
South Newton WSC[c]	237	167	167	167	167	167	167
Newton County Total	***1,579***	***1,627***	***1,573***	***1,528***	***1,514***	***1,510***	***1,510***
Orange County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Bridge City	850	796	784	770	778	786	795
County-Other	4,259	2,700	2,676	2,747	2,794	2,827	2,856
Kelly G Brewer	321	77	78	79	80	81	82
Mauriceville MUD[c]	630	637	640	659	673	683	690
Orange	2,807	2,626	2,644	2,645	2,663	2,696	2,724
Orange County WCID 1	1,222	1,553	1,569	1,576	1,595	1,614	1,631
Orange County WCID 2	335	494	500	504	510	517	522
Orangefield WSC	536	449	459	466	471	477	482
Pinehurst	256	284	284	285	290	293	296
Port Arthur[c]	1	2	2	2	2	2	2
South Newton WSC[c]	133	94	98	101	103	105	106
Orange County Total	***11,350***	***9,712***	***9,734***	***9,834***	***9,959***	***10,081***	***10,186***
Panola County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Beckville	102	136	147	153	160	166	171
Carthage	1,347	1,650	1,651	1,644	1,648	1,659	1,669
County-Other	1,181	1,595	1,608	1,600	1,613	1,639	1,664
Gill WSC	88	94	93	91	92	93	94
Minden Brachfield WSC[c]	7	4	4	5	5	6	6

Table 2.4 Historical Water Use and Projected Municipal Water Demand in the East Texas Regional Water Planning Area by County (ac-ft/yr)

County/WUG	Est.[a]	Projections					
Panola-Bethany WSC	18	18	21	25	32	36	40
Tatum[c]	54	63	73	79	85	89	93
Panola County Total	***2,797***	***3,560***	***3,597***	***3,597***	***3,635***	***3,688***	***3,737***
Polk County[b]	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Chester WSC[c]	31	39	39	39	39	39	40
Corrigan	204	231	248	260	276	288	299
County-Other	291	397	428	449	468	483	494
Damascus Stryker WSC	122	194	210	222	234	245	254
Lake Livingston WSC[c]	101	68	76	84	93	102	112
Moscow WSC[c]	204	52	57	60	64	67	69
Soda WSC	12	11	12	12	13	13	14
Polk County Total	***965***	***992***	***1,070***	***1,126***	***1,187***	***1,237***	***1,282***
Rusk County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Chalk Hill SUD	270	332	352	375	404	440	478
County-Other	611	1,042	1,111	1,182	1,278	1,390	1,507
Cross Roads SUD	256	259	273	288	310	337	366
Crystal Farms WSC	115	104	111	118	127	139	151
Ebenezer WSC	98	130	141	152	165	180	196
Elderville WSC	165	128	141	155	170	188	207
Gaston WSC	144	192	205	220	238	259	282
Goodsprings WSC	232	260	275	292	315	343	372
Henderson	2,686	3,741	4,098	4,454	4,859	5,301	5,764
Jacobs WSC	136	283	303	325	352	383	417
Kilgore	636	717	783	848	924	1,008	1,095
Minden Brachfield WSC[c]	176	100	111	123	135	147	160
Mt Enterprise WSC	188	305	330	356	387	422	459
New London	325	870	955	1,040	1,136	1,240	1,348
New Prospect WSC	132	91	96	101	109	118	129
Overton[c]	456	554	604	654	713	777	845
South Rusk County WSC	257	188	200	213	230	250	272
Southern Utilities[c]	63	72	75	80	85	92	100
Tatum[c]	204	234	254	275	300	327	355
West Gregg SUD	16	16	17	18	20	22	23
Wright City WSC[c]	30	57	61	66	71	78	84
Rusk County Total	***7,196***	***9,675***	***10,496***	***11,335***	***12,328***	***13,441***	***14,610***
Sabine County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brookeland FWSD[c]	68	76	74	72	71	71	71
County-Other	167	134	127	121	120	120	120
G M WSC[c]	544	454	454	454	454	454	454
Hemphill	545	305	302	297	295	294	294
Pineland	147	90	86	82	81	81	81
Sabine County Total	***1,471***	***1,059***	***1,043***	***1,026***	***1,021***	***1,020***	***1,020***
San Augustine County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**

Table 2.4 Historical Water Use and Projected Municipal Water Demand in the East Texas Regional Water Planning Area by County (ac-ft/yr)

County/WUG	Est.[a]	Projections					
County-Other	433	481	461	445	436	434	434
G M WSC[c]	53	38	38	38	38	38	38
San Augustine	467	519	508	499	498	498	498
San Augustine Rural WSC	141	120	114	110	108	108	108
San Augustine County Total	***1,094***	***1,158***	***1,121***	***1,092***	***1,080***	***1,078***	***1,078***
Shelby County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Center	2,067	1,842	1,952	2,050	2,152	2,255	2,351
Choice WSC	115	127	131	134	140	146	152
County-Other	730	898	927	956	993	1,038	1,082
East Lamar WSC	90	109	113	117	122	127	133
Five Way WSC	156	163	168	172	179	187	195
Flat Fork WSC	137	129	133	136	142	149	155
Huxley	200	285	295	304	318	333	347
Joaquin	168	180	187	194	203	213	222
McClelland WSC	196	216	225	234	244	256	267
Sand Hills WSC	152	297	310	323	338	354	369
Tenaha	259	227	237	247	258	271	282
Timpson	165	178	185	192	200	209	218
Shelby County Total	***4,435***	***4,651***	***4,863***	***5,059***	***5,289***	***5,538***	***5,773***
Smith County[b]	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Algonquin Water Resources of Texas	189	58	64	71	78	86	94
ARP	162	175	178	182	189	197	206
Ben Wheeler WSC	1	1	2	2	2	2	2
Bullard	576	728	920	1,115	1,329	1,547	1,773
Carroll WSC	78	99	106	115	125	137	150
County-Other	577	475	610	745	894	1,049	1,209
Crystal Systems Texas	91	411	512	616	730	848	973
Dean WSC	427	763	772	784	805	833	864
Emerald Bay MUD	197	175	170	167	166	165	165
Jackson WSC	177	212	222	234	252	272	294
Lindale	325	476	604	733	875	1,020	1,170
Lindale Rural WSC	434	298	308	321	341	365	391
Overton[c]	26	32	39	47	55	64	73
R P M WSC[c]	22	29	31	34	38	41	45
Southern Utilities[c]	5,826	6,079	6,289	6,527	6,848	7,223	7,617
Troup[c]	331	416	447	481	520	564	610
Tyler	25,724	20,032	21,313	22,676	24,310	26,118	28,007
Walnut Grove WSC	844	1,082	1,231	1,388	1,569	1,763	1,964
Whitehouse	900	1,166	1,331	1,503	1,700	1,910	2,128
Wright City WSC[c]	143	272	295	319	348	380	415
Smith County Total	***37,050***	***32,979***	***35,444***	***38,060***	***41,174***	***44,584***	***48,150***

Table 2.4 Historical Water Use and Projected Municipal Water Demand in the East Texas Regional Water Planning Area by County (ac-ft/yr)

County/WUG	Est.[a]	Projections					
Trinity County[b]	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Centerville WSC	90	106	111	109	105	109	114
County-Other	186	131	133	134	130	137	144
Groveton	63	55	57	55	53	55	57
Pennington WSC[c]	45	52	54	53	50	52	54
Trinity County Total	***384***	***344***	***355***	***351***	***338***	***353***	***369***
Tyler County	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Chester WSC[c]	122	151	151	151	152	154	155
Colmesneil	150	252	247	243	241	241	241
County-Other	1,368	793	764	736	719	714	711
Cypress Creek WSC	63	117	115	113	112	112	112
Lake Livingston WSC[c]	3	2	2	2	3	3	3
Moscow WSC[c]	8	2	2	3	3	3	3
Tyler County WSC	512	660	638	617	606	604	604
Warren WSC	476	185	180	175	173	172	172
Wildwood POA[c]	62	116	119	120	122	123	125
Woodville	1,154	1,241	1,218	1,196	1,184	1,182	1,182
Tyler County Total	***3,918***	**3,519**	**3,436**	**3,356**	**3,315**	**3,308**	**3,308**
Total For ETRWPA	**174,756**	**192,049**	**199,870**	**207,822**	**218,266**	**230,468**	**243,611**

[a] Historical WUG demand data was retrieved from municipal supporting data on the TWDB's website in a spreadsheet titled "Historical Population & GPCD for WUGs." County-Other population data was also retrieved from the same location in a spreadsheet titled "Historical Population & GPCD for County-Other Rural Areas."

[b] These counties are split between more than one TWDB regional water planning area. The demand shown represents the portion that falls within the East Texas Regional Water Planning Area (ETRWPA).

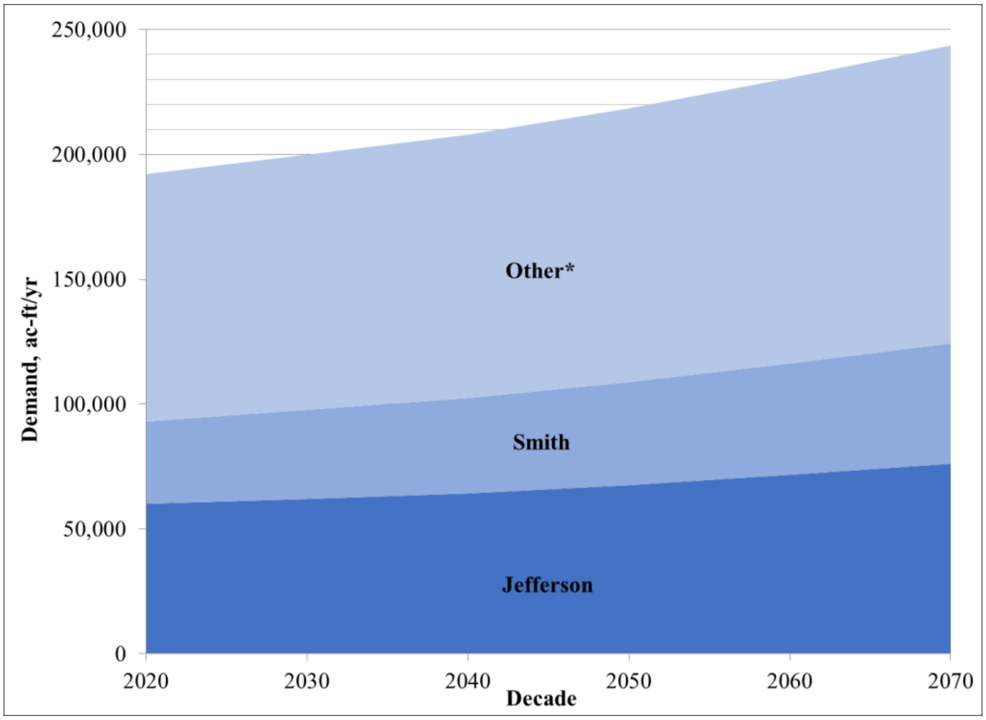
[c] These WUGS are split between more than one county. The demand shown represents the portion that falls within the county indicated.

SOURCE: TEXAS WATER DEVELOPMENT BOARD

Table 2.5 Municipal Demand Projection Percentages in the East Texas Regional Water Planning Area by County

County	Percent Change in Demand 2020 to 2070	Percent of Total ETRWPA Demand	
		2020	2070
Anderson	-0.2%	6.9%	5.4%
Angelina	19.2%	6.1%	5.7%
Cherokee	45.2%	4.3%	5.0%
Hardin	11.9%	3.1%	2.7%
Henderson	37.4%	1.5%	1.6%
Houston	-5.5%	2.2%	1.6%
Jasper	-4.6%	2.6%	1.9%
Jefferson	26.6%	31.3%	31.2%
Nacogdoches	56.2%	6.0%	7.4%
Newton	-7.2%	0.8%	0.6%
Orange	4.9%	5.1%	4.2%
Panola	5.0%	1.9%	1.5%
Polk	29.2%	0.5%	0.5%
Rusk	51.0%	5.0%	6.0%
Sabine	-3.7%	0.6%	0.4%
San Augustine	-6.9%	0.6%	0.4%
Shelby	24.1%	2.4%	2.4%
Smith	46.0%	17.2%	19.8%
Trinity	7.3%	0.2%	0.2%
Tyler	-6.0%	1.8%	1.4%

SOURCE: TEXAS WATER DEVELOPMENT BOARD



*For a breakdown of Other Municipal Demand Projections by County see Figure 2.5.

Figure 2.4 Municipal Demand Projections in the East Texas Regional Water Planning Area Greater than 20,000 ac-ft/yr by County

SOURCE: TEXAS WATER DEVELOPMENT BOARD

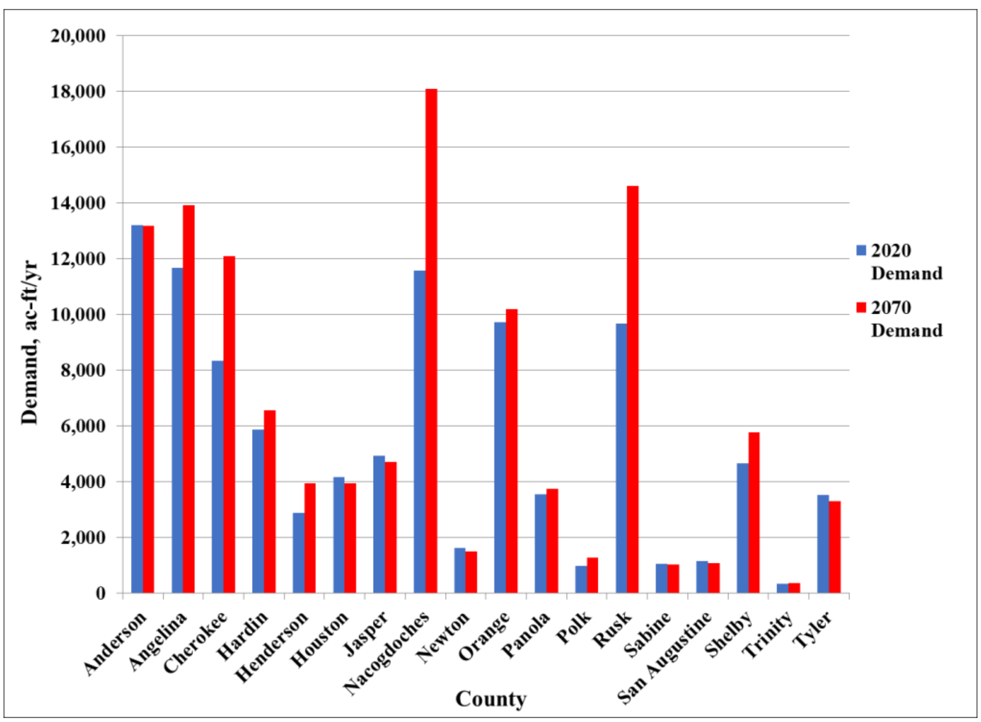


Figure 2.5 Municipal Demand Projections in the East Texas Regional Water Planning Area Less than 20,000 ac-ft/yr by County

SOURCE: TEXAS WATER DEVELOPMENT BOARD

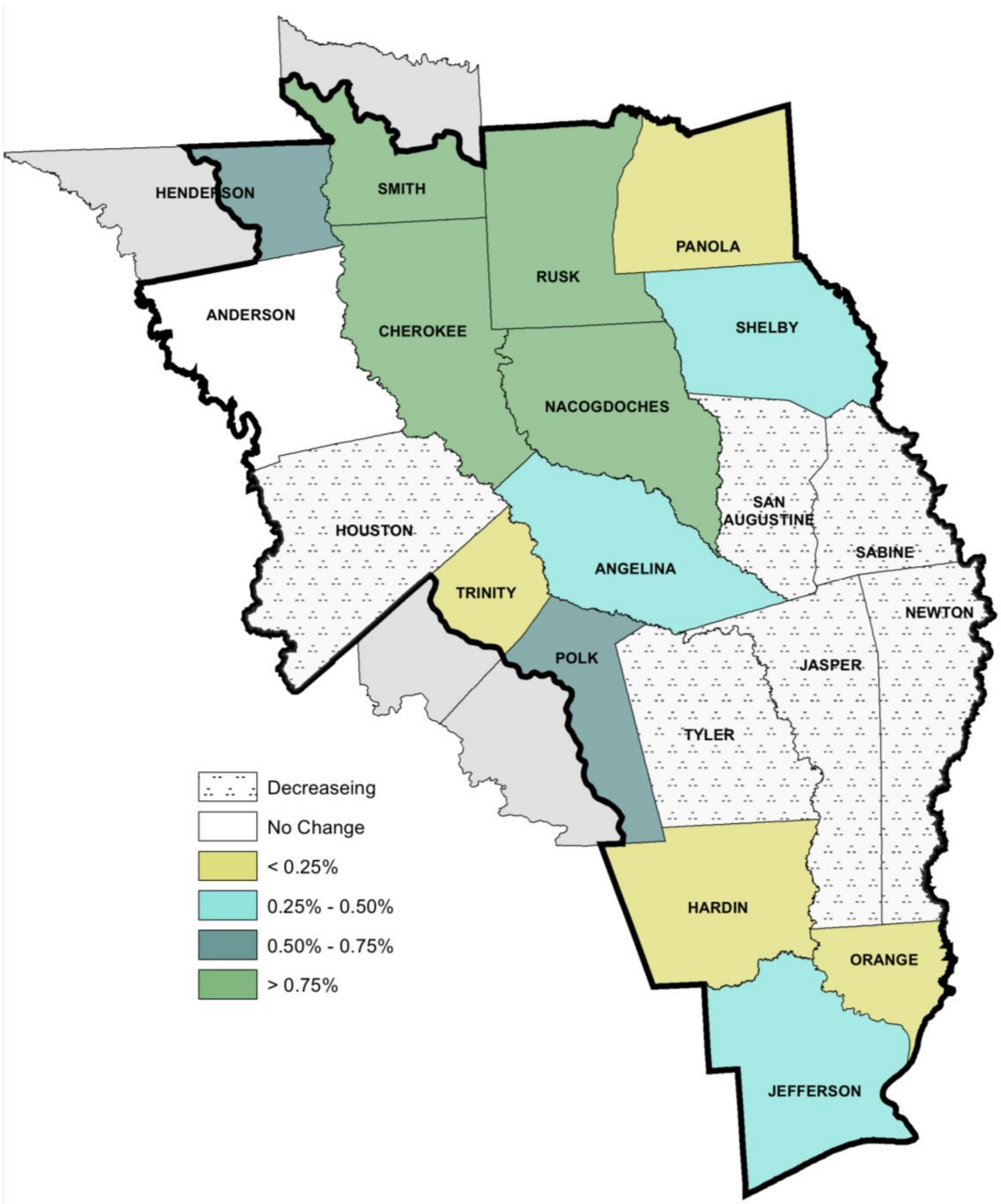


Figure 2.6 Municipal Demand Annual Growth Rate

SOURCE: TEXAS WATER DEVELOPMENT BOARD

2.3.2 Manufacturing Demands

Manufacturing demands are expected to increase from 305,973 ac-ft per year to 353,415 ac-ft per year during the planning period. Table 2.6 summarizes the manufacturing usage by each county. The percent change in manufacturing demand by county is presented in Table 2.7. Counties with projected demands over 10,000 ac-ft per year are summarized on Figure 2.7. All other counties are summarized on Figure 2.8. The average annual projected growth for manufacturing water use is shown on Figure 2.9.

Manufacturing water demand in the ETRWPA is concentrated primarily in Jefferson County, which accounts for almost 70% of all manufacturing water demand in 2020, and nearly 75% in 2070. Use is primarily in the petrochemical industry. The Lower Neches Valley Authority (LNVA) meets over 96% of this demand; a large percentage of this demand was not under contract at the time the 2016 Plan was developed and appears as a Water Management Strategy (WMS) in Chapter 5B.

Angelina, Jasper, and Orange counties are projected to comprise an additional 28% of use in 2020. Although manufacturing water demand will increase in these three counties over the planning period, their collective percentage of use in the region will decrease to approximately 23% by 2070.

Table 2.6 Historical and Projected Manufacturing Water Demand in the East Texas Regional Water Planning Area by County (ac-ft/yr)

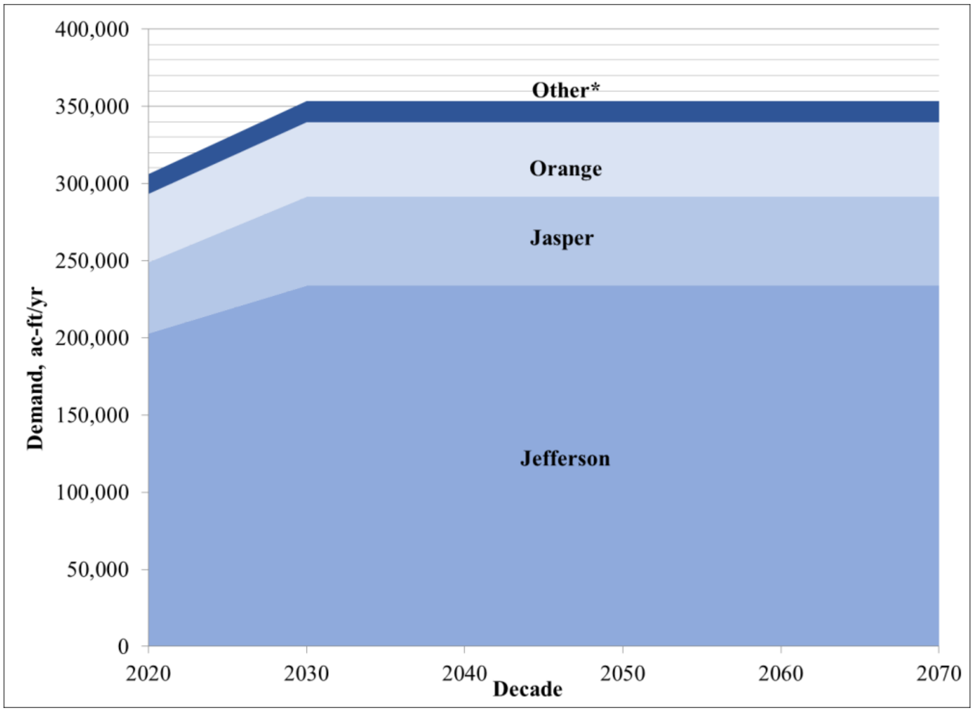
County	2015 Historical*	Projections					
		2020	2030	2040	2050	2060	2070
Anderson	724	-	-	-	-	-	-
Angelina	3,821	3,658	3,878	3,878	3,878	3,878	3,878
Cherokee	60	115	129	129	129	129	129
Hardin	30	40	45	45	45	45	45
Henderson[a]	0	-	-	-	-	-	-
Houston	158	169	232	232	232	232	232
Jasper	49,876	45,973	57,364	57,364	57,364	57,364	57,364
Jefferson	121,794	202,902	233,902	233,902	233,902	233,902	233,902
Nacogdoches	2,357	2,508	2,529	2,529	2,529	2,529	2,529
Newton	0	52	56	56	56	56	56
Orange	38,517	44,335	48,193	48,193	48,193	48,193	48,193
Panola	1,025	852	1,272	1,272	1,272	1,272	1,272
Polk[a]	334	433	466	466	466	466	466
Rusk	14	32	34	34	34	34	34
Sabine	226	246	265	265	265	265	265
San Augustine	3	6	6	6	6	6	6
Shelby	1,693	1,696	1,696	1,696	1,696	1,696	1,696
Smith[a]	2,580	2,956	3,348	3,348	3,348	3,348	3,348
Trinity[a]	0	-	-	-	-	-	-
Tyler	0	-	-	-	-	-	-
Total for ETRWPA	***223,212***	***305,973***	***353,415***	***353,415***	***353,415***	***353,415***	***353,415***

*Source: TWDB Water Use Survey: Historical Summary Estimates by County
[a] These counties are split between more than one Texas Water Development Board regional water planning area. The demands shown represent the portion that fall within the East Texas Regional Water Planning Area (ETRWPA).

Table 2.7 Manufacturing Demand Projection Percentages in the East Texas Regional Water Planning Area by County

County	Percent Change in Demand 2020 to 2070	Percent of Total ETRWPA Demand	
		2020	2070
Angelina	6.0%	1.2%	1.1%
Cherokee	12.2%	<0.1%	<0.1%
Hardin	12.5%	<0.1%	<0.1%
Houston	37.3%	0.1%	0.1%
Jasper	24.8%	15.0%	16.2%
Jefferson	15.3%	66.3%	66.2%
Nacogdoches	0.8%	0.8%	0.7%
Newton	7.7%	<0.1%	<0.1%
Orange	8.7%	14.5%	13.6%
Panola	49.3%	0.3%	0.4%
Polk	7.6%	0.1%	0.1%
Rusk	6.3%	<0.1%	<0.1%
Sabine	7.7%	0.1%	0.1%
San Augustine	0.0%	<0.1%	<0.1%
Shelby	0.0%	0.6%	0.5%
Smith	13.3%	1.0%	0.9%

SOURCE: TEXAS WATER DEVELOPMENT BOARD



*For a breakdown of Other Manufacturing Demand Projections by County see Figure 2.8.

Figure 2.7 Manufacturing Demand Projections in the East Texas Regional Water Planning Area Greater than 10,000 ac-ft/yr by County

SOURCE: TEXAS WATER DEVELOPMENT BOARD

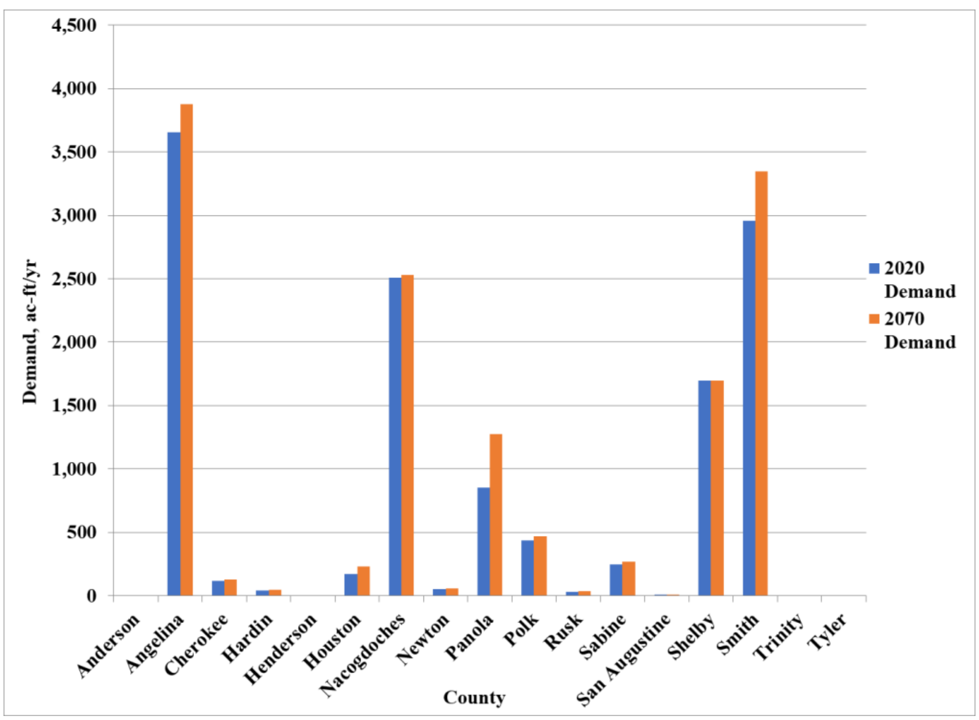


Figure 2.8 Manufacturing Demand Projections in the East Texas Regional Water Planning Area Less than 10,000 ac-ft/yr by County

SOURCE: TEXAS WATER DEVELOPMENT BOARD

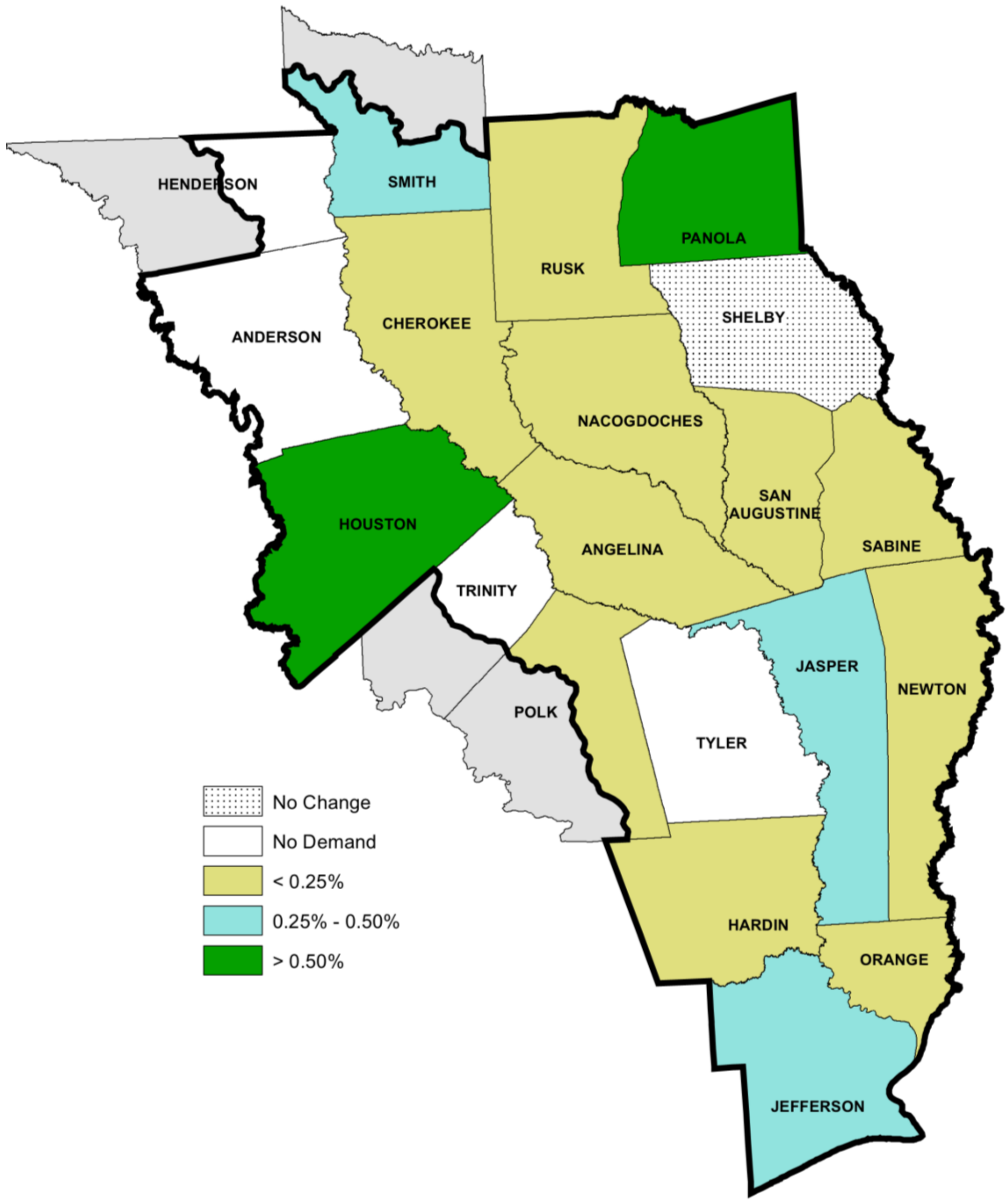


Figure 2.9 Manufacturing Demand Annual Growth Rate

SOURCE: TEXAS WATER DEVELOPMENT BOARD

2.3.3 Irrigation Demands

The 2016 Plan projects irrigation demands in 19 of the 20 counties in the region, with no projected demand increase over the planning period. Water use for irrigation is presented in Table 2.8 and 2.9. Orange and Houston County projected demands are presented in Figure 2.10 with the remaining counties presented in Figure 2.11.

Table 2.8 Historical and Projected Irrigation Water Demand in the East Texas Regional Water Planning Area by County (ac-ft/yr)

County	2015 Historical*	Projections					
		2020	2030	2040	2050	2060	2070
Anderson	675	657	657	657	657	657	657
Angelina	110	779	779	779	779	779	779
Cherokee	498	451	451	451	451	451	451
Hardin	131	989	989	989	989	989	989
Henderson[a]	403	303	303	303	303	303	303
Houston	1,262	2,137	2,137	2,137	2,137	2,137	2,137
Jasper	124	151	151	151	151	151	151
Jefferson	65,528	88,536	88,536	88,536	88,536	88,536	88,536
Nacogdoches	108	266	266	266	266	266	266
Newton	42	101	101	101	101	101	101
Orange	1,901	1,824	1,824	1,824	1,824	1,824	1,824
Panola	1,122	574	574	574	574	574	574
Polk[a]	113	230	230	230	230	230	230
Rusk	139	276	276	276	276	276	276
Sabine	0	-	-	-	-	-	-
San Augustine	0	4	4	4	4	4	4
Shelby	6	10	10	10	10	10	10
Smith[a]	400	448	448	448	448	448	448
Trinity[a]	229	278	278	278	278	278	278
Tyler	293	354	354	354	354	354	354
Total for ETRWPA	***73,084***	***98,368***	***98,368***	***98,368***	***98,368***	***98,368***	***98,368***

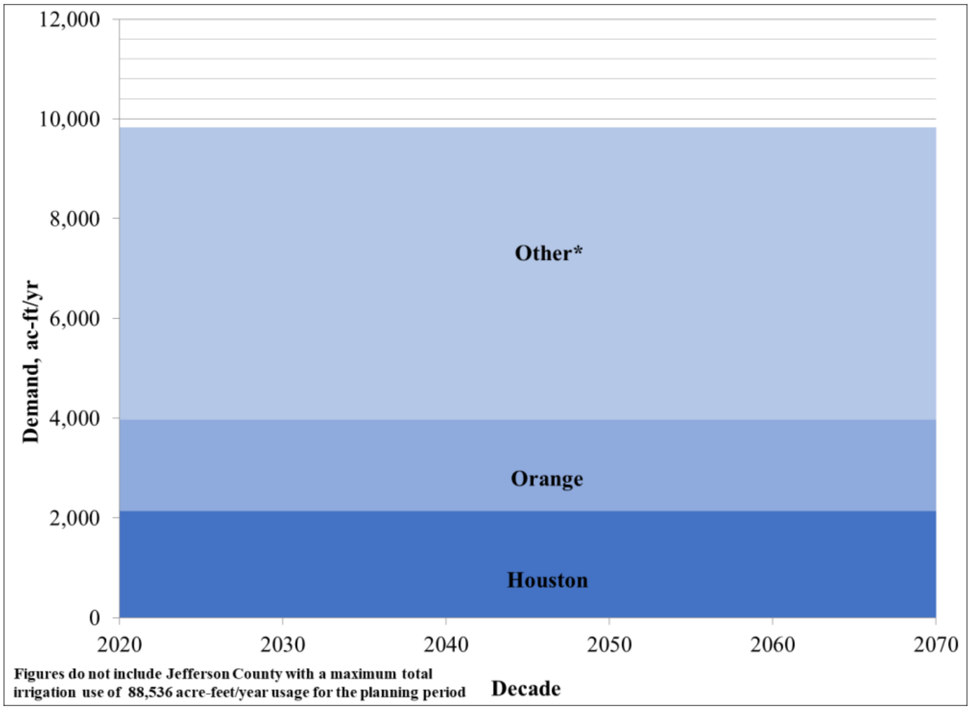
*Source: TWDB Water Use Survey: Historical Summary Estimates by County

[a] These counties are split between more than one Texas Water Development Board regional water planning area. The demands shown represent the portion that fall within the East Texas Regional Water Planning Area (ETRWPA).

Table 2.9 Irrigation Demand Projection Percentages in the East Texas Regional Water Planning Area by County

County	Percent Change in Demand 2020 to 2070	Percent of Total ETRWPA Demand	
		2020	2070
Anderson	0.0%	0.7%	0.7%
Angelina	0.0%	0.8%	0.8%
Cherokee	0.0%	0.5%	0.5%
Hardin	0.0%	1.0%	1.0%
Henderson	0.0%	0.3%	0.3%
Houston	0.0%	2.2%	2.2%
Jasper	0.0%	0.2%	0.2%
Jefferson	0.0%	90.0%	90.0%
Nacogdoches	0.0%	0.3%	0.3%
Newton	0.0%	0.1%	0.1%
Orange	0.0%	1.9%	1.9%
Panola	0.0%	0.6%	0.6%
Polk	0.0%	0.2%	0.2%
Rusk	0.0%	0.3%	0.3%
San Augustine	0.0%	<0.1%	<0.1%
Shelby	0.0%	<0.1%	<0.1%
Smith	0.0%	0.5%	0.5%
Trinity	0.0%	0.3%	0.3%
Tyler	0.0%	0.4%	0.4%

SOURCE: TEXAS WATER DEVELOPMENT BOARD



*For a breakdown of Other Irrigation Demand Projections by County see Figure 2.11.

Figure 2.10 Irrigation Demand Projections in the East Texas Regional Water Planning Area Greater than 1,000 ac-ft/yr by County

SOURCE: TEXAS WATER DEVELOPMENT BOARD

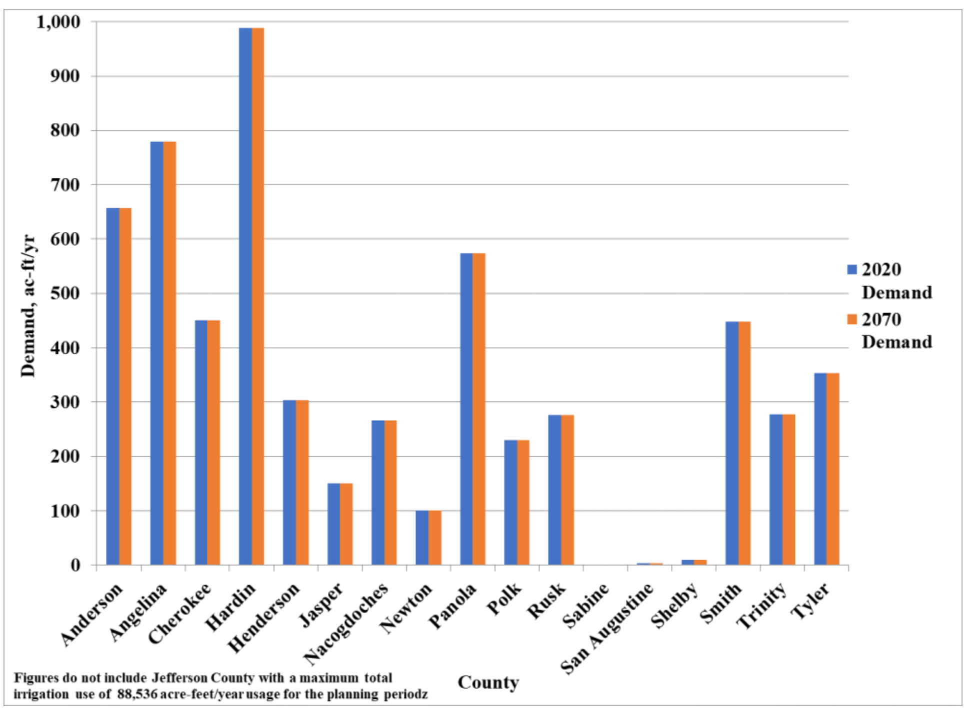


Figure 2.11 Irrigation Demand Projections in the East Texas Regional Water Planning Area Less than 1,000 ac-ft/yr by County

SOURCE: TEXAS WATER DEVELOPMENT BOARD

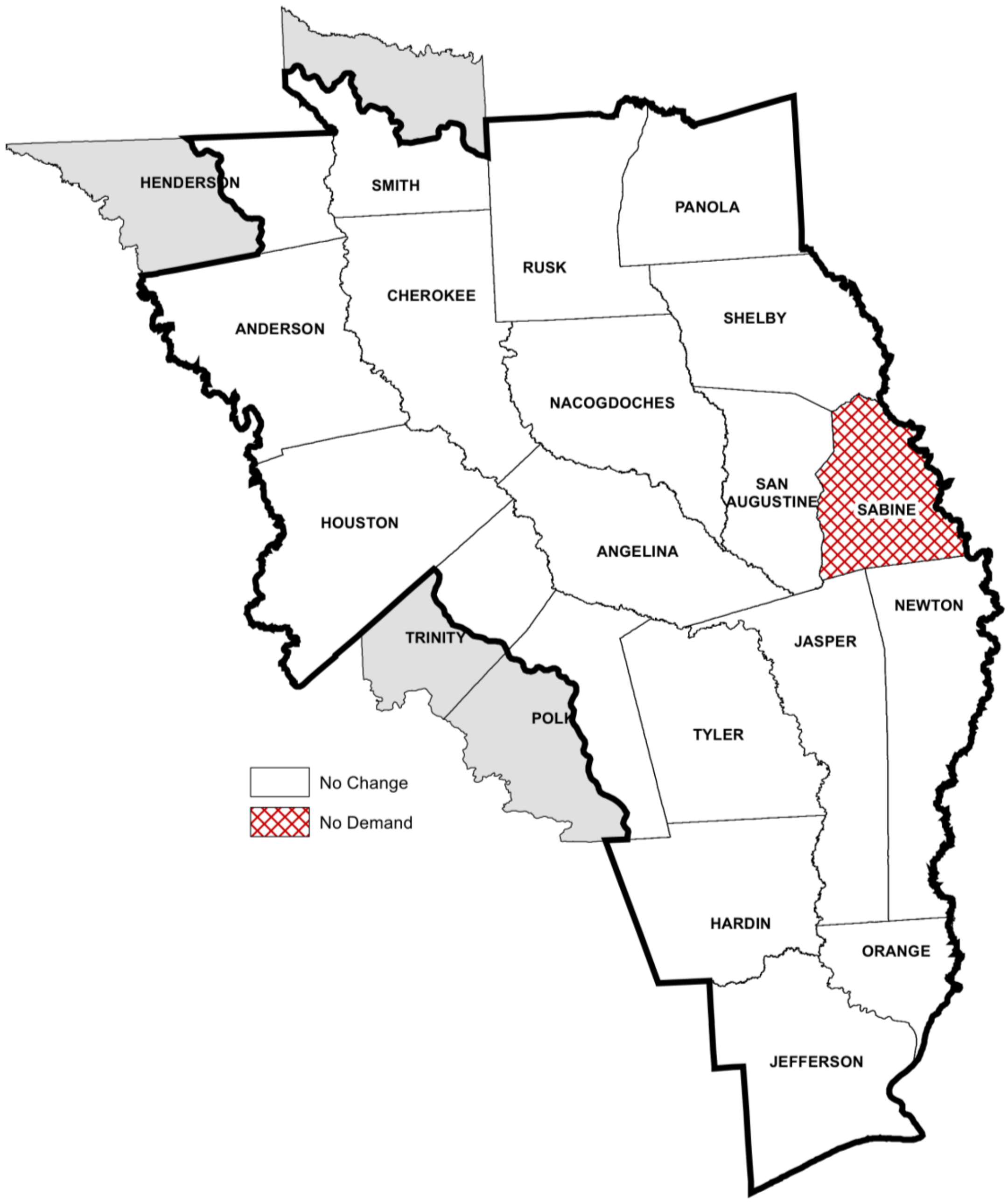


Figure 2.12 Irrigation Demand Annual Growth Rate

SOURCE: TEXAS WATER DEVELOPMENT BOARD

2.3.4 Steam Electric Power Demands

There are nine counties with projected steam electric power demands in the ETRWPA. Compared to the last round of planning, the projected demands have decreased for every county with exception to Rusk County, which had a 65% increase in projected demand compared to the 2016 Plan in the decade 2020. Region-wide steam electric power demands are projected to remain constant at 67,011 ac-ft pear year. Projected demands for each county are summarized in Table 2.10 and 2.11. Figure 2.13 graphically depicts the demand projections for the nine counties in the region with steam electric power demands. Figure 2.14 shows the distribution of steam electric power demands in the region.

Table 2.10 Historical and Projected Steam Electric Power Water Demand in the East Texas Regional Water Planning Area by County (ac-ft/yr)

County	2015 Historical*	Projections					
		2020	2030	2040	2050	2060	2070
Anderson	0	1,408	1,408	1,408	1,408	1,408	1,408
Angelina	51	3,520	3,520	3,520	3,520	3,520	3,520
Cherokee	290	3,211	3,211	3,211	3,211	3,211	3,211
Hardin	0	1	1	1	1	1	1
Henderson[a]	0	-	-	-	-	-	-
Houston	0	-	-	-	-	-	-
Jasper	0	-	-	-	-	-	-
Jefferson	0	3,291	3,291	3,291	3,291	3,291	3,291
Nacogdoches	0	-	-	-	-	-	-
Newton	5,778	5,778	5,778	5,778	5,778	5,778	5,778
Orange	3,897	4,298	4,298	4,298	4,298	4,298	4,298
Panola	0	-	-	-	-	-	-
Polk[a]	0	-	-	-	-	-	-
Rusk	13,861	45,304	45,304	45,304	45,304	45,304	45,304
Sabine	0	-	-	-	-	-	-
San Augustine	0	-	-	-	-	-	-
Shelby	0	-	-	-	-	-	-
Smith[a]	0	-	-	-	-	-	-
Trinity[a]	0	-	-	-	-	-	-
Tyler	0	200	200	200	200	200	200
Total for ETRWPA	***23,877***	***67,011***	***67,011***	***67,011***	***67,011***	***67,011***	***67,011***

*Source: TWDB Water Use Survey: Historical Summary Estimates by County

[a] These counties are split between more than one Texas Water Development Board regional water planning area. The demands shown represent the portion that fall within the East Texas Regional Water Planning Area (ETRWPA).

Table 2.11 Steam Electric Power Demand Projection Percentages in the East Texas Regional Water Planning Area by County

County	Percent Change in Demand 2020 to 2070	Percent of Total ETRWPA Demand	
		2020	2070
Anderson	0.0%	2.1%	2.1%
Angelina	0.0%	5.3%	5.3%
Cherokee	0.0%	4.8%	4.8%
Hardin	0.0%	<0.1%	<0.1%
Jefferson	0.0%	4.9%	4.9%
Newton	0.0%	8.6%	8.6%
Orange	0.0%	6.4%	6.4%
Rusk	0.0%	67.6%	67.6%
Tyler	0.0%	0.3%	0.3%

SOURCE: TEXAS WATER DEVELOPMENT BOARD

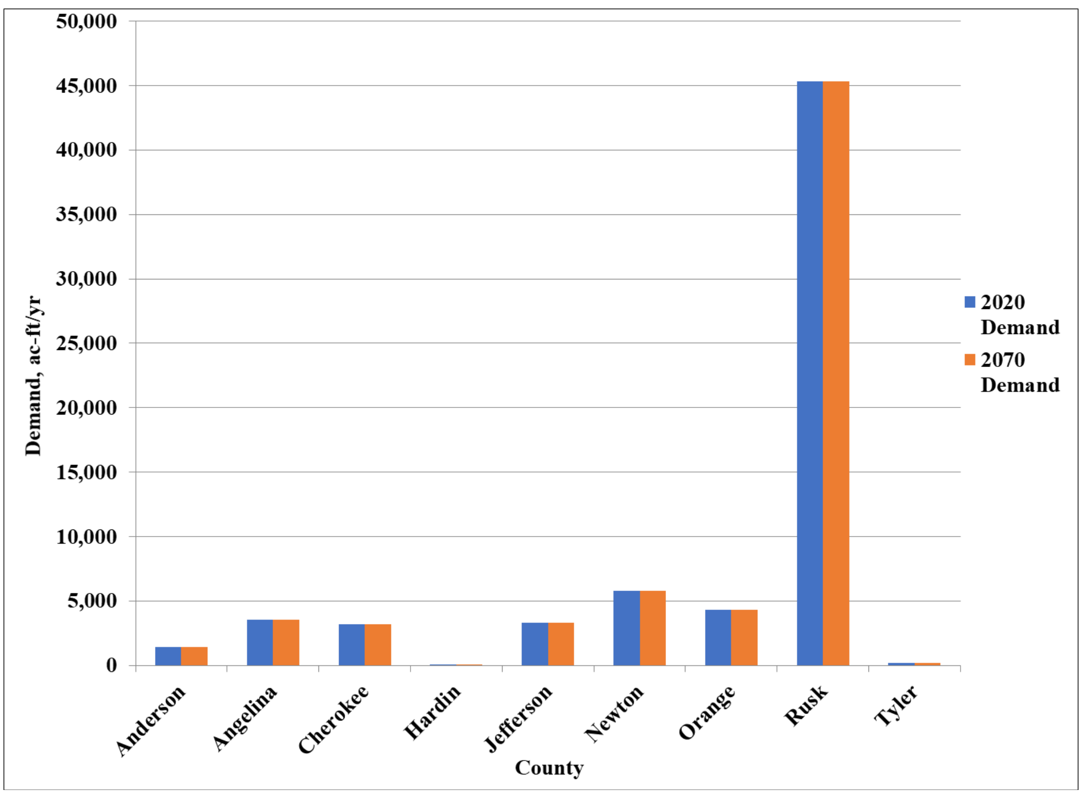


Figure 2.13 Steam Electric Power Demand Projections in the East Texas Regional Water Planning Area by County

SOURCE: TEXAS WATER DEVELOPMENT BOARD, WATER USE SURVEY

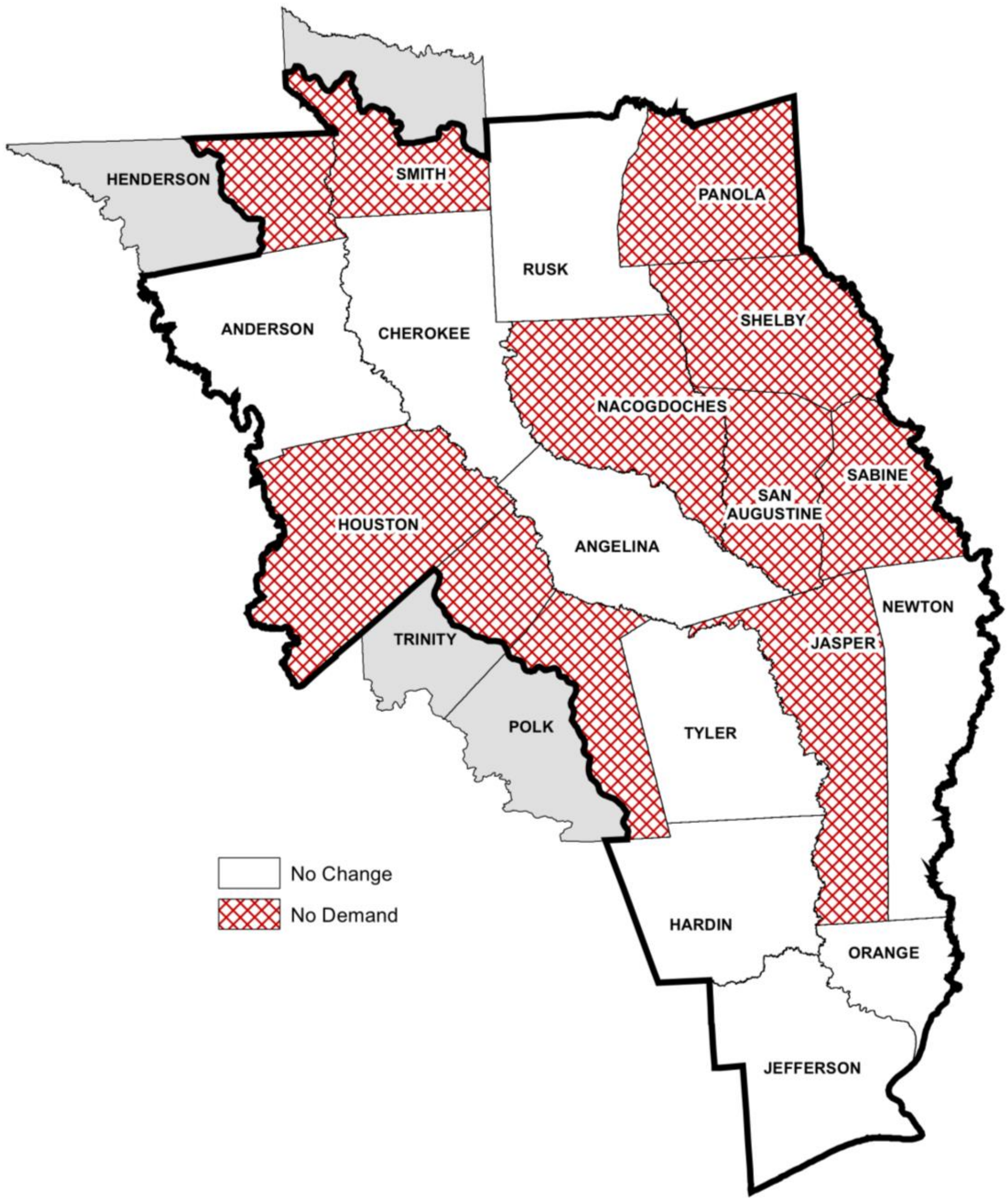


Figure 2.14 Steam Electric Power Demands Annual Growth Rate

SOURCE: TEXAS WATER DEVELOPMENT BOARD

2.3.5 Livestock Demands

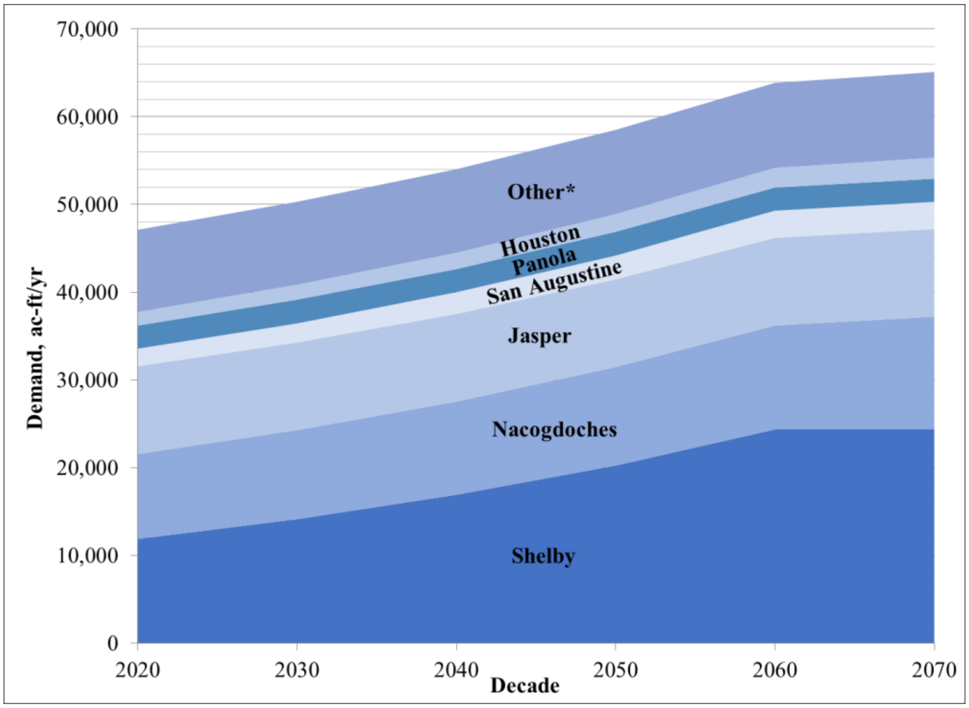
All twenty counties in the ETRWPA include projected demands for livestock with 67% of that demand in Jasper, Nacogdoches, and Shelby counties in 2020 increasing to 73% of the region's demands in 2070. The total livestock water usage is expected to increase over the planning period from 47,157 ac-ft per year to 65,103 ac-ft per year. Compared to the projections in the last round of planning for the same planning period, this represents almost a 100% increase. The projected usage by county during the planning period is presented in Table 2.12. The largest percentage change in total demand is expected to occur in Sabine County at 181%. Additional percent changes can be seen in Table 2.13. Counties with a projected demand over 2,000 ac-ft per year are presented in Figure 2.15 with the remaining counties presented in Figure 2.16. The livestock demand change rates are presented graphically in Figure 2.17.

Table 2.12 Historical and Projected Livestock Water Demand in the East Texas Regional Water Planning Area by County (ac-ft/yr)

County	2015 Historical*	Projections					
		2020	2030	2040	2050	2060	2070
Anderson	1,070	1,026	1,026	1,026	1,026	1,026	1,026
Angelina	976	1,028	1,028	1,028	1,028	1,028	1,028
Cherokee	1,759	1,874	1,874	1,874	1,874	1,874	1,874
Hardin	199	198	198	198	198	198	198
Henderson[a]	458	1,006	1,006	1,006	1,006	1,006	1,006
Houston	1,391	1,564	1,707	1,860	2,027	2,208	2,439
Jasper	469	10,000	10,000	10,000	10,000	10,000	10,000
Jefferson	782	837	837	837	837	837	837
Nacogdoches	9,783	9,693	10,122	10,619	11,195	11,854	12,836
Newton	112	168	168	168	168	168	168
Orange	183	255	255	255	255	255	255
Panola	2,581	2,652	2,652	2,652	2,652	2,652	2,652
Polk[a]	149	174	174	174	174	174	174
Rusk	1,693	1,660	1,683	1,714	1,745	1,777	1,777
Sabine	108	129	176	231	294	363	363
San Augustine	1,982	2,004	2,219	2,465	2,751	3,066	3,066
Shelby	11,920	11,858	14,128	16,891	20,263	24,373	24,373
Smith[a]	490	580	580	580	580	580	580
Trinity[a]	157	202	202	202	202	202	202
Tyler	232	249	249	249	249	249	249
Total for ETRWPA	***36,494***	***47,157***	***50,284***	***54,029***	***58,524***	***63,890***	***65,103***

*Source: TWDB Water Use Survey: Historical Summary Estimates by County

[a] These counties are split between more than one Texas Water Development Board regional water planning area. The demands shown represent the portion that fall within the East Texas Regional Water Planning Area (ETRWPA).



*For a breakdown of Other Livestock Demand Projections by County see Figure 2.16.

Figure 2.15 Livestock Demand Projections in the East Texas Regional Water Planning Area Greater than 2,000 ac-ft/yr by County

SOURCE: TEXAS WATER DEVELOPMENT BOARD

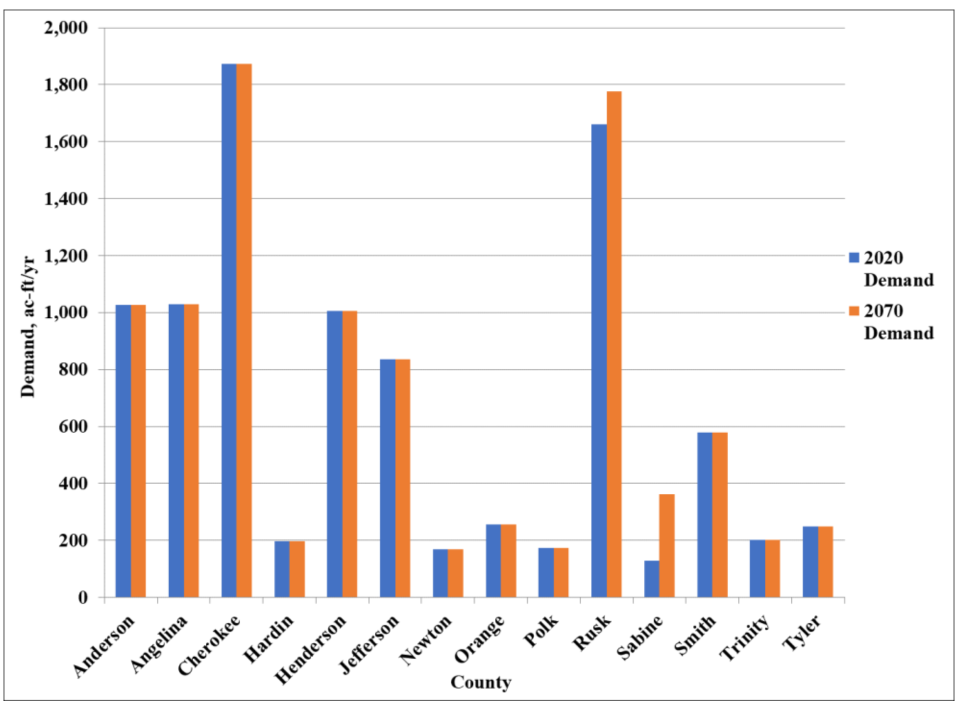


Figure 2.16 Livestock Demand Projections in the East Texas Regional Water Planning Area Less than by 2,000 ac-ft/yr by County

SOURCE: TEXAS WATER DEVELOPMENT BOARD

Table 2.13 Livestock Demand Projection Percentages in the East Texas Regional Water Planning Area by County

County	Percent Change in Demand 2020 to 2070	Percent of Total ETRWPA Demand	
		2020	2070
Anderson	0.0%	2.2%	1.6%
Angelina	0.0%	2.2%	1.6%
Cherokee	0.0%	4.0%	2.9%
Hardin	0.0%	0.4%	0.3%
Henderson	0.0%	2.1%	1.5%
Houston	55.9%	3.3%	3.7%
Jasper	0.0%	21.2%	15.4%
Jefferson	0.0%	1.8%	1.3%
Nacogdoches	32.4%	20.6%	19.7%
Newton	0.0%	0.4%	0.3%
Orange	0.0%	0.5%	0.4%
Panola	0.0%	5.6%	4.1%
Polk	0.0%	0.4%	0.3%
Rusk	7.0%	3.5%	2.7%
Sabine	181.4%	0.3%	0.6%
San Augustine	53.0%	4.2%	4.7%
Shelby	105.5%	25.1%	37.4%
Smith	0.0%	1.2%	0.9%
Trinity	0.0%	0.4%	0.3%
Tyler	0.0%	0.5%	0.4%

SOURCE: TEXAS WATER DEVELOPMENT BOARD

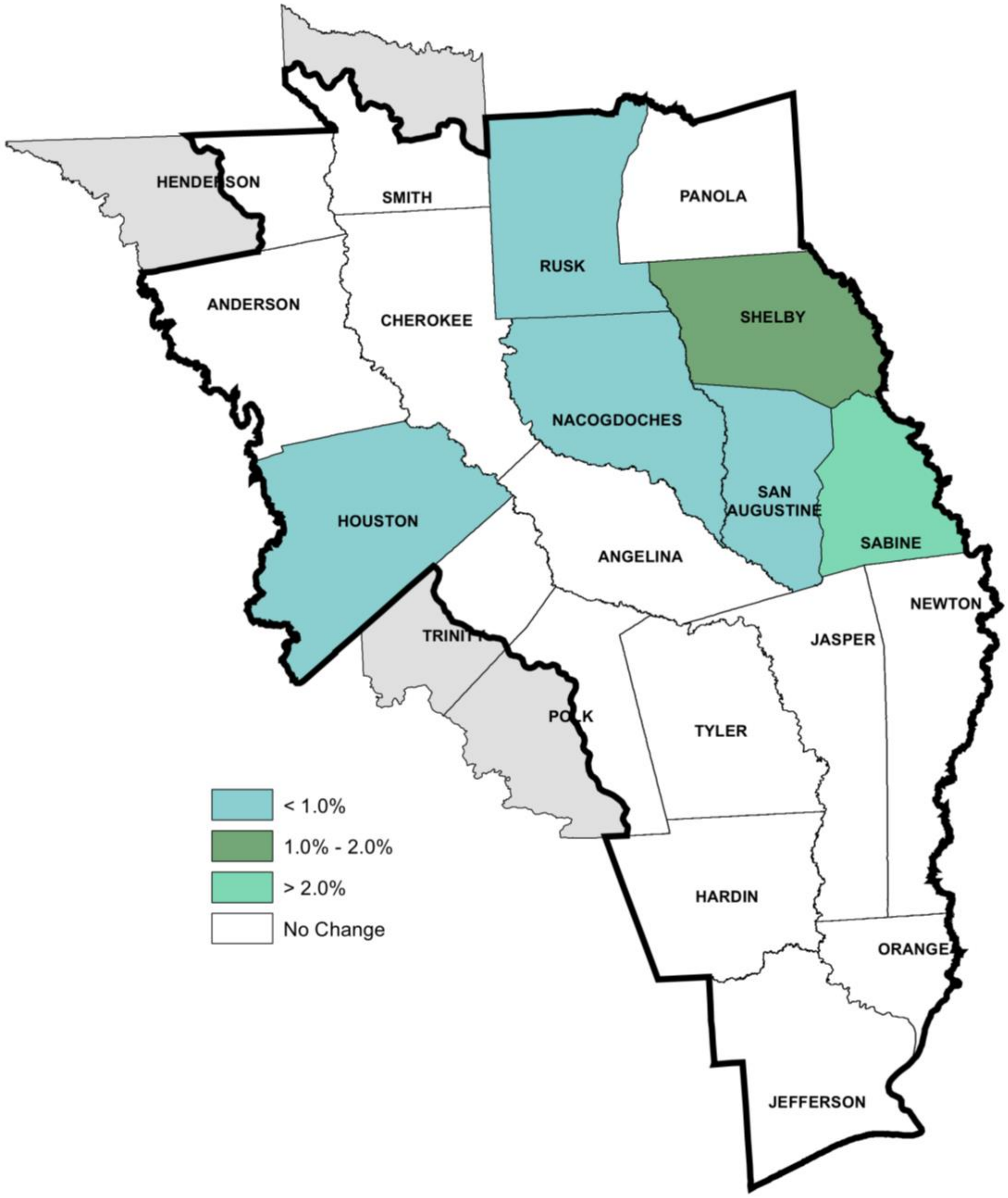


Figure 2.17 Livestock Demand Annual Growth Rate

SOURCE: TEXAS WATER DEVELOPMENT BOARD

2.3.6 Mining Demands

In the 2011 Plan, mining demands were identified in 16 of the 20 counties in the ETRWPA. Much of the demand (approximately 38,000 ac-ft per year in 2010 and declining to approximately 20,000 ac-ft per year in 2060) was related to the expanding shale-gas play located within much of the region. Since 2011, the natural gas exploration industry has focused on the Eagle Ford shale in South Texas, resulting in lower projections for water demand in the ETRWPA. Nonetheless, gas exploration has continued in the region and is expected to comprise the majority of the mining demand for the region. For the 2016 Plan, mining water demand was updated to 27,523 ac-ft per year in 2020 and decline to 12,093 ac-ft per year in 2070 with mining water use in all 20 of the counties in the ETRWPA. The 2021 Plan matches the mining projections presented in the 2016 Plan. Table 2.14 provides mining water projections and Table 2.15 shows the percent changes for each county in the ETRWPA. Demands for counties with projections greater than 600 ac-ft per year are depicted on Figure 2.18. Those counties with lower projected demands are shown on Figure 2.19. Figure 2.20 illustrates the annual percent change for mining water in each county in the ETRWPA.

Table 2.14 Historical and Projected Mining Water Demand in the East Texas Regional Water Planning Area by County (ac-ft/yr)

County	2015 Historical*	Projections					
		2020	2030	2040	2050	2060	2070
Anderson	1	140	177	185	147	105	75
Angelina	28	486	585	410	312	237	180
Cherokee	92	295	304	267	204	141	97
Hardin	0	12	12	12	12	12	12
Henderson[a]	0	77	86	77	59	40	28
Houston	86	322	254	187	119	51	22
Jasper	2	148	118	88	58	28	14
Jefferson	13	194	216	244	294	329	368
Nacogdoches	106	7,000	4,500	1,643	1,299	958	707
Newton	0	429	373	279	209	146	107
Orange	0	309	314	313	314	319	327
Panola	2,708	5,916	5,859	5,049	4,268	3,620	3,938
Polk[a]	0	123	97	72	46	20	9
Rusk	2,560	2,990	4,007	3,870	3,724	3,601	3,592
Sabine	0	1,500	1,365	1,203	1,046	888	776
San Augustine	486	4,000	3,000	1,479	1,180	884	662
Shelby	126	3,283	2,938	2,496	1,980	1,467	1,087
Smith[a]	388	134	139	140	109	80	58
Trinity[a]	0	5	5	5	5	5	5
Tyler	0	160	198	150	103	55	29
Total for ETRGWA	***6,596***	***27,523***	***24,547***	***18,169***	***15,488***	***12,986***	***12,093***

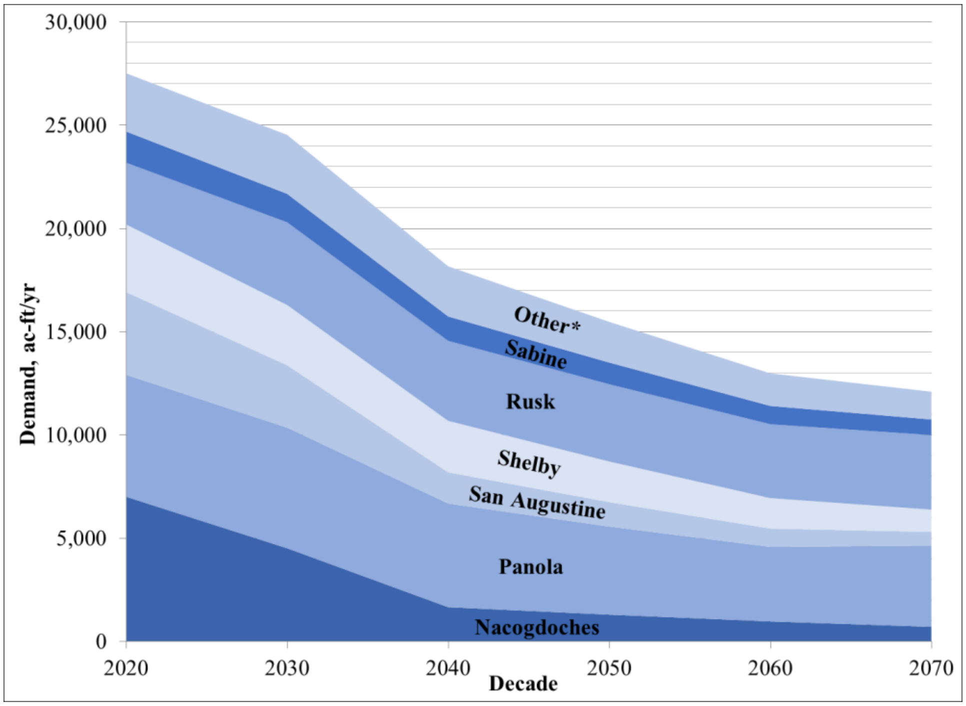
*Source: TWDB Water Use Survey: Historical Summary Estimates by County

[a] These counties are split between more than one Texas Water Development Board regional water planning area. The demands shown represent the portion that fall within the East Texas Regional Water Planning Area (ETRWPA).

Table 2.15 Mining Demand Projection Percentages in the East Texas Regional Water Planning Area by County

County	Percent Change in Demand 2020 to 2070	Percent of Total ETRWPA Demand	
		2020	2070
Anderson	-46.4%	0.5%	0.6%
Angelina	-63.0%	1.8%	1.5%
Cherokee	-67.1%	1.1%	0.8%
Hardin	0.0%	0.0%	0.1%
Henderson	-63.6%	0.3%	0.2%
Houston	-93.2%	1.2%	0.2%
Jasper	-90.5%	0.5%	0.1%
Jefferson	89.7%	0.7%	3.0%
Nacogdoches	-89.9%	25.4%	5.8%
Newton	-75.1%	1.6%	0.9%
Orange	5.8%	1.1%	2.7%
Panola	-33.4%	21.5%	32.6%
Polk	-92.7%	0.4%	0.1%
Rusk	20.1%	10.9%	29.7%
Sabine	-48.3%	5.4%	6.4%
San Augustine	-83.5%	14.5%	5.5%
Shelby	-66.9%	11.9%	9.0%
Smith	-56.7%	0.5%	0.5%
Trinity	0.0%	0.0%	0.0%
Tyler	-81.9%	0.6%	0.2%

SOURCE: TEXAS WATER DEVELOPMENT BOARD



*For a breakdown of Other Mining Demand Projections by County see Figure 2.19.

Figure 2.18 Mining Demand Projections in the East Texas Regional Water Planning Area Greater than 600 ac-ft/yr by County

SOURCE: TEXAS WATER DEVELOPMENT BOARD

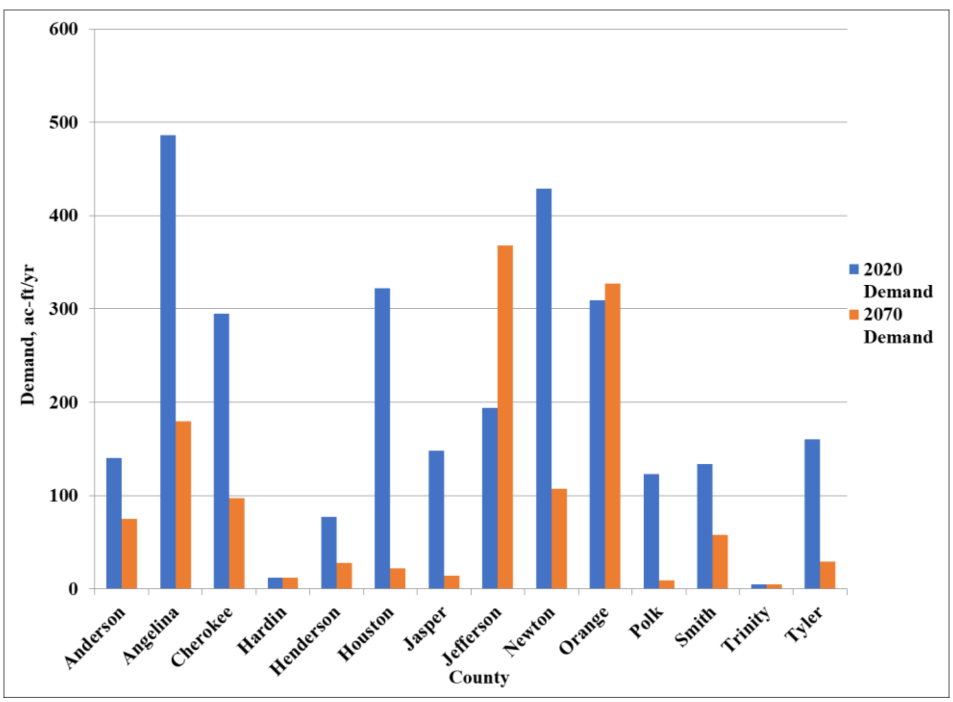


Figure 2.19 Mining Demand Projections in the East Texas Regional Water Planning Area Less than 600 ac-ft/yr by County

SOURCE: TEXAS WATER DEVELOPMENT BOARD

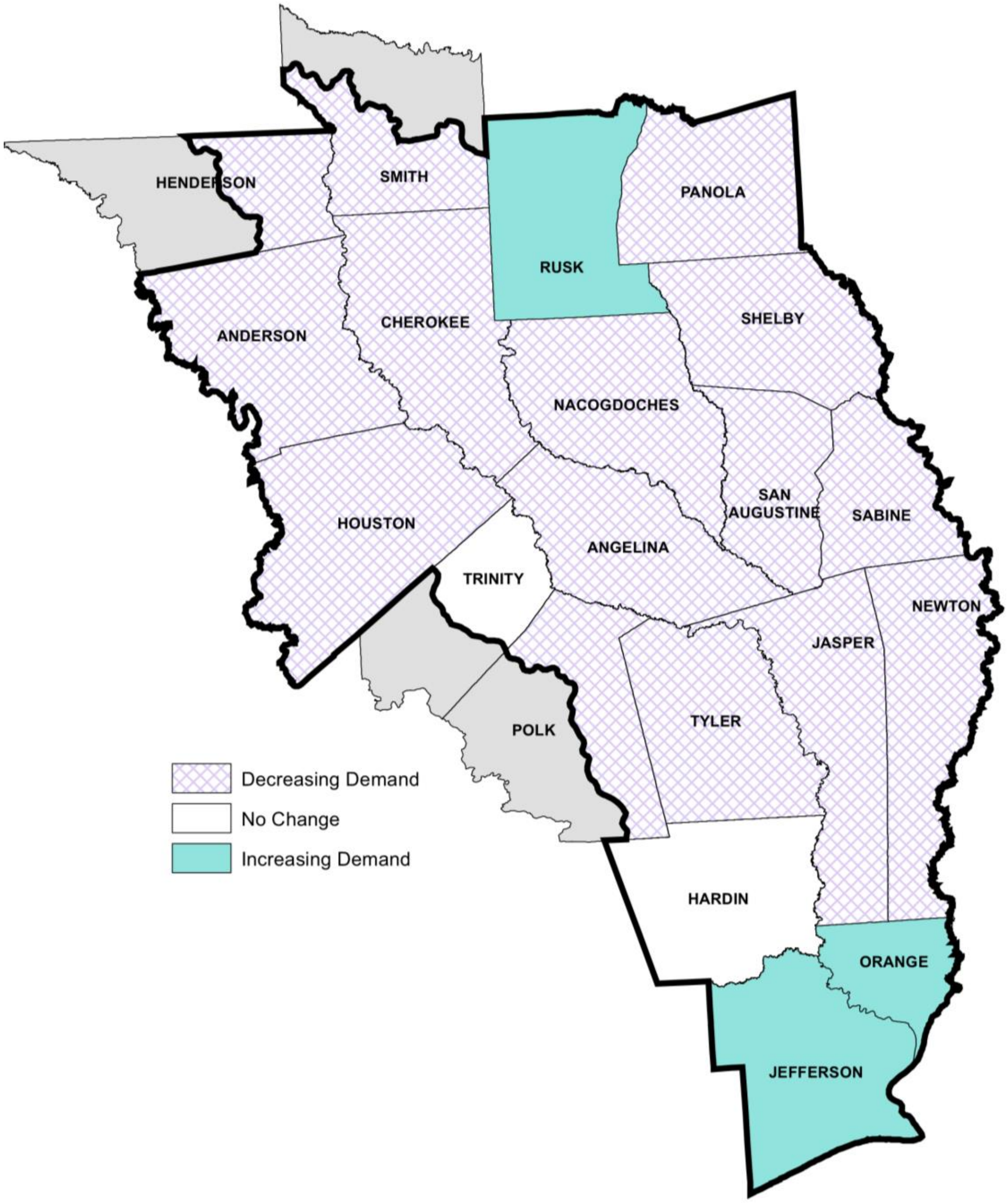


Figure 2.20 Mining Demand Annual Growth Rate

SOURCE: TEXAS WATER DEVELOPMENT BOARD

2.3.7 Sales Between Water User Groups

The 2021 Plan is required to present the current contractual obligations of WUGs in the ETRWPA to supply water to other WUGs in addition to any demands projected for the corresponding WUG or WWP. Table 2.16 summarizes this information by decade; the table does not include sales from WUGs who are also MWPs; see Section 2.4 for a summary of MWP obligations.

Table 2.16 Contractual Obligations of Water User Groups in the East Texas Regional Water Planning Area (ac-ft/yr)

Customer	WUG	Demands					
		2020	2030	2040	2050	2060	2070
Manufacturing - Angelina	Diboll	134	134	134	134	134	134
Manufacturing - Hardin	North Hardin WSC	2	2	2	2	2	2
Manufacturing - Hardin	Silsbee	4	4	4	4	4	4
D & M WSC	Nacogdoches	444	443	441	440	439	437
Manufacturing - Rusk	Rusk County-Other	4	4	4	4	4	4
Manufacturing - Rusk	Henderson	29	29	29	29	29	29
G M WSC	Hemphill	517	517	517	517	517	517
San Augustine Rural WSC	San Augustine	120	114	110	108	108	108
Whitehouse	City of Tyler	664	664	664	664	664	664
Groveton	Trinity River Authority*	282	283	282	283	284	283
Tyler Steam Electric Power	Woodville	838	838	838	838	838	838

*Region C Major Water Provider

2.4 Demands for Major Water Providers

As part of the development of the regional water plan, current water demands were identified for the MWPs in the ETRWPA. The MWPs are as follows:

- Angelina and Neches River Authority
- Angelina-Nacogdoches Water Control and Improvements District No. 1
- Athens Municipal Water Authority
- City of Beaumont
- City of Carthage
- City of Center
- City of Jacksonville
- City of Lufkin
- City of Nacogdoches
- City of Port Arthur
- City of Tyler
- Houston County WCID No. 1
- Lower Neches Valley Authority
- Panola County Freshwater Supply District No. 1

- Sabine River Authority
- Upper Neches River Municipal Water Authority

Chapter 1 provides a description of each MWP in the ETRWPA. For details regarding MWP supplies and water management strategies, see Chapters 3 and 5, respectively. The expected demands of each customer on each MWP can be found in Table 2.17 on the following pages; where applicable, the expected demand is equal to the contract volume. Table 2.18 presents MWP demands by water use category for 2020.

Table 2.17 Expected Demands for each Major Water Provider in the East Texas Regional Water Planning Area (ac-ft/yr)

MWP/Customer	Demands					
Angelina and Neches River Authority	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Cherokee County-Other	3,848	3,848	3,848	3,848	3,848	3,848
City of Jacksonville	4,275	4,275	4,275	4,275	4,275	4,275
City of New Summerfield	2,565	2,565	2,565	2,565	2,565	2,565
North Cherokee WSC	4,275	4,275	4,275	4,275	4,275	4,275
City of Rusk	4,275	4,275	4,275	4,275	4,275	4,275
Rusk Rural WSC	855	855	855	855	855	855
City of Alto	428	428	428	428	428	428
Caro WSC	428	428	428	428	428	428
City of Nacogdoches	8,551	8,551	8,551	8,551	8,551	8,551
City of New London	855	855	855	855	855	855
City of Troup	4,275	4,275	4,275	4,275	4,275	4,275
City of Arp	428	428	428	428	428	428
Blackjack WSC	855	855	855	855	855	855
Jackson WSC	855	855	855	855	855	855
City of Whitehouse	8,551	8,551	8,551	8,551	8,551	8,551
Dallas	0	0	0	0	0	56,050
Total Demand - Lake Columbia	*45,319*	*45,319*	*45,319*	*45,319*	*45,319*	*101,369*
Additional Contracts						
Holmwood Utility	65	70	70	70	70	70
Steam Electric Power	8,000	15,000	20,000	20,000	20,000	20,000
Rusk County Refinery	5,600	5,600	5,600	5,600	5,600	5,600
Angelina County Mining	473	572	397	299	224	167
Cherokee County Mining	238	247	210	147	84	40
Nacogdoches County Mining	5,475	2,975	118	0	0	0
San Augustine County Mining	2,102	1,102	0	0	0	0
Rusk County Mining	0	305	168	22	0	0
Angelina and Neches River Authority Total Demand	***67,272***	***71,190***	***71,882***	***71,457***	***71,297***	***127,246***

Table 2.17 Expected Demands for each Major Water Provider in the East Texas Regional Water Planning Area (ac-ft/yr) (cont.)

MWP/Customer	Demands					
Angelina-Nacogdoches Water Control and Improvement District No. 1	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Luminant Energy	5,000	5,000	5,000	5,000	5,000	5,000
Nacogdoches / Southern Power	7,280	7,280	7,280	7,280	7,280	7,280
City of Henderson (Future)	0	0	8,289	8,289	8,289	8,289
Angelina-Nacogdoches Water Control and Improvement District No. 1 Total Demand	***12,280***	***12,280***	***20,569***	***20,569***	***20,569***	***20,569***
Athens Municipal Water Authority	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
City of Athens	2,962	3,233	3,461	3,795	6,462	9,556
Lakeside Irrigation	170	170	170	170	170	170
TPWD Fish Hatchery	3,023	3,023	3,023	3,023	3,023	3,023
Manufacturing, Henderson (Region C)	484	591	591	591	591	591
Athens Municipal Water Authority Total Demand	***6,639***	***7,017***	***7,245***	***7,579***	***10,246***	***13,340***
City of Beaumont	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
City of Beaumont	30,788	32,110	33,623	35,671	38,168	41,012
County-Other, Jefferson	2,034	2,678	3,470	4,000	4,000	4,000
Manufacturing, Jefferson	1,642	1,658	1,675	1,692	1,709	1,726
Meeker MWD	4	4	5	5	5	6
City of Beaumont Total Demand	***34,469***	***36,451***	***38,773***	***41,368***	***43,882***	***46,743***
City of Carthage	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
City of Carthage	1,650	1,651	1,644	1,648	1,659	1,669
County-Other, Panola	300	300	300	300	300	300
Manufacturing, Panola	906	945	984	1,017	1,084	1,115
City of Carthage Total Demand	***2,856***	***2,896***	***2,928***	***2,965***	***3,043***	***3,084***

Table 2.17 Expected Demands for each Major Water Provider in the East Texas Regional Water Planning Area (ac-ft/yr) (cont.)

MWP/Customer	Demands					
City of Center	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Sand Hills WSC	96	99	102	106	111	116
Shelbyville WSC	6	6	6	7	7	7
Manufacturing, Shelby	1,696	1,696	1,696	1,696	1,696	1,696
City of Center	1,842	1,952	2,050	2,152	2,255	2,351
City of Center Total Demand	***3,640***	***3,753***	***3,855***	***3,961***	***4,069***	***4,170***
Houston County Water Control and Improvement District No. 1	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Existing Customers						
City of Crockett	1,282	1,282	1,282	1,282	1,282	1,282
City of Grapeland	170	170	170	170	170	170
City of Lovelady	29	29	29	29	29	29
Manufacturing	169	232	232	232	232	232
The Consolidated WSC	616	616	616	616	616	616
Total Demand for Existing Customers	*2,266*	*2,329*	*2,329*	*2,329*	*2,329*	*2,329*
Future Customers						
The Consolidated WSC	522	522	522	522	522	522
Total Demand for Future Customers	*522*	*522*	*522*	*522*	*522*	*522*
Houston County Water Control and Improvement District No. 1 Total Demand	***2,788***	***2,851***	***2,851***	***2,851***	***2,851***	***2,851***
City of Jacksonville	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Afton Grove WSC, Gum Creek WSC	318	336	357	387	421	458
Craft Turney WSC	485	503	524	562	610	665
City of Jacksonville [2]	3,045	3,247	3,457	3,745	4,076	4,440
Manufacturing, Cherokee	115	129	129	129	129	129
North Cherokee WSC	614	653	693	749	814	885
City of Jacksonville Total Demand	***4,577***	***4,868***	***5,160***	***5,572***	***6,050***	***6,577***

Table 2.17 Expected Demands for each Major Water Provider in the East Texas Regional Water Planning Area (ac-ft/yr) (cont.)

MWP/Customer	Demands					
Lower Neches Valley Authority	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Region I						
City of Beaumont - Contract and Supplemental Reserve	9,036	10,219	11,603	12,991	14,075	13,718
County-Other, Jefferson	208	273	354	450	559	680
City of Groves	2,218	2,141	2,076	2,051	2,045	2,045
Irrigation, Jefferson	140,000	140,000	140,000	140,000	140,000	140,000
Jefferson County WCID 10	493	499	510	534	570	612
Manufacturing, Jasper	45,973	57,364	57,364	57,364	57,364	57,364
Manufacturing, Jefferson	91,781	80,390	80,390	80,390	80,390	80,390
Manufacturing, Nacogdoches	10,000	10,000	10,000	10,000	10,000	10,000
City of Nederland	2,553	2,615	2,697	2,835	3,021	3,236
City of Port Arthur	25,684	25,655	25,434	25,389	25,370	25,369
City of Port Neches	1,431	1,450	1,484	1,557	1,662	1,785
West Jefferson County MWD	907	801	812	831	869	923
Total Demand for Region I	*330,177*	*331,419*	*332,743*	*334,430*	*335,978*	*336,185*
Region H						
Trinity Bay Conservation District	2,262	2,637	3,037	3,488	3,988	4,518
Bolivar Peninsula SUD	6,000	6,000	6,000	6,000	6,000	6,000
Irrigation, Chambers	37,000	37,000	37,000	37,000	37,000	37,000
Irrigation, Liberty	23,000	23,000	23,000	23,000	23,000	23,000
Delivery Losses	54,474	56,768	56,984	57,251	57,507	57,599
Total Demand for Region H	*68,262*	*68,637*	*69,037*	*69,488*	*69,988*	*70,518*
Other Obligations						
City of Woodville - Contract	5,600	5,600	5,600	5,600	5,600	5,600
Obligation sub-total	*5,600*	*5,600*	*5,600*	*5,600*	*5,600*	*5,600*
Lower Neches Valley Authority Total Demand	***404,039***	***405,656***	***407,380***	***409,518***	***411,566***	***412,303***
City of Lufkin	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Angelina Fresh Water	74	74	74	74	74	74
Woodlawn WSC	221	221	221	221	221	221
City of Diboll	1,940	1,940	1,940	1,940	1,940	1,940
City of Huntington	448	448	448	448	448	448
Irrigation, Angelina	779	779	779	779	779	779
Lower Neches Valley Authority	28,000	0	0	0	0	0
City of Lufkin	7,253	7,545	7,792	8,073	8,382	8,668
Manufacturing, Angelina	732	776	776	776	776	776
Redland WSC	307	307	307	307	307	307
Power Plants	16,802	16,802	16,802	16,802	16,802	16,802
City of Lufkin Total Demand	***56,555***	***28,891***	***29,138***	***29,419***	***29,728***	***30,014***

Table 2.17 Expected Demands for each Major Water Provider in the East Texas Regional Water Planning Area (ac-ft/yr) (cont.)

MWP/Customer	Demands					
City of Nacogdoches	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Appleby WSC	93	93	93	93	93	93
Nacogdoches MUD#1, Lilly Grove SUD	67	67	67	67	67	67
D & M WSC	258	258	258	258	258	258
Manufacturing, Nacogdoches	2,508	2,529	2,529	2,529	2,529	2,529
Melrose WSC	37	37	37	37	37	37
City of Nacogdoches	6,868	7,514	8,177	8,945	9,818	10,742
City of Nacogdoches Total Demand	***9,831***	***10,498***	***11,161***	***11,929***	***12,802***	***13,726***
Panola County Freshwater Supply District No. 1	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
City of Carthage	13,452	13,452	13,452	13,452	13,452	13,452
Mining, Panola	3,550	3,515	3,029	2,561	2,172	2,363
Panola County Freshwater Supply District No. 1 Total Demand	***17,002***	***16,967***	***16,481***	***16,013***	***15,624***	***15,815***
City of Port Arthur	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Texas Parks and Wildlife	5	5	5	5	5	5
BASF Total, Petrochemicals LLC	57	57	57	57	57	57
Cheniere LNG	5646	5646	5646	5646	5646	5646
Flint Hills Resources	55	55	55	55	55	55
Golden Pass LNG	28	28	28	28	28	28
Manufacturing, Jefferson	282	282	282	282	282	282
Motiva	280	280	280	280	280	280
Total Petrochemicals	95	95	95	95	95	95
City of Port Arthur	19,234	19,205	18,984	18,939	18,920	18,919
City of Port Arthur Total Demand	***25,682***	***25,653***	***25,432***	***25,387***	***25,368***	***25,367***
Sabine River Authority	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Upper Basin Customers						
Lake Fork Division Customers						
Bright Star Salem SUD	354	758	750	742	734	725
Eastman Chemical	3,500	3,157	3,124	3,092	3,057	3,022
Cash SUD	0	0	0	0	0	3,325
City of Dallas	120,000	108,253	107,099	105,996	104,819	103,628
City of Henderson	1,500	4,548	4,499	4,453	4,403	4,353
City of Kilgore	2,240	6,063	5,998	5,937	5,919	6,411
City of Longview	8,000	18,042	17,850	17,666	17,470	17,271

Table 2.17 Expected Demands for each Major Water Provider in the East Texas Regional Water Planning Area (ac-ft/yr) (cont.)

MWP/Customer	Demands					
Sabine River Authority (cont.)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Lake Fork Division Customers (cont.)						
City of Quitman	316	1,010	1,000	989	978	967
North Texas MWD	30,266	0	0	0	0	0
Tawakoni Division WUGs						
Cash SUD	1,679	1,762	1,824	2,272	3,425	2,353
City of Dallas	190,480	182,237	180,738	179,241	177,734	176,218
City of Emory	1,218	1,267	1,272	1,276	1,280	1,283
City of Greenville	10,297	20,362	20,194	20,027	19,879	19,690
City of Point	376	391	392	393	395	395
City of West Tawakoni	276	804	797	738	784	777
City of Wills Point	753	1,607	1,594	1,265	1,045	1,036
Commerce Water District	1,629	6,025	5,975	5,531	3,917	3,884
Combined Consumers SUD	594	684	816	1,013	1,304	1,726
Edgewood	272	285	295	307	318	329
MacBee SUD	516	572	621	673	724	779
South Tawakoni WSC	438	472	498	530	562	590
Tawakoni Plant Farm Ltd.	184	166	164	163	161	159
North Texas MWD	20,935	10,655	10,565	10,475	10,395	10,293
Total Demand by Current Customers in Upper Basin	*395,823*	*369,120*	*366,065*	*362,779*	*359,303*	*359,214*
Additional Requests from Existing Customers						
South Tawakoni WSC	561	561	561	561	561	561
Cash SUD	2,242	2,242	2,242	2,242	2,242	2,242
Combined Consumers WSC						
City of Henderson	5,605	5,605	5,605	5,605	5,605	5,605
City of Kilgore	5,045	5,045	5,045	5,045	5,045	5,045
NTMWD (Able Springs WSC)	3,363	3,363	3,363	3,363	3,363	3,363
MacBee SUD	2,242	2,242	2,242	2,242	2,242	2,242
City of Quitman	1,121	1,121	1,121	1,121	1,121	1,121
City of Emory	4,484	4,484	4,484	4,484	4,484	4,484
Greenville	9,865	9,865	9,865	9,865	9,865	9,865
Willis Point	1,121	1,121	1,121	1,121	1,121	1,121
Point	1,233	1,233	1,233	1,233	1,233	1,233
West Tawakoni	1,121	1,121	1,121	1,121	1,121	1,121
New Customers - Upper Basin						
Bright Star- Salem WSC	841	841	841	841	841	841
City of East Tawakoni	1,233	1,233	1,233	1,233	1,233	1,233
Poetry WSC	2,242	2,242	2,242	2,242	2,242	2,242
College Mound WSC						
North Kaufman WSC	1,233	1,233	1,233	1,233	1,233	1,233
Golden WSC	1,121	1,121	1,121	1,121	1,121	1,121
City of Quinlan	561	561	561	561	561	561
City of Lindale	5,045	5,045	5,045	5,045	5,045	5,045
Total Future Demands in Upper Basin	*50,279*	*50,279*	*50,279*	*50,279*	*50,279*	*50,279*

Table 2.17 Expected Demands for each Major Water Provider in the East Texas Regional Water Planning Area (ac-ft/yr) (cont.)

MWP/Customer	Demands					
Sabine River Authority (cont.)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Lower Basin Customers						
Toledo Bend						
Beechwood WSC	190	190	190	190	190	190
El Camino WSC	36	36	36	36	36	36
Huxley	280	280	280	280	280	280
G M WSC	560	560	560	560	560	560
City of Hemphill	476	476	476	476	476	476
Invista	31	31	31	31	31	31
XTO	7500	7500	7500	7500	7500	7500
Tenaska	17922	17,922	17,922	17,922	17,922	17,922
Canal (Gulf Coast Division)						
Honeywell	1,120	1,120	1,120	1,120	1,120	1,120
Chevron Phillips	1,841	1,841	1,841	1,841	1,841	1,841
Dow DuPont	24,643	24,643	24,643	24,643	24,643	24,643
Entergy	4,481	4,481	4,481	4,481	4,481	4,481
Firestone Polymers	1,473	1,473	1,473	1,473	1,473	1,473
International Paper	22,403	22,403	22,403	22,403	22,403	22,403
Optimus Steel	1,120	1,120	1,120	1,120	1,120	1,120
Arlanxeo	4,480	4,480	4,480	4,480	4,480	4,480
NRG Cottonwood Energy	13,442	13,442	13,442	13,442	13,442	13,442
Rose City (Orange County-Other)	478	478	478	478	478	478
Irrigation (Orange County)	1,255	1,255	1,255	1,255	1,255	1,255
Potential Future Customers - Lower Basin						
East Texas Transfer (H)			250,000	250,000	250,000	250,000
Pipeline to City of Center from Toledo Bend (I)			2,242	2,242	2,242	2,242
LNVA (I)				200,000	200,000	200,000
NTMWD (C)						100,000
Orange Irrigation (I)	2,432	2,685	2,858	2,920	2,855	2,758
Contract for Orange County Manufacturing	3,943	9,890	15,850	21,141	27,092	33,477
Contract for SEP Orange (I)	0	14	1,038	2,286	3,807	4,846
Contract for Newton County Mining & Steam Electric Demand (I)	805	3,139	5,994	9,545	13,875	19,021
Contract for Shelby County Livestock	1,367	2,375	3,602	5,099	6,924	6,924
Rusk Steam Electric Power Demand	1,103	1,103	1,103	1,103	1,103	1,103
Harrison County Manufacturing (D)	50,000	55,000	65,000	70,000	80,000	0
Steam Electric Power Harrison County (D)	2,000	6,000	10,000	15,000	21,000	47,000
Greenville (D)	0	0	0	0	0	9,090

Table 2.17 Expected Demands for each Major Water Provider in the East Texas Regional Water Planning Area (ac-ft/yr) (cont.)

MWP/Customer	Demands					
Sabine River Authority (cont.)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Total Future Demands in Lower Basin	*61,650*	*80,206*	*357,687*	*579,336*	*608,898*	*676,461*
Sabine River Authority Total Demand	***611,483***	***603,336***	***877,762***	***1,096,125***	***1,122,211***	***1,189,685***
City of Tyler	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Community Water	239	239	239	239	239	239
Golf Course Irrigation	400	400	400	400	400	400
Manufacturing, Smith	1,774	2,009	2,009	2,009	2,009	2,009
Southern Utilities	304	314	326	342	361	381
Tyler (Region I)	20,032	21,313	22,676	24,310	26,118	28,007
Tyler (Region D)	185	206	232	263	301	347
Walnut Grove WSC	1,495	1,495	1,495	1,495	1,495	1,495
Whitehouse	747	747	747	747	747	747
Potential Customers						
Bullard	141	332	526	739	956	1182
Crystal Systems Texas	0	0	0	52	164	291
Lindale	25	136	259	384	535	696
Manufacturing	0	84	84	84	84	84
Mining	0	0	0	0	0	0
Chandler	0	0	0	0	0	118
City of Tyler Total Demand	***25,342***	***27,276***	***28,994***	***31,065***	***33,409***	***35,996***
Upper Neches River Municipal Water Authority	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Monarch Utilities	100	100	100	100	100	100
City of Dallas	114,337	114,337	114,337	114,337	114,337	114,337
Arborgen Super Tree Farm	300	300	300	300	300	300
Irrigation, Cherokee	41	36	32	28	25	25
Irrigation, Henderson	82	73	64	57	51	51
Irrigation, Smith	82	73	64	57	51	51
Emerald Bay Golf Course	105	105	105	105	105	105
City of Palestine	28,000	28,000	28,000	28,000	28,000	28,000
City of Tyler	67,200	67,200	67,200	67,200	67,200	67,200
City of Dallas (Future Contract)	0	0	0	0	47,250	47,250
Upper Neches River Municipal Water Authority Total Demand	***210,247***	***210,224***	***210,202***	***210,184***	***257,419***	***257,419***

SOURCE: TEXAS WATER DEVELOPMENT BOARD

Table 2.18 2020 Major Water Provider Demands in the East Texas Regional Water Planning Area by Water Use Category

Major Water Provider	Municipal	Manufacturing	Irrigation	Electric Steam Power	Mining	Livestock	To Other Major Water Provider*
Angelina and Neches River Authority	32,558	5,600		8,000	8,288		12,761
Angelina-Nacogdoches WCID #1				12,280			
Athens Municipal Water Authority	2,545	484	170			3,023	
City of Beaumont	32,826	1,642					
City of Carthage	1,950	281					
City of Center	1,944	1,696					
City of Jacksonville	4,462	115					
City of Lufkin	10,242	732	779	16,802			28,000
City of Nacogdoches	7,323	2,508					
City of Port Arthur	19,239	6,443					
City of Tyler	22,855	1,774	400				
Houston County WCID #1	3,995	45,054		1,000			
Lower Neches Valley Authority	15,906	233,510	202,432	3,908		1,367	34,718
Panola County FWSD #1					3,550		13,452
Sabine River Authority	46,648	57,111		35,845	7,640		401,415
Upper Neches River MWA	28,000	100	610				67,200

*The water use category for sales To Other Major Water Providers is captured in the recipient Major Water Provider demands. For recipient Major Water Provider details, see Chapter 2, Table 2.17.

2.5 Sub-WUG Planning Option

As provided in the guidance from the TWDB, at the discretion of each RWPG, certain WUGs may be subdivided into sub-WUG level units for purposes of doing more detailed analysis and accounting of a WUG. The RWPG considered and decided to forgo sub-WUG planning during its regular meeting held August 16, 2017.

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Chapter 3

Evaluation of Current Water Supplies in the Region

Under regional water planning guidelines, each region is to identify currently available water supplies to the region by 1) source and 2) user. The supplies available by source are based on the supply available during drought-of-record conditions. Surface water and groundwater represent the primary types of water supply sources. Reuse of treated wastewater (i.e., water reuse) is also considered a source of supply. However, water reuse in the East Texas Regional Water Planning Area (ETRWPA) is small as compared to groundwater and surface water supplies.

Existing water supplies that are available to each user include those that have been permitted or contracted, with infrastructure in place to transport and treat (if necessary). Some water supplies are permitted or are contracted for use, but the infrastructure is not yet in place or some other water supply limitation exists. Water supply limitations considered in this analysis include raw water source availability, well field production capacities, permit limits, contract amounts, water quality, transmission infrastructure, and water treatment capacities. In this case, connecting such supplies is considered a water management strategy for future use. The following sections discuss the water supplies available in the ETRWPA on a regional basis by water source type with water available through surface water included in Section 3.2, groundwater in Section 3.3, and reuse in Section 3.4. Discussions are also included for existing supplies by water user group (WUG) (Section 3.5), and by major water provider (MWP) (Section 3.6). The Texas Water Development Board (TWDB) data reports pertaining to water availability and water supplies are included in Appendix ES-A, Reports 04 and 05, respectively. These reports include a listing of total available supply by source, existing supplies available to water users, and the amount of water by source that may be available for future use.

Most of the available water in the ETRWPA is surface water. Approximately 12 percent of the total freshwater supply is groundwater. However, groundwater is a very important resource in the region and is used to supply much of the municipal and rural water needs of the region.

Groundwater resources in the region consist of two major aquifers and three minor aquifers. The two major aquifers are the Gulf Coast aquifer and the Carrizo Wilcox aquifer (Figure 3.1). The three minor aquifers are the Sparta, Queen City, and Yegua-Jackson (Figure 3.2). A small amount of water is also available from "non-relevant" and "other" local aquifers that have not been designated as major or minor aquifers by the TWDB.

Surface water includes reservoirs, run-of-river supplies, and local surface water (such as stock ponds). For surface water reservoirs, the reliable supply by source is the equivalent of firm yield supply or permitted amount (whichever is lower). For run-of-the-river supplies, this is the minimum supply available in a year over the historical hydrologic record. For both of these types of surface water supplies, the water availability models (WAMs) are used to determine reliable supplies. For local surface water, estimates of historical use as reported by the TWDB are the basis for these supply quantities. Figure 3.3 presents the major surface water sources in the ETRWPA, including river basins and water supply reservoirs.

Other water supplies considered for planning purposes include reuse of treated wastewater and saline or brackish surface water sources. Reuse supplies are assessed based on historical and current use. Saline or brackish surface water is based on water right permits granted by the Texas Commission on Environmental Quality (TCEQ). Generally, saline or brackish surface water is not distributed to water users because the demands developed in Chapter 2 are freshwater demands. However, in the ETRWPA several industries use these brackish water supplies for manufacturing processes. These demands are not included in the region's manufacturing demands. Generally, the brackish supplies in ETRWPA are run-of-river supplies associated with tidally influenced segments of river and are not based on brackish groundwater supplies.

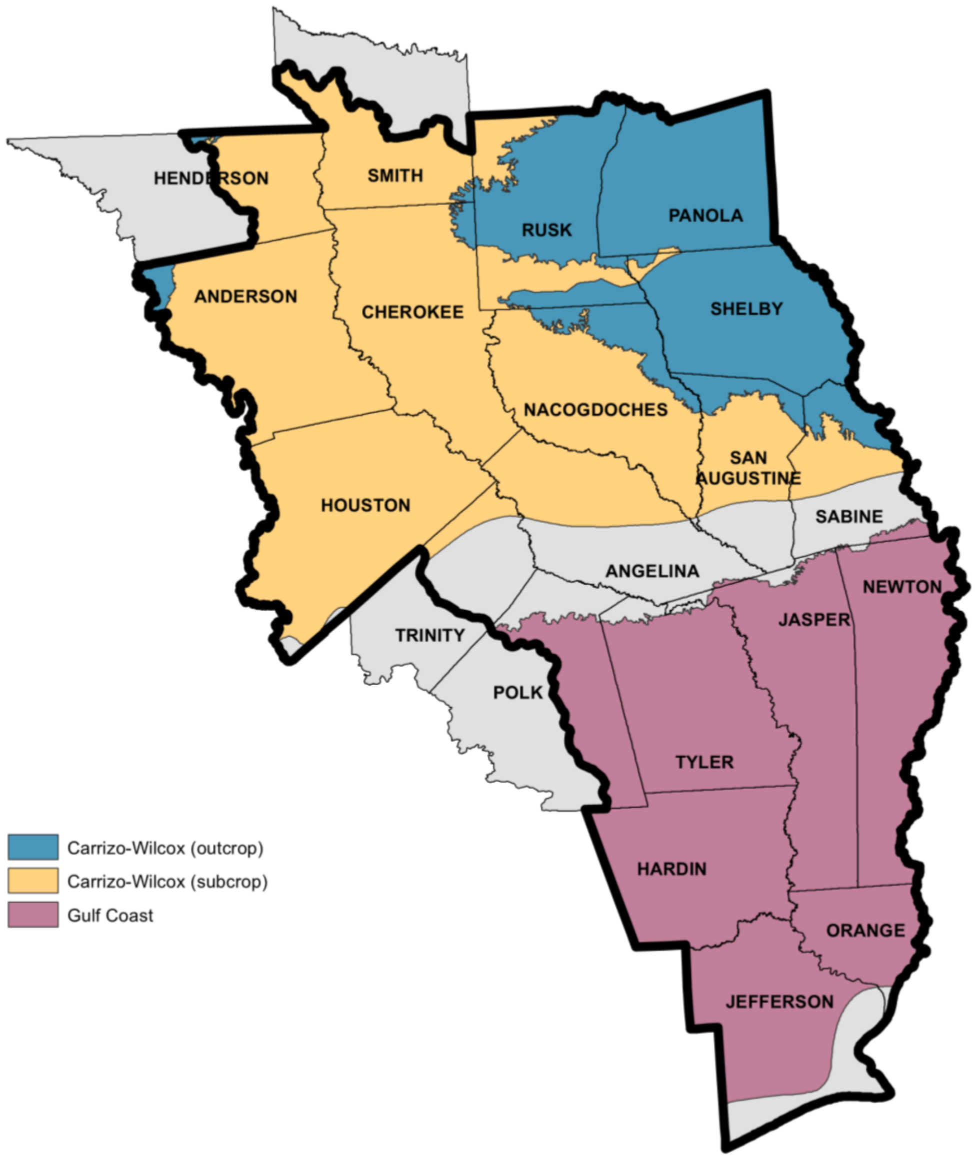

Figure 3.1: Major Aquifers

SOURCE: TEXAS WATER DEVELOPMENT BOARD

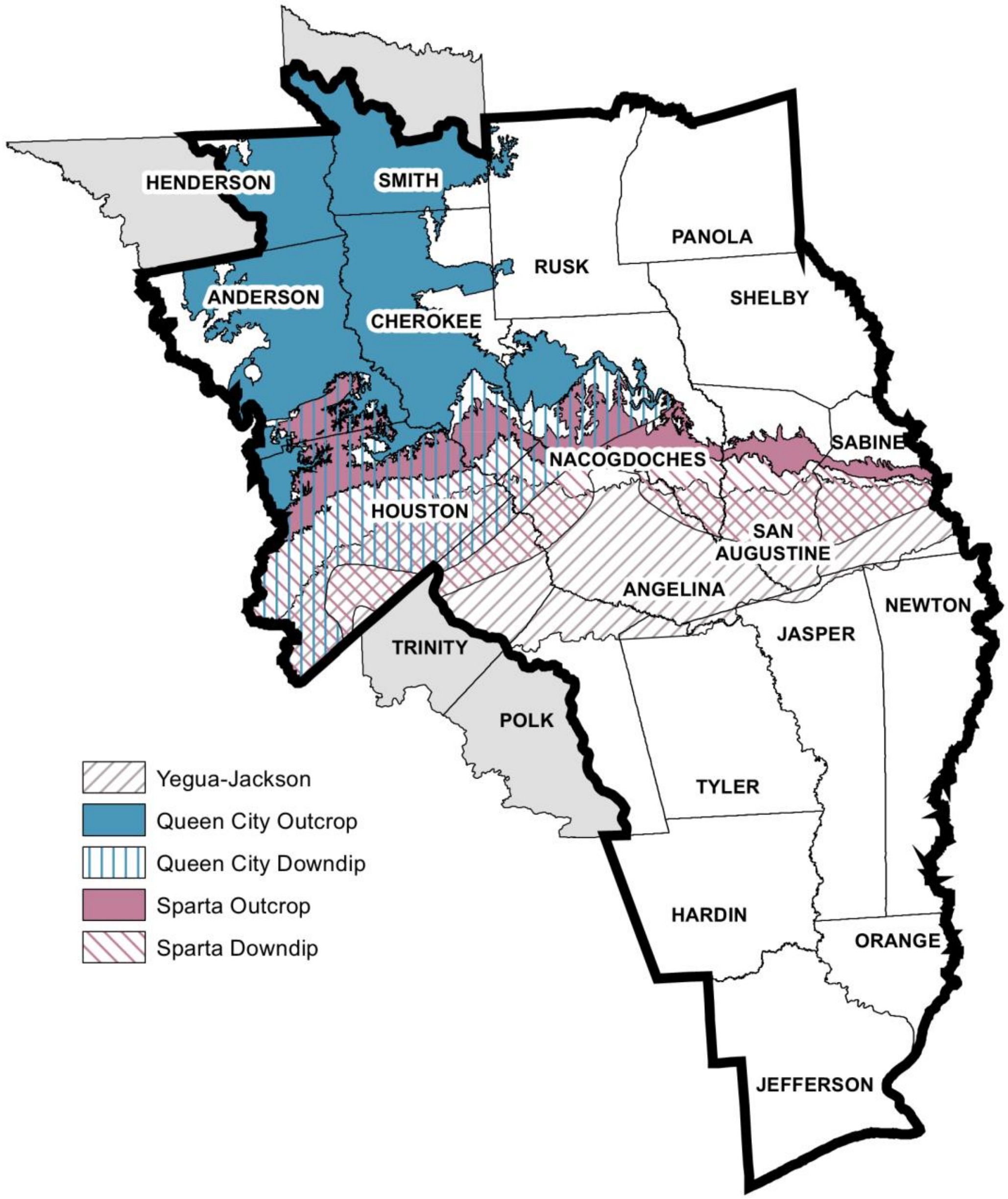

Figure 3.2: Minor Aquifers

SOURCE: TEXAS WATER DEVELOPMENT BOARD

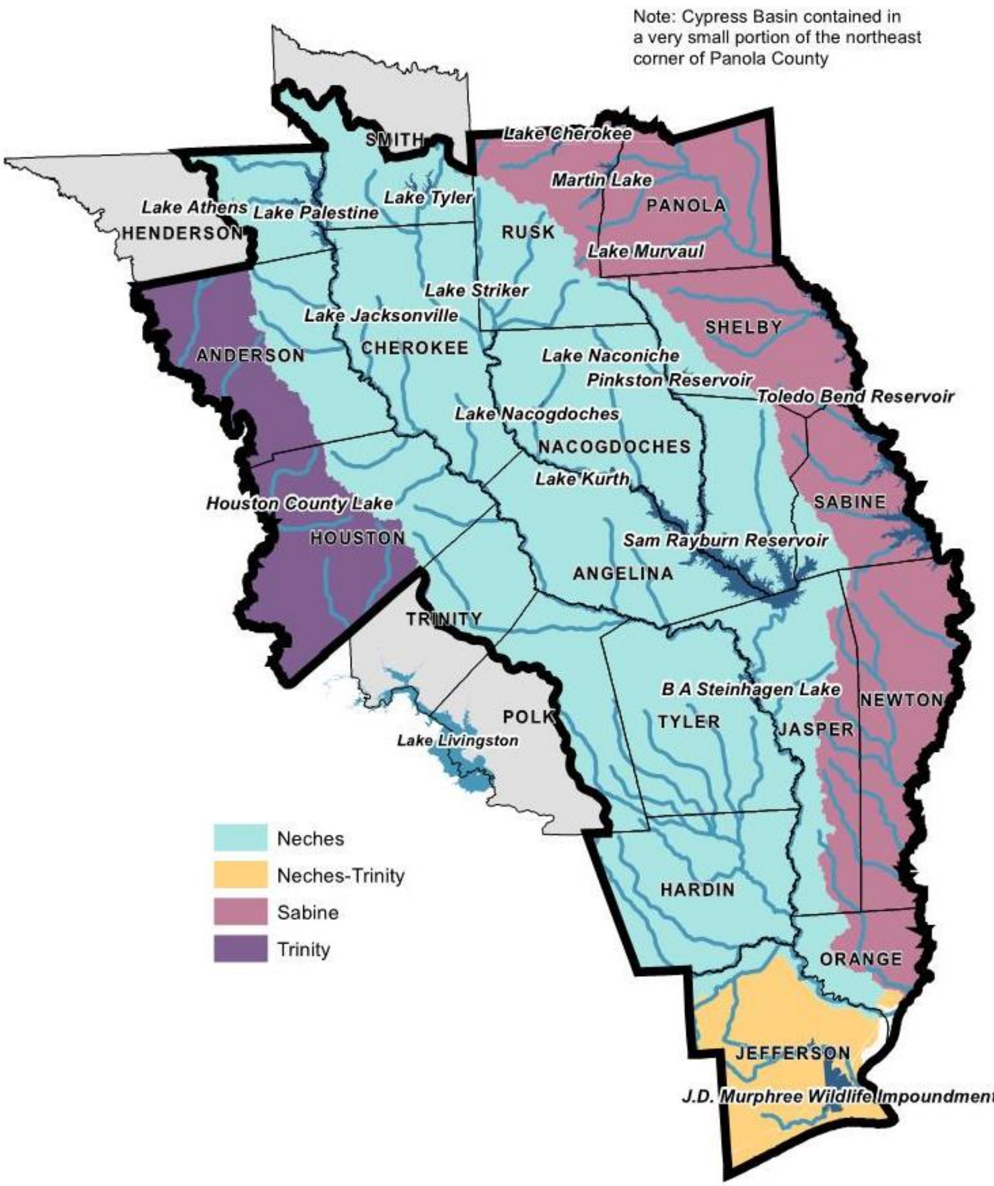

Figure 3.3: Surface Water Sources

SOURCE: TEXAS WATER DEVELOPMENT BOARD & U.S. CENSUS BUREAU

Table 3.1 and Figure 3.4 summarize overall water supply availability in the ETRWPA. Approximately 4.5 million ac-ft per year of surface water supplies are available in the region. Of this amount, approximately 3.4 million ac-ft per year is considered to be freshwater supplies. Groundwater availability in ETRWPA is slightly less than 549,000 ac-ft per year. Reuse supplies total approximately 14,000 ac-ft per year.

Table 3.1 Summary of Currently Available Water Supplies in the East Texas Regional Water Planning Area (ac-ft/yr)

Source of Supply	2020	2030	2040	2050	2060	2070
Reservoirs (permitted)	2,255,265	2,251,402	2,247,600	2,243,702	2,239,008	2,233,125
Run-of-the-River (freshwater)	588,603	589,402	590,340	591,547	592,977	594,258
Run-of-the-River (brackish)	1,036,462	1,036,462	1,036,462	1,036,462	1,036,462	1,036,462
Groundwater	548,868	548,258	548,121	547,520	546,379	545,543
Local Supplies	21,783	21,783	21,783	21,783	21,783	21,783
Reuse	13,986	13,999	14,012	14,023	14,037	14,052
Total	**4,464,967**	**4,461,306**	**4,458,318**	**4,455,037**	**4,450,646**	**4,445,223**

SOURCE: TEXAS WATER DEVELOPMENT BOARD

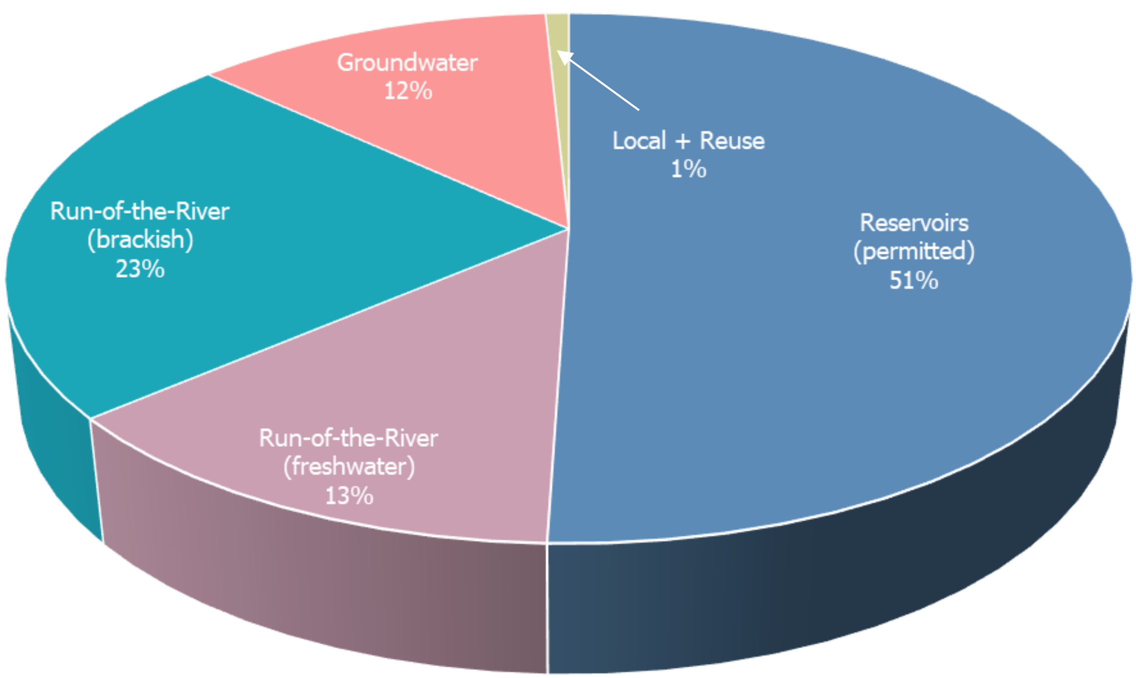

Figure 3.4 Year 2020 Available Supplies by Source Type

SOURCE: TEXAS WATER DEVELOPMENT BOARD

3.1 Surface Water Availability

In accordance with established procedures of the TWDB, the surface water supplies for the regional water plans were determined using the WAMs. In the ETRWPA, four basins were evaluated: Neches, Neches-Trinity, Trinity, and Sabine (See Figure 3.3).

The WAMs were developed for the purpose of reviewing and granting new surface water rights permits using a hypothetical repetition of historical hydrology. The results from the modeling for regional water planning are used for planning purposes only and do not affect the right of an existing water right holder to divert and use the full amount of water authorized by its permit. The assumptions in the WAMs are based in part on the legal interpretation of water rights, and in some cases do not accurately reflect current operations. For planning purposes, adjustments were made to the TCEQ WAMs to better reflect current and future surface water conditions in the region. WAM Run 3, as modified below, was used to assess surface water supplies. The principal assumptions of Run 3 are that all water right holders divert the full permitted amount of their right by priority date order and do not return any of the diversion to the watershed unless an amount is specified in the permit. This assumption provides a conservative estimate of surface water supplies in the ETRWPA. For the 2021 Regional Water Plan (2021 Plan), a hydrologic variance request was submitted to use modified versions of the WAM Run 3 for the Trinity River, Neches River, and Sabine River Basins to develop supplies. Changes to the TCEQ WAMs generally include the following:

- Assessment of reservoir sedimentation rates, and the calculation of area-capacity conditions for current (2000) and future (2060) conditions. Reservoir supplies for 2070 conditions were estimated using a straight line interpolation of the reservoir yields for 2050 to 2060.
- Inclusion of subordination agreements that are currently in place
- Inclusion of system operations where appropriate
- Basin-specific modifications

3.1.1 Trinity Basin Water Availability Model

For the Trinity River Basin, Region I adopted the updated Trinity Basin WAM developed by the Region C Water Planning Group. These changes are documented in Region C's hydrologic variance request to the TWDB. Region I also includes part of the Neches-Trinity Coastal Basin. No changes were proposed by Region I to the Neches-Trinity WAM, therefore surface water supplies in that basin were developed using the unmodified Neches-Trinity Coastal Basin WAM Run 3.

3.1.2 Neches River Basin Water Availability Model for the 2021 Plan

Changes to the Neches River Basin WAM for the 2021 Plan are based on changes in previous cycles, as well as the inclusion of updated sedimentation of major reservoirs, as specified by Exhibit C ("Second Amended General Guidelines for Fifth Cycle of Regional Water Plan Development"). The following subsections describe all changes made to the TCEQ Neches WAM Run 3 (2012) to develop the modified Neches WAM, which was used to determine existing supplies in the Neches River Basin in the 2021 Plan.

Area-Capacity Relationships. Exhibit C requires RWPGs to include anticipated sedimentation of all major reservoirs (those with a capacity greater than 5,000 ac-ft) in the WAM model runs. There are 12 such permitted reservoirs in the Neches Basin; information related to sedimentation of these reservoirs is shown in Table 3.2.
Lake Columbia has not yet been constructed, so to be conservative, Lake Columbia's full design capacity and original area-capacity curve was used when evaluating firm yields for all other reservoirs. Conversely,

to estimate the yield from Lake Columbia, it was assumed that the reservoir would be built in 2020 and begin collecting sediment at that time.

Table 3.2 Sedimentation Rates and Projected Storage Capacity of Major Reservoirs in the Neches River Basin

Reservoir	Most Recent Survey		Sediment-Contributing Drainage Area (mi^2)	Sedimentation Rate (ac-ft/yr/mi^2)	Projected 2070 Capacity (ac-ft)
	Year	Conservation Pool Capacity (ac-ft)			
Lake Athens	1998	29,475	22	4.35	22,719
Lake Columbia**	*	195,500	277	0.19	192,910
Lake Jacksonville	2006	25,732	34	2.88	19,508
Lake Kurth	1996	14,769	4	8.57	12,265
Lake Nacogdoches	1994	39,523	89	1.75	27,664
Lake Naconiche	*	9,072	27	0.19	8,750
Lake Palestine	2012	367,310	817	0.76	331,689
Pinkston Lake	*	7,380	14	0.19	7,130
Sam Rayburn Reservoir	2004	2,876,033	3,010	0.18	2,839,698
Lake B. A. Steinhagen	2011	69,259	3,251	0.06	58,731
Lake Striker	1996	22,865	182	0.85	11,561
Lake Tyler	2013	77,284	107	1.00	71,192

** No survey available. Conservation pool capacity reflects design capacity.*
*** Permitted but not yet constructed. Projected 2070 capacity based on assumption of sedimentation beginning 1/1/2030.*

SOURCE: NECHES RIVER BASIN WAM RUN

Subordination of Sam Rayburn Reservoir and B. A. Steinhagen Lake. Special conditions 5C and 5D of Certificate of Adjudication 06-4411 require subordination of LNVA's rights in the Rayburn-Steinhagen system to (a) water rights upstream of the proposed Weches and Ponta Dam sites and (b) intervening municipal rights above Sam Rayburn Reservoir. These conditions were last amended in Amendment H, filed August 14, 2008, and granted July 20, 2010, which limited subordination to rights with priority dates between November 1963 and April 2008.

Several changes were implemented in the WAM related to dual simulation, output, and the refilling of Rayburn and Steinhagen:

a) Water rights benefiting from subordination were updated to run in both the first and second WRAP simulation.
b) Additional rights were added for each water right benefiting from Rayburn/Steinhagen subordination, such that the original right does not have subordination, and the added right applies the subordination and backs up the original without subordination. In doing so, the effects of subordination can be distinguished in the model output.
c) Subordination rights at Rayburn and Steinhagen to back up other rights were modeled to not refill storage (Type 2 water rights) so that Rayburn and Steinhagen would not be refilling between multiple subordinations.
d) The 1963 rights for impoundment at Rayburn and Steinhagen were reordered so that Rayburn, the upstream reservoir, would be filled from available streamflow before Steinhagen is refilled.

Reservoir System Operations. Two additional reservoir system operations were identified and implemented within the Neches River Basin WAM Run 3:

(1) **UNRMWA – Lake Palestine and Rocky Point Dam**. The Upper Neches River Municipal Water Authority operates Lake Palestine in conjunction with its downstream dam on the Neches River in Anderson and Cherokee Counties. The 2012 WAM Run 3 allows rights associated with the downstream dam to draw from both reservoirs, which limits the firm yield of Lake Palestine when it is used to back up the downstream dam. This set of rights was modified so that downstream diversions would first be backed up by the subordination agreement at Steinhagen Lake, and any remaining shortages would be backed up by Lake Palestine.

(2) **LNVA – Sam Rayburn Backup of Pine Island Bayou**. The modified WAM approved by TWDB for the development of supplies in the 2011 Regional Water Plan included "operation of LNVA's water rights […] as a system by including backup of LNVA's Pine Island water rights with storage from Sam Rayburn."

Minimum Elevations – Sam Rayburn and B.A. Steinhagen. WS and OR records were used to set inactive pool capacity for Sam Rayburn Reservoir. The top elevation of inactive pool is 149 ft msl, and the inactive pool capacity was updated each decade based on updated area-capacity-elevation curves. The City of Lufkin has a right to a lakeside diversion of up to 28,000 ac-ft/yr from Sam Rayburn Reservoir; no inactive pool capacity was applied for this right. This diversion is lakeside and does not generate hydropower, so it is not limited by the inlet elevation.

A dead pool capacity was also set for B. A. Steinhagen using an inactive pool elevation of 81 ft msl. Inactive pools were not applied to subordination-related backup rights for either reservoir.

Lake Tyler. For the 2021 Region I WAM, Lake Tyler was modeled as a single reservoir, and associated water rights were adjusted accordingly. This is consistent with the development of the original Neches WAM, which treated this source as one reservoir.

Environmental Flows Standard for Permit 5585. The TCEQ Run 3 WAM included an incorrect target value for the instream flow record at Lake Naconiche (5585A) due to a unit conversion error. The target was corrected to 4744 ac-ft/yr (see `IF` record at 5585A).

3.1.3 Sabine River Basin WAM for the 2021 Plan

The following subsections describe all changes made to the TCEQ Sabine WAM Run 3 (2015) to develop the modified Sabine WAM, which was used to determine existing supplies from the Sabine River Basin in the 2021 Plan.

Area-Capacity Relationships. Exhibit C requires RWPGs to include anticipated sedimentation of all major reservoirs (those with a capacity greater than 5,000 ac-ft) in the WAM model runs. There are 12 such permitted reservoirs in the Sabine Basin; information related to sedimentation of these reservoirs is shown in Table 3.3. For each of the 12 reservoirs, sedimentation conditions were estimated based on an average annual sedimentation rate and the number of years since the last survey.

Table 3.3 Sedimentation Rates and Projected Storage Capacity of Major Reservoirs in the Sabine River Basin

Reservoir	Most Recent Survey		Sediment-Contributing Drainage Area (mi2)	Sedimentation Rate (ac-ft/yr/mi2)	Projected 2070 Capacity (ac-ft)
	Year	Conservation Pool Capacity (ac-ft)			
Lake Tawakoni	2009	871,693	756	2.96	736,428
Lake Fork Reservoir	2009	636,504	493	3.83	522,671
Lake Gladewater	2000	4,738	35	1.33	1,480
Lake Cherokee	2015	44,475	158	0.26	42,230
Brandy Branch Reservoir	*	29,513	4	0.24	29,429
Martin Lake	2014	75,726	130	0.37	73,097
Murvaul Lake	1998	38,284	115	1.64	24,873
Toledo Bend Reservoir	*	4,477,000	5,384	0.12	4,410,291
Lake Hawkins	1962	11,890	30	0.24	11,117
Lake Holbrook	*	7,990	15	0.24	7,604
Lake Quitman	*	7,440	31	0.24	6,639
Lake Winnsboro	*	8,100	27	0.24	7,403

** No recent survey available. Conservation pool capacity reflects design capacity.*
SOURCE: SABINE RIVER BASIN WAM RUN

Firm Yield of Toledo Bend Reservoir. Hydropower operations at Toledo Bend were excluded during the determination of total available supply from the lake. However, hydropower operations were included in the evaluation of supplies for all other reservoirs and run-of-river supplies. The canal water rights owned by Sabine River Authority (SRA) in the lower basin modeled as being subordinate to diversions from Toledo Bend Reservoir for the purposes of determining firm yield. The remainder of the yield of Toledo Bend was evaluated assuming all diversions were taken lakeside. Within the WAM, all diversions from the lake are shared equally between SRA-Texas and SRA-Louisiana, including the additional unpermitted yield.

3.1.4 Reservoir Water Availability

Reservoirs in the ETRWPA with over 5,000 ac-ft of conservation storage (i.e., major reservoirs) were evaluated, as were some smaller reservoirs that are used for municipal supply. The available water supply from reservoirs is limited to currently permitted diversions or firm yield. The firm yield is the greatest amount of water a reservoir could have supplied on an annual basis without shortage during a repeat of historical hydrologic conditions, particularly the drought of record.

Both Sam Rayburn and Toledo Bend Reservoirs were constructed for multiple purposes and include hydropower generation. Hydropower is not considered a consumptive use of water, but it is an operational consideration. The inclusion of hydropower in the firm yield analyses was an operating decision by the reservoir owner. As mentioned above, hydropower is not considered in the yield determination of Toledo Bend Reservoir. Hydropower is included for the Sam Rayburn/Lake B. A. Steinhagen System; however, the actual operation of hydropower may differ from the assumptions in the WAM models. A summary of the available supplies for reservoirs in the ETRWPA is shown in Table 3.4.

Table 3.4 Currently Available Supplies from Permitted Reservoirs Serving the East Texas Regional Water Planning Area (ac-ft/yr)

Reservoir	Water Right Numbers	Priority Date	Basin	County	Permitted Diversion	Currently Available Supply					
						2020	2030	2040	2050	2060	2070
Lake Athens	CA- 3256	1/17/1955	Neches	Henderson	8,500	5,950	5,864	5,778	5,692	5,606	5,520
Bellwood Lake	CA-3237	11/10/1915 10/10/1978	Neches	Smith	2,200	996	996	996	996	996	996
Lake Kurth	CA-4393	9/1/1957	Neches	Angelina	19,100	18,500	18,500	18,500	18,500	18,500	18,500
Lake Columbia	CA-4537	1/22/1985	Neches	Cherokee	85,507	75,800	75,720	75,640	75,560	75,480	75,400
Lake Jacksonville	CA-3274	6/13/1955	Neches	Cherokee	6,200	6,200	6,200	6,200	6,200	6,200	6,200
Lake Nacogdoches	CA-4864	5/24/1988	Neches	Nacogdoches	22,000	16,200	15,800	15,400	15,000	14,600	14,200
Lake Palestine system	CA-3254	01/05/1970 06/27/1977	Neches	Anderson	238,110	197,710	196,110	194,610	193,010	191,310	189,010
Lake Tyler/Tyler East	CA-4853	Multiple	Neches	Smith	40,325	34,830	34,666	34,502	34,338	34,174	34,010
Pinkston Reservoir	CA-4404	2/7/1972	Neches	Shelby	3,800	3,800	3,800	3,800	3,800	3,800	3,800
Rusk City Lake	CA-4219	6/1/1982	Neches	Cherokee	160	40	40	40	40	40	40
San Augustine City Lake	CA-4409	11/1/1957	Neches	San Augustine	1,285	1,285	1,285	1,285	1,285	1,285	1,285
Sam Rayburn & Steinhagen System	CA-4411	Multiple	Neches	Jasper	820,000	820,000	820,000	820,000	820,000	820,000	820,000

Table 3.4 Currently Available Supplies from Permitted Reservoirs Serving the East Texas Regional Water Planning Area (ac-ft/yr) (Cont.)

Reservoir	Water Right Numbers	Priority Date	Basin	County	Permitted Diversion	Currently Available Supply					
						2020	2030	2040	2050	2060	2070
Lake Striker	CA-4847	1/10/1984	Neches	Rusk	20,600	20,340	19,635	18,890	18,150	16,715	14,690
Lake Timpson	A-4399	5/9/1955	Neches	Shelby	350	350	350	350	350	350	350
Lake Cherokee[1]	CA-4642	10/5/1946	Sabine	Cherokee/ Gregg	62,400	31,456	31,309	31,162	31,015	30,867	30,720
Lake Center	CA-4657	08/04/1922 08/14/1952	Sabine	Shelby	1,460	1,460	1,460	1,460	1,460	1,460	1,460
Lake Murvaul	CA-4654	7/19/1956	Sabine	Panola	22,400	21,367	20,686	20,006	19,325	18,644	17,963
Martin Lake	CA-4649	7/19/1971	Sabine	Rusk	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Toledo Bend	CA-4658	03/05/1958 01/22/1986	Sabine	Sabine	970,067	970,067	970,067	970,067	970,067	970,067	970,067
Houston County Lake	CA-5097	03/03/0965	Trinity	Houston	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Total – Permitted Reservoirs						**2,474,918**	**2,471,055**	**2,467,253**	**2,463,355**	**2,458,661**	**2,452,778**

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP AND 2021 WAM MODELS

3.1.5 Run-of-the-River Diversion Availability

Table 3.5 presents the run-of-the-river supplies by county and basin. The run-of-the-river supplies were calculated using the TCEQ WAM Run 3. The firm supply was determined as the minimum annual diversion from the river for all use types (municipal, industrial, mining, recreational, and irrigation). Since all municipal users in ETRWPA have multiple sources of water, it was assumed that the run-of-the-river supplies would be used conjunctively with these sources and a monthly analysis was not appropriate to determine availability. The run of river supplies associated with City of Beaumont (WR 4415) increase over time because of this reason. Appendix 3-B includes a memorandum summarizing the WAM analysis for this municipal water right. Generally, brackish run-of-the-river water supplies are located in tidally influenced river segments and are not expected to be developed beyond current levels of use. These supplies are shown in red italics on Table 3.5.

Table 3.5 Summary of the Available Supply from Run-of-River Diversions (ac-ft/yr)

County	Basin/ River	Use	Water Right Number	Owner	2020	2030	2040	2050	2060	2070
Anderson	Neches	Irrigation	Multiple	Multiple	162	162	162	162	162	162
Anderson	Trinity	Irrigation	Multiple	Multiple	1,290	1,290	1,290	1,290	1,290	1,290
Angelina	Neches	Industrial	4384	Georgia-Pacific Panel Products LLC	32	32	32	32	32	32
Angelina	Neches	Irrigation	Multiple	Multiple	14	14	14	14	14	14
Cherokee	Neches	Irrigation	Multiple	Multiple	108	108	108	108	108	108
Hardin	Neches	Irrigation	4432	Idylwild Golf Club, Inc.	57	57	57	57	57	57
Henderson	Neches	Irrigation	3248, 3250	Multiple	0	0	0	0	0	0
Houston	Neches	Irrigation	Multiple	Multiple	208	208	208	208	208	208
Houston	Trinity	Irrigation	Multiple	Multiple	2,522	2,522	2,522	2,522	2,522	2,522
Jasper	Neches	Industrial	4412	TPWD (hatchery)	548	548	548	548	548	548
Jasper	Neches	Industrial	5027	Louisiana Pacific	6	6	6	6	6	6
Jasper	Neches	Irrigation	4413, 4414	Tin LLC, Crown Pine Timber	123	123	123	123	123	123
Jasper, Jefferson	Neches	Multiple	4411	LNVA	381,876	381,876	381,876	381,876	381,876	381,876
Jefferson	Neches	Industrial	4437	Huntsman Corp., TPC LLC	*434,400*	*434,400*	*434,400*	*434,400*	*434,400*	*434,400*
Jefferson	Neches	Industrial	4436	Jefferson Railport Terminal I LLC	*2,700*	*2,700*	*2,700*	*2,700*	*2,700*	*2,700*
Jefferson	Neches	Industrial	4415	Beaumont	526	552	583	623	670	712

Table 3.5 Summary of the Available Supply from Run-of-River Diversions (ac-ft/yr) (Cont.)

County	Basin/ River	Use	Water Right Number	Owner	2020	2030	2040	2050	2060	2070
Jefferson	Neches	Industrial	4435	Union Oil Company	*4,300*	*4,300*	*4,300*	*4,300*	*4,300*	*4,300*
Jefferson	Neches	Industrial	4434	Exxon Mobil Oil	*17,922*	*17,922*	*17,922*	*17,922*	*17,922*	*17,922*
Jefferson	Neches	Industrial	4433, 5206, 5213	Multiple	*319*	*319*	*319*	*319*	*319*	*319*
Jefferson	Neches	Industrial	3879	Motiva Enterprises LLC	*12,900*	*12,900*	*12,900*	*12,900*	*12,900*	*12,900*
Jefferson	Neches	Industrial	3860	Entergy Texas, Inc.	*279,131*	*279,131*	*279,131*	*279,131*	*279,131*	*279,131*
Jefferson	Neches	Industrial	-	Premcor Refining Group, Inc.	*480*	*480*	*480*	*480*	*480*	*480*
Jefferson	Neches-Trinity	Industrial	4441, 4479	Kansas City Southern Railway Co.; Veolia ES Technical Solutions	586	586	586	586	586	586
Jefferson	Neches-Trinity	Irrigation	Multiple	Multiple	40,194	40,194	40,194	40,194	40,194	40,194
Jefferson	Neches-Trinity	Irrigation	4475	M Half Circle Ranch Company	5,139	5,139	5,139	5,139	5,139	5,139
Jefferson	Neches-Trinity	Irrigation	4477	Joe E. Broussard, II	5,321	5,321	5,321	5,321	5,321	5,321
Jefferson	Neches-Trinity	Mining	4442	Premcor Pipeline Co	34	34	34	34	34	34
Jefferson	Neches	Municipal	4415	Beaumont	15,407	16,180	17,087	18,254	19,637	20,876

Table 3.5 Summary of the Available Supply from Run-of-River Diversions (ac-ft/yr) (Cont.)

County	Basin/ River	Use	Water Right Number	Owner	2020	2030	2040	2050	2060	2070
Nacogdoches	Neches	Industrial	4401	George B Frederick Et Al	2	2	2	2	2	2
Nacogdoches	Neches	Irrigation	Multiple	Multiple	67	67	67	67	67	67
Orange	Neches	Industrial	5091	Enterprise Refined Products Company LLC	*100*	*100*	*100*	*100*	*100*	*100*
Orange	Neches	Industrial	4438	Entergy Texas, Inc.	*17,210*	*17,210*	*17,210*	*17,210*	*17,210*	*17,210*
Rusk	Neches	Industrial	4839, 5314	CR Kelley Estate & CD Josh Ham	1	1	1	1	1	1
Rusk	Neches	Irrigation	4839, 4840, 4841, 5629	Multiple	80	80	80	80	80	80
Sabine	Neches	Industrial	4410	Georgia-Pacific Wood Products LLC	178	178	178	178	178	178
Smith	Neches	Irrigation	3224	Multiple	50	50	50	50	50	50
Smith	Neches	Mining	3230, 3231	Bell Sand Company	0	0	0	0	0	0
Trinity	Neches	Irrigation	4380	Temple Boggy Slough, LLC	3	3	3	3	3	3
Tyler	Neches	Irrigation	Multiple	Multiple	88	88	88	88	88	88
Newton	Sabine	Industrial	4659	Wiergate Lumber Company, Inc.	135	135	135	135	135	135
Newton	Sabine	Industrial	4662	SRA	93,987	93,987	93,987	93,987	93,987	93,987
Newton	Sabine	Irrigation	4662	SRA	38,956	38,956	38,956	38,956	38,956	38,956
Newton	Sabine	Irrigation	4660	Crown Pine Timber 1, L.P.	50	50	50	50	50	50
Orange	Sabine	Industrial	4664	Performance Materials NA, Inc.	*267,000*	*267,000*	*267,000*	*267,000*	*267,000*	*267,000*
Orange	Sabine	Irrigation	4663	J A Heard Et Al	28	28	28	28	28	28
Panola	Sabine	Industrial	4652	Hills Lake Fishing Club	114	114	114	114	114	114

Table 3.5 Summary of the Available Supply from Run-of-River Diversions (ac-ft/yr) (Cont.)

County	Basin/ River	Use	Water Right Number	Owner	2020	2030	2040	2050	2060	2070
Panola	Sabine	Industrial	5219	Luminant Mining Company LLC	254	254	254	254	254	254
Panola	Sabine	Irrigation	4226, 4238, 4653, 4656	Multiple	152	152	152	152	152	152
Panola	Sabine	Mining	5747	Luminant Mining Company LLC	168	168	168	168	168	168
Rusk	Sabine	Irrigation	4627, 4638, 4639, 4640	Multiple	127	127	127	127	127	127
Rusk	Sabine	Municipal	5578	Henderson	10	10	10	10	10	10
TOTAL					**1,625,065**	**1,625,864**	**1,626,802**	**1,628,009**	**1,629,439**	**1,630,720**
Subtotal Freshwater					**588,603**	**589,402**	**590,340**	**591,547**	**592,977**	**594,258**
Subtotal Brackish water					***1,036,462***	***1,036,462***	***1,036,462***	***1,036,462***	***1,036,462***	***1,036,462***

*Supplies shown in red italics are brackish water supplies and are generally not considered to meet the projected demands.

SOURCE: TCEQ WAM RUN 3

3.1.6 Local Supply Availability

Local supply generally includes small surface water supplies that are not associated with a water right. Most of the local supply is surface water used from livestock ponds. A small amount of local supply is for mining purposes. These stock ponds are generally filled using groundwater supplies or recycled water captured from surface flow that has not entered the waters of the State. The maximum recent historical use from these sources (according to TWDB records) is assumed to be available in the future. Local supply availability estimates are based on these known historical quantities, which represent firm supply during drought of record conditions for planning purposes. Local supplies are listed in Table 3.6.

Table 3.6 Summary of Available Local Supply (ac-ft/yr)

County	Basin	Use	Supply (acre-ft/yr)
Local Supplies			
Anderson	Neches	Livestock	333
Anderson	Trinity	Livestock	684
Angelina	Neches	Livestock	661
Cherokee	Neches	Livestock	1,555
Cherokee	Neches	Mining	19
Hardin	Neches	Livestock	155
Hardin	Trinity	Livestock	0
Henderson	Neches	Livestock	770
Houston	Neches	Livestock	1,007
Houston	Trinity	Livestock	783
Jasper	Neches	Livestock	332
Jasper	Sabine	Livestock	215
Jefferson	Neches-Trinity	Other	1,000
Jefferson	Neches-Trinity	Livestock	800
Jefferson	Neches	Mining	110
Nacogdoches	Neches	Livestock	2,386
Nacogdoches	Neches	Mining	494
Newton	Sabine	Livestock	155
Newton	Sabine	Mining	158
Orange	Neches	Livestock	56
Orange	Sabine	Livestock	42
Orange	Sabine	Mining	178
Panola	Cypress	Livestock	30
Panola	Sabine	Livestock	1,224
Polk	Neches	Livestock	396
Polk	Neches	Other	20
Rusk	Neches	Livestock	808

Table 3.6 Summary of Available Local Supply (ac-ft/yr) (Cont.)

County	Basin	Use	Supply (acre-ft/yr)
Local Supplies (cont.)			
Rusk	Sabine	Livestock	308
Rusk	Sabine	Other	1,230
Sabine	Neches	Livestock	71
Sabine	Sabine	Livestock	634
San Augustine	Neches	Livestock	465
San Augustine	Sabine	Livestock	71
Shelby	Neches	Livestock	334
Shelby	Sabine	Livestock	2,998
Smith	Neches	Livestock	605
Trinity	Neches	Livestock	449
Tyler	Neches	Livestock	239
Tyler	Neches	Other	8
		Total Local Supply	**21,783**

SOURCE: HISTORICAL SUPPLY, TEXAS WATER DEVELOPMENT BOARD

3.2 Groundwater Availability

Chapter 36 of the Texas Water Code generally describes how groundwater conservation districts (GCDs) are the preferred entities to manage groundwater resources in Texas and that chapter contains provisions that require the GCDs to prepare management plans. Consistent with the Texas Water Code, the TWDB has also created 16 Groundwater Management Areas (GMAs), which are based largely on hydrogeologic and aquifer boundaries instead of political boundaries. One of the purposes for GMAs is to manage groundwater resources on a more aquifer-wide basis. GCDs within each GMA are responsible executing joint groundwater planning as described in Chapter 36 to develop the amount of groundwater available for use and/or development by the Regional Water Planning Groups. To accomplish this, all GCDs within each GMA determine the Desired Future Conditions (DFCs) for the groundwater resources within the GMA boundaries at least once every 5 years. Figure 3.5 shows the regulatory boundaries of the GCDs and GMAs within the ETRWPA.

DFCs are defined by statute as "the desired, quantified condition of groundwater resources (such as water levels, spring flows, or volumes) within a management area at one or more specified future times as defined by participating groundwater conservation districts within a groundwater management area as part of the joint groundwater planning process." DFCs are quantifiable management goals that reflect what metrics the GCDs will use to manage groundwater in each GCD and throughout the GMA. The most common DFCs are based on the volume of groundwater in storage over time, water levels (limiting decline within the aquifer), water quality (limiting deterioration of quality) or spring flow (defining a minimum flow to sustain).

After the DFCs are determined by the GMAs, the TWDB performs quantitative analysis to determine the amount of groundwater available for production to meet the DFC. For aquifers where a Groundwater Availability Model (GAM) exists, the GAM is used to develop the Modeled Available Groundwater (MAG). For aquifers without a GAM, other quantitative approaches or models are used to estimate the MAG.

TWDB technical guidelines establish that the MAG (within each aquifer, county, and river basin) is the maximum amount of groundwater that can be used for existing uses and new strategies in Regional Water Plans. In other words, the MAG volumes are a cap on groundwater production for TWDB planning purposes.

3.2.1 Model Assumptions

In the ETRWPA, GAM Run 17-024 for GMA-11 and GAM Run 16-024 for GMA-14 were used to develop the MAG volumes. Both models meet the desired future conditions adopted by the members of each groundwater management area. The TWDB Reports documenting the Desired Future Conditions (DFCs) and Modeled Available Groundwater (MAGs) for aquifers in Region I are included in Appendix 3-A.

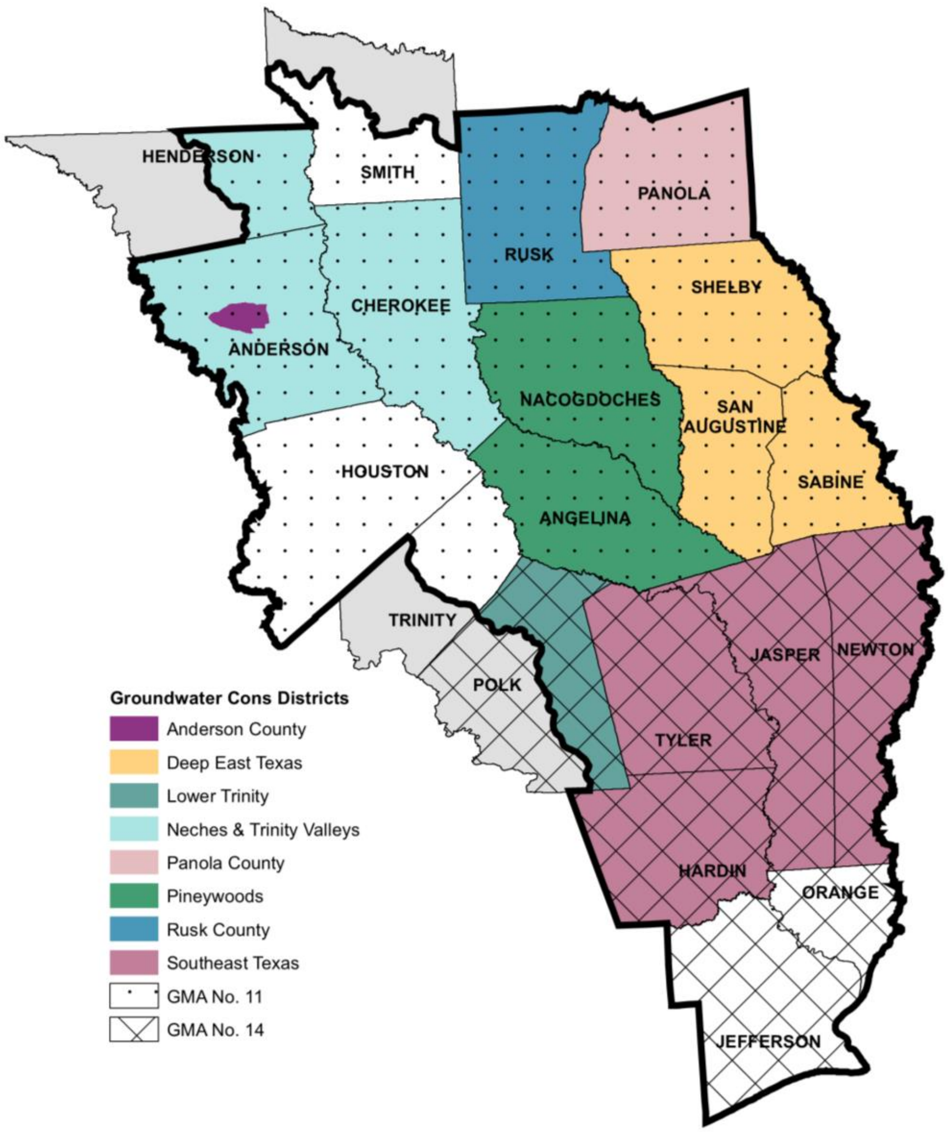

Figure 3.5: Groundwater Conservation Districts and Groundwater Management Areas

SOURCE: TEXAS WATER DEVELOPMENT BOARD

GAM Run 17-024. One model was used for the northern portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers (Fryar and others, 2003; Kelley and others, 2004). The Trinity, Nacatoch, Yegua-Jackson and Gulf Coast aquifers were declared non-relevant in GMA-11. GMA-11 adopted the DFCs in Table 3.7 for each county within the ETRWPA.

Table 3.7 Desired Future Conditions in Groundwater Management Area-11 Modeled Drawdowns (in feet) by County and Aquifer

County	Carrizo-Wilcox	Queen City	Sparta
Anderson	90	9	NRS
Angelina	48	NRS	16
Cherokee	99	14	NRS
Henderson	50	5	NP
Houston	80	6	3
Nacogdoches	29	4	5
Panola	3	NP	NP
Rusk	23	NRS	NP
Sabine	9	NP	1
San Augustine	7	NP	2
Shelby	1	NP	NP
Smith	119	17	NP
Trinity	51	NRS	9

NP = Not present
NRS = Not relevant due to size (less than 200 square miles)
SOURCE: TWDB GAM MODEL

On January 11, 2017, GMA-11 adopted DFCs intended to protect and conserve groundwater resources within the GMA, while allowing for anticipated growth in the area. Model runs were conducted to determine an amount and distribution of pumping that would stimulate the adopted DFC; this pumping amount was then reported as the MAG for the GMA, RWPA, Districts, counties and river basins.

GAM Run 16-024 MAG. Resolution No. 2016-01-01 by GMA-14 provided the DFCs for each county in the GMA as the average modeled drawdown in the Chicot, Evangeline, and Jasper aquifers, as well as the Burkeville confining unit. On April 29, 2016, GMA-14 adopted the DFCs in Table 3.8 for each county within the ETRWPA.

Prior to the resolution by GMA-14, the TWDB had conducted several model runs using the GAM for the northern part of the Gulf Coast Aquifer. The DFCs presented in the resolution are the simulated drawdown in each aquifer at the end of the year 2070 from year 2009.

Table 3.8 Desired Future Conditions in Groundwater Management Area-14 Modeled Drawdowns (in feet) by County and Aquifer*

County	Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Hardin	21	27	29	89
Jasper	23	41	46	40
Jefferson	15	17	0	0
Newton	35	45	44	37
Orange	14	16	0	0
Polk	26	10	15	73
Tyler	42	35	30	62

* Simulated drawdown in feet after 61 years of pumping.

SOURCE: TWDB GAM MODEL

3.2.2 Regional Groundwater Availability

Groundwater supplies in the ETRWPA may be divided into the northern and southern regions. The northern region is generally consistent with GMA-11 and the southern region is generally consistent with GMA-14. The conditions and available information for each region are presented separately. A limited supply of groundwater in the region is also found in what are known as "non-relevant" portions of known aquifers and "other" aquifers. These local supplies are addressed at the end of this section.

Northern Region. The Carrizo-Wilcox Aquifer provides the majority of the groundwater supply in the northern region. Minor aquifers in the northern region include the Queen City, Sparta, and Yegua-Jackson. In some areas, the Queen City aquifer provides a significant quantity of water, although the well yields are typically smaller than in the underlying Carrizo-Wilcox aquifer. Because it has a relatively large surface area, the Queen City aquifer also receives a significant volume of recharge from precipitation and thus provides significant baseflow to creeks and rivers in the region. The Yegua-Jackson aquifer provides water in the area between the downdip extent of the Carrizo-Wilcox and the outcrop area of the Gulf Coast aquifer (See Figures 3.1 and 3.2).

The modeled available groundwater volumes for the counties in the northern region are provided in Table 3.9. MAG volumes are the largest amount of water that can be withdrawn from a given source without violating DFCs. Table 3.9 presents the total MAG volumes by aquifer in the ETRWPA. The Trinity, Nacatoch, Yegua-Jackson and Gulf Coast aquifers were declared non-relevant in GMA-11.

Southern Region. The Gulf Coast Aquifer provides most of the groundwater supply in the southern region (Figure 3.1) and has the largest amount of modeled available groundwater in the ETRWPA (Table 3.9). The Southeast Texas GCD (Jasper, Newton, Tyler, and Hardin Counties), is the only groundwater conservation district located in the southern region. Table 3.9 also contains a summary of modeled available groundwater volume in the southern region.

Table 3.9 Modeled Available Groundwater by Aquifer (ac-ft/yr)

County	Aquifer	Basin	2020	2030	2040	2050	2060	2070
Northern Region								
Anderson	Carrizo-Wilcox	Neches	23,335	23,335	23,335	23,335	23,335	23,335
		Trinity	5,753	5,753	5,753	5,753	5,753	5,753
	Queen City	Neches	11,828	11,828	11,828	11,828	11,828	11,828
		Trinity	7,274	7,274	7,274	7,274	7,274	7,274
	Sparta	Neches	Non-Relevant					
		Trinity						
Angelina	Carrizo-Wilcox	Neches	27,591	27,591	27,591	27,591	27,591	27,591
	Queen City	Neches	Non-Relevant					
	Sparta	Neches	371	371	371	371	371	371
	Yegua-Jackson	Neches	Non-Relevant					
Cherokee	Carrizo-Wilcox	Neches	20,933	20,933	20,933	20,933	20,933	20,470
	Queen City	Neches	23,211	23,211	23,211	23,211	23,039	22,866
	Sparta	Neches	Non-Relevant					
Henderson	Carrizo-Wilcox	Neches	6,036	6,036	6,036	6,036	6,036	6,036
	Queen City	Neches	12,067	12,067	12,067	12,067	12,067	12,067
Houston	Carrizo-Wilcox	Neches	22,488	22,488	22,488	22,488	22,488	22,488
		Trinity	3,806	3,806	3,806	3,806	3,806	3,806
	Queen City	Neches	2,043	2,043	2,043	2,043	2,043	2,043
		Trinity	258	258	258	258	258	258
	Sparta	Neches	477	477	477	477	477	477
		Trinity	977	977	977	977	977	977
	Yegua-Jackson	Neches	Non-Relevant					
		Trinity						
Nacogdoches	Carrizo-Wilcox	Neches	24,181	24,181	24,181	24,181	24,181	24,181
	Queen City	Neches	2,985	2,985	2,985	2,985	2,985	2,985
	Sparta	Neches	365	365	365	365	365	365
	Yegua-Jackson	Neches	Non-Relevant					

Table 3.9 Modeled Available Groundwater by Aquifer (ac-ft/yr) (Cont.)

County	Aquifer	Basin	2020	2030	2040	2050	2060	2070
Panola	Carrizo-Wilcox	Cypress	6	6	6	6	6	6
		Sabine	8,370	8,212	8,212	8,212	8,062	8,062
Polk	Yegua-Jackson	Neches	570	570	570	570	570	570
Rusk	Carrizo-Wilcox	Neches	11,769	11,769	11,769	11,750	11,750	11,750
		Sabine	9,068	9,068	9,068	9,068	9,068	9,068
	Queen City	Neches	Non-Relevant					
		Sabine						
Sabine	Carrizo-Wilcox	Neches	356	356	356	356	356	356
		Sabine	3,249	3,249	3,249	3,249	3,249	3,249
	Gulf Coast	Sabine	Non-Relevant					
	Sparta	Neches	37	37	37	37	37	37
		Sabine	160	160	160	160	160	160
	Yegua-Jackson	Neches	Non-Relevant					
		Sabine						
San Augustine	Carrizo-Wilcox	Neches	1,149	1,149	1,149	1,149	1,149	1,149
		Sabine	290	290	290	290	290	290
	Sparta	Neches	163	163	163	163	163	163
		Sabine	3	3	3	3	3	3
	Yegua-Jackson	Neches	Non-Relevant					
		Sabine						
Shelby	Carrizo-Wilcox	Neches	2,577	2,288	2,151	2,018	2,018	2,018
		Sabine	8,317	8,154	8,154	7,705	7,269	7,081
Smith	Carrizo-Wilcox	Neches	22,705	22,705	22,705	22,705	22,705	22,693
	Queen City	Neches	30,692	30,692	30,692	30,692	30,692	30,692
Trinity	Carrizo-Wilcox	Neches	269	269	269	269	269	269
	Queen City	Neches	Non-Relevant					
	Sparta	Neches	154	154	154	154	154	154
	Yegua-Jackson	Neches	Non-Relevant					
Tyler	Yegua-Jackson	Neches	Non-Relevant					

Table 3.9 Modeled Available Groundwater by Aquifer (ac-ft/yr) (Cont.)

County	Aquifer	Basin	2020	2030	2040	2050	2060	2070
Southern Region								
Hardin	Gulf Coast	Neches	34,789	34,789	34,789	34,789	34,789	34,789
		Trinity	138	138	138	138	138	138
Jasper	Gulf Coast	Neches	37,630	37,630	37,630	37,630	37,630	37,630
		Sabine	29,854	29,854	29,854	29,854	29,854	29,854
Jefferson	Gulf Coast	Neches	803	803	803	803	803	803
		Neches-Trinity	1,722	1,722	1,722	1,722	1,722	1,722
Newton	Gulf Coast	Neches	176	176	176	176	176	176
		Sabine	34,043	34,043	34,043	34,043	34,043	34,043
Orange	Gulf Coast	Neches	3,287	3,287	3,287	3,287	3,287	3,287
		Neches-Trinity	256	256	256	256	256	256
		Sabine	15,821	15,821	15,821	15,821	15,821	15,821
Polk	Gulf Coast	Neches	14,897	14,897	14,897	14,897	14,897	14,897
Tyler	Gulf Coast	Neches	38,211	38,211	38,211	38,211	38,211	38,211

SOURCE: TWDB GAM MODEL

Table 3.10 presents the total MAG volumes by aquifer for the 2020 planning year. The Gulf Coast aquifer has the largest volume of modeled available groundwater at 211,627 ac-ft per year in the ETRWPA.

Table 3.10 2020 Modeled Available Groundwater Aquifer Totals (ac-ft/yr)

Region	Aquifer			
	Carrizo-Wilcox	Queen City	Sparta	Gulf Coast
Northern Region Total	202,248	90,358	2,707	N/A
Southern Region Total	N/A	N/A	N/A	211,627

SOURCE: DATA PROVIDED BY TWDB GAM RUN 16-024 MAG; GAM RUN 17-024 MAG

Groundwater Local Supplies (Non-Relevant Aquifer) Availability. Non-relevant aquifers are areas determined by the GCDs that have aquifer characteristics, groundwater demands, and current groundwater uses that do not warrant adoption of a DFC for purposes of joint groundwater planning. Declaring an area non-relevant does not preclude a GCD from managing the groundwater in the area through other means available to the district as outlined in Chapter 36 of the Texas Water Code. In some cases, an area is determined non-relevant because declaring a DFC for the aquifer or portion of the aquifer would not affect other GCDs or GMAs. Generally, if a groundwater conservation district determines an aquifer (or portions of an aquifer) to be non-relevant, it is anticipated that there will be no large-scale production from in the area prior to the next round of joint groundwater planning. Additionally, it is assumed that what production does occur will not affect conditions in relevant portions of the aquifer(s) or other GCDs or GMAs. Regional Water Planning Groups and the TWDB work together to establish groundwater volumes available from non-relevant aquifers by evaluating modeling data and local hydrogeologic information.

Groundwater Local Supplies (Other Aquifer) Availability. Groundwater from 'other aquifer' local supplies refers to groundwater that originates from an alluvial aquifer or has not been classified as either a major or a minor aquifer of the state. These areas are generally small but can be locally significant. Some may originate from a major or minor aquifer but have historically been classified incorrectly.

The 2021 Plan estimate of 12,482 acre-feet is based upon average historical pumping data for years 2007 through 2011. These estimates have not been increased to account for future pumping because some of the pumping would be subjected to a MAG if it were classified correctly. Table 3.11 includes availability estimates for supplies in 'other aquifer.'

Table 3.11 Groundwater Availability from Other Undifferentiated Aquifers

County	Basin	Amount (ac-ft/yr)
Anderson	Trinity	298
Angelina	Neches	812
Cherokee	Neches	268
Henderson	Neches	5
Henderson	Trinity	680
Houston	Neches	378
Houston	Trinity	888
Nacogdoches	Neches	1,131
Rusk	Neches	270
Rusk	Sabine	469
Sabine	Neches	336
San Augustine	Neches	1,395
Smith	Neches	922
Trinity	Neches	700
TOTAL		**8,552**

SOURCE: TWDB GAM MODEL

3.3 Reuse Availability

There are two types of reuse: direct reuse and indirect reuse. Direct reuse is treated wastewater effluent that is beneficially reused directly from the treatment facility and is not discharged to a State water course. Indirect reuse is treated effluent that is discharged to a State water course and then re-diverted by the owner for beneficial use. The reuse listed as available to the region is for existing projects based on current permits and authorizations. Categories of reuse include (1) currently operating indirect reuse projects for non-industrial purposes, in which water is reused after being returned to the stream; and (2) authorized direct reuse projects for which facilities are already developed. The specific reuse projects are listed in Table 3.12. The indirect reuse project in Jefferson County is associated with irrigation tail water that is returned to the basin for subsequent irrigation use.

Table 3.12 Summary of Available Reuse Supply (ac-ft/yr)

County	Basin	Use	Supply (ac-ft/yr)
Direct Reuse Supplies			
Sabine	Neches	Manufacturing	20
Orange	Sabine	Irrigation	15
Shelby	Sabine	Irrigation	82
Shelby	Sabine	Manufacturing	151
Indirect Reuse Supplies			
Jefferson	Neches-Trinity	Irrigation	13,687
		Total Reuse Supply	**13,955**

SOURCE: TEXAS WATER DEVELOPMENT BOARD

3.4 Impacts on Availability

3.4.1 Imports and Exports

There are several small imported supplies to the ETRWPA from adjoining regions and Louisiana. Water from Lake Fork in the Northeast Region is used by the Cities of Henderson and Kilgore and their customers. Other surface water imports include water from Lake Livingston to Trinity County-Other, the TRWD Reservoir System to Henderson County-Other, and surface water for the City of Joaquin and Shelby County-Other from the City of Logansport, Louisiana. The specific source for this import is the Louisiana portion of the Toledo Bend Reservoir.

There are also uses of groundwater from sources located outside of the ETRWPA. Most are associated with entities that extend over multiple regions. Groundwater from the Carrizo-Wilcox Aquifer in the Northeast Region (Region D) is provided to Jackson WSC and Southern Utilities, while groundwater from this aquifer in Region C is provided to Bethel Ash WSC and Henderson County-Other. A small amount of groundwater from the Yegua-Jackson Aquifer in Trinity County (Region H) is provided to Pennington WSC, Trinity County-Other, and irrigation, livestock, and mining industries within Trinity County. Groundwater from the Gulf Coast Aquifer System supplies Trinity County-Other and manufacturing in Polk County, and the Queen City aquifer supplies livestock in Smith County.

Some water from the ETRWPA is exported to users outside of the region. This supply is included in the total available supply in the ETRWPA but is not available to water users in the region. Water from the ETRWPA is used to supply the City of Tyler's customers in the Northeast Region, City of Athens in Region C and several customers of the LNVA in Region H. There is also an existing contract to supply water to Dallas from Lake Palestine for an amount 114,337 ac-ft per year. The infrastructure for this supply has not been constructed. A summary of exports and imports is provided in Table 3.13.

Table 3.13 Summary of Existing Exports and Imports in East Texas Regional Water Planning Area (ac-ft/yr)

Source	2020	2030	2040	2050	2060	2070
Exports						
Lake Athens – Region C	4,787	5,041	5,146	5,316	5,215	5,048
Carrizo-Wilcox – Region C	0	0	0	964	1,758	1,790
Sam Rayburn/B.A. Steinhagen – Region H	66,737	66,737	66,737	66,737	66,737	66,737
Trinity Run-of-River – Region H	2,173	2,173	2,173	2,173	2,173	2,173
Lake Palestine – Region C	82	73	64	57	51	51
Lake Palestine – Region D	100	100	100	100	100	100
Lake Tyler – Region D	113	113	113	113	113	113
Carrizo-Wilcox – Region D	26	26	26	26	26	26
Total	**74,018**	**74,263**	**74,359**	**75,486**	**76,173**	**76,038**
Imports						
Carrizo-Wilcox Aquifer – Region C	376	376	376	376	376	376
Carrizo-Wilcox Aquifer – Region D	2,529	2,744	3,021	3,473	3,943	4,503
Yegua-Jackson Aquifer – Region H	581	577	574	570	571	570
Queen City Aquifer – Region D	514	514	514	514	514	514
Gulf Coast Aquifer – Region H	28	27	23	18	23	22
TRWD Reservoir System – Region D	251	146	134	59	0	35
Lake Fork – Region D	1,500	4,548	4,499	4,453	4,403	4,353
Lake Livingston – Region H	270	270	270	270	270	270
Trinity Run-of-River – Region H	34	34	34	34	34	34
Toledo Bend - Louisiana	343	343	343	343	343	343
Total	**6,426**	**9,579**	**9,788**	**10,110**	**10,477**	**11,020**

SOURCE: TEXAS WATER DEVELOPMENT BOARD

3.4.2 Impacts of Water Quality on Supplies

The quality of a surface water body or groundwater aquifer can be a significant factor in the ability to use the water for specific purposes. Water quality dictates the level of treatment necessary to render a water body available for its intended use, which can affect the quantity of produced water. In cases of severe contamination, it is possible that a water supply source could be considered untreatable and, hence, unusable for some specific uses. The water quality impacts for sources within the ETRWPA are generally minor with respect to their effect on availability and treatability.

Key water quality parameters for the ETRWPA are identified and discussed in Chapter 6. These parameters are generally a consideration for surface waters. Some of these parameters could be an issue for groundwater as well. The key water quality parameters identified include the following:

- Total Dissolved Solids (TDS)
- Dissolved Oxygen
- Nutrients

- Metals
- Turbidity

These parameters can potentially affect some aspect of aquatic life or the use of the water for recreation. However, in some cases they could affect its availability for water supply as well. Water quality impacts for surface water and groundwater as they relate to availability and treatment requirements are discussed below. Overall, surface water quality in the ETRWPA is addressed in Chapter 1.

Generally, the water quality impairments identified for surface water sources through the TCEQ's Clean Rivers Program does not limit the availability of surface water or the treatability of these sources. The brackish or saline run-of-the-river water rights are limited to uses that are compatible with high TDS water. This plan assumes that these water rights are being used for such purposes.

Based on water quality data for aquifers within the ETRWPA the limitations on water supply availability or treatability are rare for groundwater supplies in the ETRWPA. The most prevalent of the primary drinking water contaminants was found to be arsenic, which exceeded the standard of 0.10 mg/L in about nine percent of samples collected between 1981 and 2019 in the Carrizo-Wilcox, Gulf Coast, Queen City and Sparta aquifers. However, the median concentration of arsenic is 2.0 mg/L and the average is 5.8 mg/L. Arsenic can be removed from water using advanced treatment processes such as iron removal (adsorption and co-precipitation in high iron waters), coagulation and filtration, filters, or ion exchange. Given the relatively low incidence of arsenic contamination, it is unlikely that it would become a significant issue for the ETRWPA.

Secondary drinking water contaminants evaluated included copper, fluoride, chloride, iron, manganese, pH, sulfate, and TDS. Of these, copper, iron, manganese, and pH were commonly found in excess of secondary standards in some samples from all four aquifers. Iron and manganese are naturally occurring constituents in groundwater. In excess, they can cause taste and odor problems in drinking water, but not significant health problems. This is commonly treated by aeration. Industrial users of water with excessive levels of iron or manganese may require significant removal prior to using the water in industrial processes.

The well data also indicated that it is relatively common for pH concentrations in groundwater to be outside the allowable range (i.e., 6.5 to 8.5 standard units) for the four aquifers evaluated. However, neither the median nor the average values were found outside the range for any of the aquifers. Control of pH is easily accomplished through the addition of pH adjusting chemicals. This indicates that the pH concerns for groundwater in the ETRWPA are not a significant limiting factor in availability or treatability.

TDS was found to exceed the Texas secondary standard of 1,000 mg/L in only five percent of the samples. The average concentration for samples in the Carrizo-Wilcox and Gulf Coast aquifers is 392 mg/L. In the Queen City and Sparta samples, the average TDS is 429 mg/L.

3.4.3 Impact of Environmental Flow Policies on Water Rights, water Availability, and Water Planning

With the passage of Senate Bill 3 in the 2007 80th Regular Session, the State created a basin-by-basin process for developing recommendations to meet the instream flow needs of rivers as well as freshwater inflow needs of affected bays and estuaries and required TCEQ to adopt the recommendations in the form of environmental flow standards. Standards for the Neches and Sabine River Basins were adopted by the TCEQ on April 20, 2011. These standards are utilized in the decision-making process for new water right applications and in establishing an amount of unappropriated water to be set aside for the environment. Existing water rights at the time of the adoption are not subject to the environmental flow standards. These water rights were evaluated on a case by case basis to assess the effect of authorizing a new use of water with the need for that water to maintain a sound ecological system as part of the water rights permitting process. The environmental flow requirements set forth through Senate Bill 3 do not impact the region's currently available supplies shown in previous sections.

The implementation of environmental flow recommendations will result in a need to more carefully consider environmental flow needs during the development of surface water management strategies. Environmental flow requirements are one component that is considered when assessing the long-term protection of the region's water resources in Chapter 6.

3.5 Existing Water Supplies by Water User Group

The water availability by WUG is limited by the ability to deliver and/or use the water. These limitations include firm yield of reservoirs, well field capacity, aquifer characteristics, water quality, water rights, permits, contracts, regulatory restrictions, raw water delivery infrastructure and water treatment capacities where appropriate. Appendix ES-A, Report 05 presents the current water supplies for each WUG by county. (WUGs are cities, water supply corporations, county-other municipal users and county-wide manufacturing, irrigation, mining, livestock, and steam electric uses.) For county-wide user groups, historical use was considered in the determination of currently available supplies.

Appendix ES-A, Report 05 presents the amount of supply available to each user group from each source by decade based on existing facilities. The supplies summarized by county are shown in Table 3.14Table 3.15.

Table 3.14 Summary of Existing Water Supplies of Water User Groups by County (ac-ft/yr)

County	2020	2030	2040	2050	2060	2070
Anderson	19,164	19,326	19,290	19,183	19,140	19,120
Angelina	38,612	39,004	39,301	39,640	40,009	40,349
Cherokee	17,563	17,965	18,381	18,966	19,641	20,297
Hardin	8,022	8,223	8,356	8,479	8,606	8,710
Henderson*	7,457	7,518	7,581	7,796	7,075	6,565
Houston	11,692	11,670	11,589	11,518	11,445	11,412
Jasper	85,173	96,446	96,282	96,177	96,129	96,117
Jefferson	368,771	359,445	360,495	360,859	361,398	362,053
Nacogdoches	31,947	32,716	33,499	34,400	35,427	36,601
Newton	16,846	16,876	16,915	16,973	17,037	17,109
Orange	74,632	74,688	74,713	74,770	74,840	74,900
Panola	16,925	17,251	17,104	16,680	17,375	17,612
Polk*	2,671	2,747	2,822	2,902	2,975	3,041
Rusk	61,526	65,287	65,656	66,106	66,633	67,180
Sabine	5,488	5,501	5,495	5,493	5,493	5,493
San Augustine	4,294	4,303	4,314	4,326	4,340	4,340
Shelby	16,149	16,044	15,924	16,132	15,355	15,570
Smith*	39,562	41,768	43,842	46,406	49,285	52,121
Trinity*	1,571	1,581	1,575	1,567	1,576	1,584
Tyler	10,940	10,928	10,831	10,757	10,703	10,676
Total	**839,003**	**849,286**	**853,964**	**859,128**	**864,482**	**870,849**

***** County is split between two planning regions. The available supply presented in this table represents only the portion of the county within the Region I boundary.

3.6 Existing Water Supplies by Major Water Provider

There are 16 designated MWPs in the ETRWPA. The ETRWPG has designated an MWP as a WUG or WWP that has wholesale water contracts for 1,000 ac-ft per year or is expected to contract for 1,000 ac-ft per year or more during at least one decade in the planning period. Similar to the available supply to WUGs, the water availability for each MWP is limited by the ability to deliver the raw water. These limitations include firm yield of reservoirs, well field capacity, aquifer characteristics, water quality, water rights, permits, contracts, regulatory restrictions, and infrastructure. Total available supply by decade for each wholesale provider is shown in Table 3.15.

Table 3.15 Summary of Existing Water Supplies for Major Water Provider (ac-ft/yr)

Water Provider	Currently Available Supply					
	2020	2030	2040	2050	2060	2070
Angelina and Neches River Authority	65	70	70	70	70	70
Angelina-Nacogdoches Water Control & Improvement District (WCID) No. 1	20,340	19,635	18,890	18,150	16,715	14,690
Athens Municipal Water Authority	8,203	8,117	8,031	7,945	7,859	7,773
Beaumont	34,469	36,451	37,525	37,525	37,525	37,525
Carthage	5,564	5,564	5,564	5,564	5,565	5,565
Center	5,260	5,260	5,260	5,260	5,260	5,260
Houston Co. WCID 1	3,500	3,500	3,500	3,500	3,500	3,501
Jacksonville	7,391	7,391	7,391	7,391	7,391	7,391
Lower Neches Valley Authority	1,201,876	1,173,876	1,173,876	1,173,876	1,173,876	1,173,876
Lufkin	38,727	38,727	38,727	38,727	38,727	38,727
Nacogdoches	22,692	22,292	21,892	21,492	21,092	20,692
Panola Co. Freshwater Supply District No. 1	21,367	20,686	20,006	19,325	18,644	17,963
Port Arthur	25,684	25,655	25,434	25,389	25,370	25,369
Sabine River Authority of Texas	1,103,010	1,103,010	1,103,010	1,103,010	1,103,010	1,103,010
Tyler	41,056	41,056	41,056	41,056	41,056	41,056
Upper Neches River Municipal Water Authority	197,710	196,110	194,610	193,010	191,310	189,010
Major Water Provider Totals	**2,736,915**	**2,707,401**	**2,704,843**	**2,701,291**	**2,696,970**	**2,691,479**

A brief description of the supply sources for each MWP is presented below. The analyses of the available supplies by source were determined using the assumptions outlined in Section 3.1.1. The results of these analyses are for planning purposes and do not affect the right of a water holder to divert and use the full amount of water authorized by its permit.

3.6.1 Angelina and Neches River Authority

Angelina and Neches River Authority has a state water right permit to construct Lake Columbia on Mud Creek in the Neches River Basin and divert 85,507 ac-ft per year. No currently available supply is shown since the reservoir is not constructed. The estimated firm yield using the modified Neches WAM Run 3 is 75,800 ac-ft per year in 2020. The supply shown in Table 3.15 for Angelina and Neches River Authority is groundwater for the Holmwood Utility.

3.6.2 Angelina-Nacogdoches Water Control Improvement District No. 1

The Angelina-Nacogdoches Water Control & Improvement District No. 1 owns and operates Lake Striker in Rusk and Cherokee Counties. The firm yield from Lake Striker in 2020 is estimated at 20,340 ac-ft per year, which is expected to decrease to 14,690 ac-ft per year by 2070.

3.6.3 Athens Municipal Water Authority

Athens Municipal Water Authority (AMWA) has 8,500 ac-ft per year of water rights in Lake Athens. The firm yield of the lake using the modified Neches WAM Run 3 was estimated at 5,950 ac-ft per year in 2020. AMWA has one existing groundwater well near the WTP with a capacity of 886 ac-ft per year that they are planning to use as a current supply. The AMWA also has a wastewater reuse permit for 2,677 ac-ft per year, but the infrastructure is not in place to utilize this source. The City of Athens and AMWA continue to study indirect reuse as a supplement to the yield of Lake Athens. The AMWA is also proposing to develop additional groundwater supplies to supplement the surface water, but these supplies are not available at this time.

3.6.4 City of Beaumont

The City of Beaumont obtains water from the Neches River, groundwater wells from the Gulf Coast Aquifer in Hardin County and a contract with LNVA for surface water. The City currently uses about 9,500 ac-ft per year of groundwater with a current well capacity of about 23 million gallons per day (MGD). However, due to aquifer availability, the estimated reliable groundwater supply for Beaumont is limited to 9,500 ac-ft per year. The reliable Neches River supplies are estimated at 15,933 ac-ft per year for 2020 based on the daily analysis of the City's run-of-the-river water rights. This supply increases over time as demands increase, whereby additional surface water is utilized during periods with sufficient flows. By 2070, the amount of available run-of-the-river water is 21,588 ac-ft per year. The City also has a contract with LNVA to supplement its surface water supplies with releases from the Sam Rayburn/Steinhagen system. It is assumed that the LNVA contract is used to meet the remainder of the City's projected demands, provided the City has available treatment capacity. The City's current water treatment system is rated for 50 MGD, limiting the available treated surface water to 28,025 ac-ft per year. Considering both its groundwater and surface water sources the City's currently available treated water supplies total 34,469 ac-ft per year for 2020.

3.6.5 City of Carthage

The City of Carthage obtains its water from groundwater from the Carrizo-Wilcox Aquifer and surface water from Panola County Freshwater Supply District. The City has a contract with Panola County Freshwater Supply District for 12 MGD of water from Lake Murvaul. Considering its current water system capacities, the city of Carthage has approximately 5,565 ac-ft per year of reliable supply.

3.6.6 City of Center

The City of Center currently obtains water from Lake Center and Lake Pinkston for use within the City and for distribution to its municipal and industrial customers. The City owns and operates Lake Center, with a firm yield of 1,460 ac-ft of municipal water. Water from Lake Pinkston is pumped from the Neches River Basin to the City, located in the Sabine River Basin. The City holds rights to 3,800 ac-ft per year of water in Lake Pinkston. The total available supply for the City of Center is 5,260 ac-ft per year.

3.6.7 Houston County Water Control Improvement District (WCID) No. 1

Houston County WCID No. 1's water rights to Houston County Lake include a right to divert 3,500 ac-ft per year at a rate not to exceed 6,300 gallons per minute. The entity originally had a right to divert 7,000 ac-ft per year, which was reduced to the current right of 3,500 ac-ft per year. Houston County WCID No. 1 has applied for a water right permit to access the additional 3,500 ac-ft per year supplies in 2007. Supplies to Houston County WCID No. 1 are limited to its permitted diversions.

3.6.8 City of Jacksonville

The City of Jacksonville obtains water supplies from Lake Jacksonville and the Carrizo-Wilcox Aquifer. The City holds 6,200 ac-ft per year in water rights in Lake Jacksonville. The ability to use this water for municipal purposes is limited by the City's water treatment capacity (estimated at 5,173 ac-ft per year). The groundwater supplies are estimated at 2,218 ac-ft per year based on current well field production. The total supply available to Jacksonville is 7,391 ac-ft per year.

3.6.9 Lower Neches Valley Authority

The LNVA maintains water rights from Lake Sam Rayburn/Lake B.A. Steinhagen and run-of-the-river diversion from the Neches River. LNVA has an agreement to use full amount of Lufkin's share of supplies (28,000 ac-ft per year) from Lake Sam Rayburn/Lake B.A. Steinhagen through the 2020-2030 decade. LNVA's water rights total 1,201,876 ac-ft per year in 2020 and 1,173,876 ac-ft per year after 2030. The LNVA currently possesses the infrastructure to divert these water rights to its municipal, manufacturing, mining, and irrigation users.

3.6.10 City of Lufkin

The City of Lufkin presently obtains groundwater from the Carrizo-Aquifer in Angelina County and surface water from Lake Kurth. Groundwater supplies for the City of Lufkin are estimated to be 20,277 ac-ft throughout the planning horizon (2020-2070), based on its well field pumping capacity. The City has water rights to divert from 16,200 ac-ft per year from Lake Kurth, plus run-of-river diversions. Lufkin also has a water right for 28,000 ac-ft per year of water from Lake Sam Rayburn. Currently there are no transmission facilities from Lake Sam Rayburn to use this water.

3.6.11 City of Nacogdoches

The City of Nacogdoches obtains groundwater from the Carrizo-Wilcox aquifer and surface water from Lake Nacogdoches. The groundwater supply of 6,492 ac-ft per year is based on the average annual current well field pumping capacity. The City currently has water rights to divert 22,000 ac-ft per year of water from Lake Nacogdoches. The modified Neches WAM Run 3 shows the current firm yield of this lake to be 16,200 ac-ft per year in 2020 and reducing to 14,200 ac-ft per year by 2070. The total supply to Nacogdoches in 2020 is 22,692 ac-ft per year.

3.6.12 Panola County Freshwater Supply District No. 1

The Panola County Freshwater Supply District No. 1 owns and operates Lake Murvaul in the ETRWPA. The estimated firm yield of Lake Murvaul using the modified Sabine WAM Run 3 is 21,367 ac-ft per year in year 2020, decreasing to 17,963 ac-ft per year by 2070.

3.6.13 City of Port Arthur

The City of Port Arthur receives raw water supply from the LNVA. Treated water is supplied to industrial users in addition to its citizens. It is assumed that LNVA will provide for 100% of the City's demands. The projected supply from LNVA is 25,684 ac-ft per year in 2020, decreasing to 25,367 ac-ft per year by 2070.

3.6.14 Sabine River Authority of Texas

The SRA owns and operates Lake Tawakoni, Lake Fork, and the Toledo Bend Reservoir. In addition, the SRA maintains run-of-the-river rights from the Sabine in Newton and Orange County. The SRA provides water to municipal and industrial customers in Region C and Region D from Lake Fork and Lake Tawakoni, located outside of the ETRWPA. Some customers in the ETRWPA receive water from Lake Fork through downstream releases and riverine diversions. Most of the water in the ETRWPA from SRA is provided from Toledo Bend Reservoir and diversions from the Sabine River through the SRA Canal System. SRA holds water rights of 238,100 ac-ft per year from Lake Tawakoni, 188,660 ac-ft per year from Lake Fork, 970,067 ac-ft per year from Toledo Bend Reservoir and 147,100 ac-ft per year from the Sabine River. The reliable supply from SRA's Lower Basin sources (Toledo Bend Reservoir and the Canal System) is 1,103,010 ac-ft per year.

3.6.15 City of Tyler

The City of Tyler receives raw water supply from Lake Tyler and Tyler East with a firm yield of 34,830 ac-ft per year in 2020. Supply from these reservoirs is limited to 19,057 ac-ft per year by the water treatment plant capacity (34 MGD). The City also has a contract with the UNRMWA for 60 MGD from Lake Palestine. The City of Tyler has constructed a 30 MGD treatment facility at the lake and currently can use 16,815 ac-ft per year from Lake Palestine. The City possesses water rights to Lake Bellwood; however, the raw water from this source is used only for irrigation. Water is not treated by the City from this source. The City also obtains water from the Carrizo-Wilcox aquifer. The estimated reliable supply from groundwater is 4,484 ac-ft per year, which was reduced from its production capacity due to limited aquifer availability. Collectively, the City has a total of 40,356 ac-ft per year of treated water and an additional 400 ac-ft per year of raw water from Lake Bellwood.

3.6.16 Upper Neches River Municipal Water Authority

The UNRMWA maintains a total water right of 238,110 ac-ft per year for diversions from Lake Palestine and a downstream location at Rocky Point Dam. The UNRMWA operates these rights as a system. Available supply using the modified Neches WAM Run 3 is estimated at 197,710 ac-ft per year in year 2020, decreasing to 189,010ac-ft per year by 2070.

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Chapter 4

Comparison of Water Demands with Water Supplies to Determine Needs

This chapter describes the comparison of estimated current water supply for drought-of-record conditions from Chapter 3 and projected water demand from Chapter 2. From this comparison, water needs (shortages) or surpluses under drought-of-record conditions have been estimated. Water shortages identified from this comparison are defined as first-tier water needs. In addition, a secondary analysis was conducted to determine needs after conservation and direct reuse strategies have been implemented. Water shortages identified from this analysis are defined as second-tier water needs. Listings of the first-tier and second-tier water needs by water user group are included in the Executive Summary, Appendix ES-A Reports 06 and 07, respectively.

As discussed in Chapter 3, allocations of existing water supplies were based on the most restrictive of current water rights, contracts, water treatment capacities, available yields for surface water, and production capacities for groundwater. The allocation process did not directly address water quality issues, which were found to be minimal for the East Texas Regional Water Planning Area (ETRWPA). Water quality issues could potentially impact local usability of some water supplies, nonetheless.

The comparison of current water supply and projected water demand in the ETRWPA is evaluated on a regional basis, by county, by water user group (WUG) and by Major water provider (MWP). Section 4.1 presents a regional comparison of current and projected supplies, demands, and water needs. Section 4.2 presents a county-by-county comparison of current and projected First-Tier water needs. Section 4.3 presents the current and projected First-Tier water needs for each WUG. Section 4.4 discusses First-Tier water needs for the MWPs in the region. Section 4.5 discusses water needs for WUGs and MWPs, after savings from conservation and direct reuse strategies are applied (second-tier water needs).

4.1 Regional Comparison of Supplies and Demands

As discussed in Chapter 3, it is estimated that the ETRWPA has approximately 3.4 million acre-feet of fresh water supplies and 1.0 million acre-feet of brackish water supplies (4.4 million acre-feet total). However, not all of these water supplies have been developed for use by water user groups yet, i.e., no infrastructure has been developed to access these supplies. Undeveloped (or unconnected) water supplies are identified by comparing the supplies that are developed for each individual entity to use, to the total regional water supply sources. In the ETRPWA, the undeveloped fresh water supplies are estimated to be between 2.5 and 2.6 million ac-ft per year throughout the planning period. Additional infrastructure and/or contracts are needed to utilize these sources. Additional details on supply versus demand (DB22 Report) are provided in Appendix ES-A, Report 03.

Table 4.1 and Figure 4.1 summarize and compare the total available, developed, and existing water supplies to the total projected water demands over the planning period for the ETRWPA. While the ETRWPA's developed supplies exceed the projected demands, not all developed supplies are currently accessible to water users due to constraints in their individual supply, infrastructure and/or contracts with their water providers and are therefore, not considered in the existing supply totals presented. In order to accurately assess the water needs within the region, only currently accessible supplies were allocated to water users. As a result, projected demands for water users exceed the existing supplies throughout the planning horizon (2020-2070). Regional water needs are shown to be nearly 140,000 ac-ft/yr in 2020 and increase to over 200,000 ac-ft/yr in 2070. However, as shown by the undeveloped supplies, the Region is a water-rich region with adequate water supply to meet projected water demands through 2070 through project and water management strategy implementation.

Table 4.1 Summary of Supply and Demand for the East Texas Regional Water Planning Area (ac-ft/yr)

	2020	2030	2040	2050	2060	2070
Available Freshwater Supplies	3,428,505	3,424,844	3,421,856	3,418,575	3,414,184	3,408,761
Developed Supplies	839,729	849,993	854,547	859,548	864,991	871,472
Existing Supplies	598,782	611,412	615,930	621,102	626,903	633,846
WUG Demands	738,081	793,495	798,814	811,072	826,138	839,601
Total Water Needs (Shortages)	**-139,299**	**-182,083**	**-182,884**	**-189,970**	**-199,235**	**-205,755**

SOURCE: TEXAS WATER DEVELOPMENT BOARD

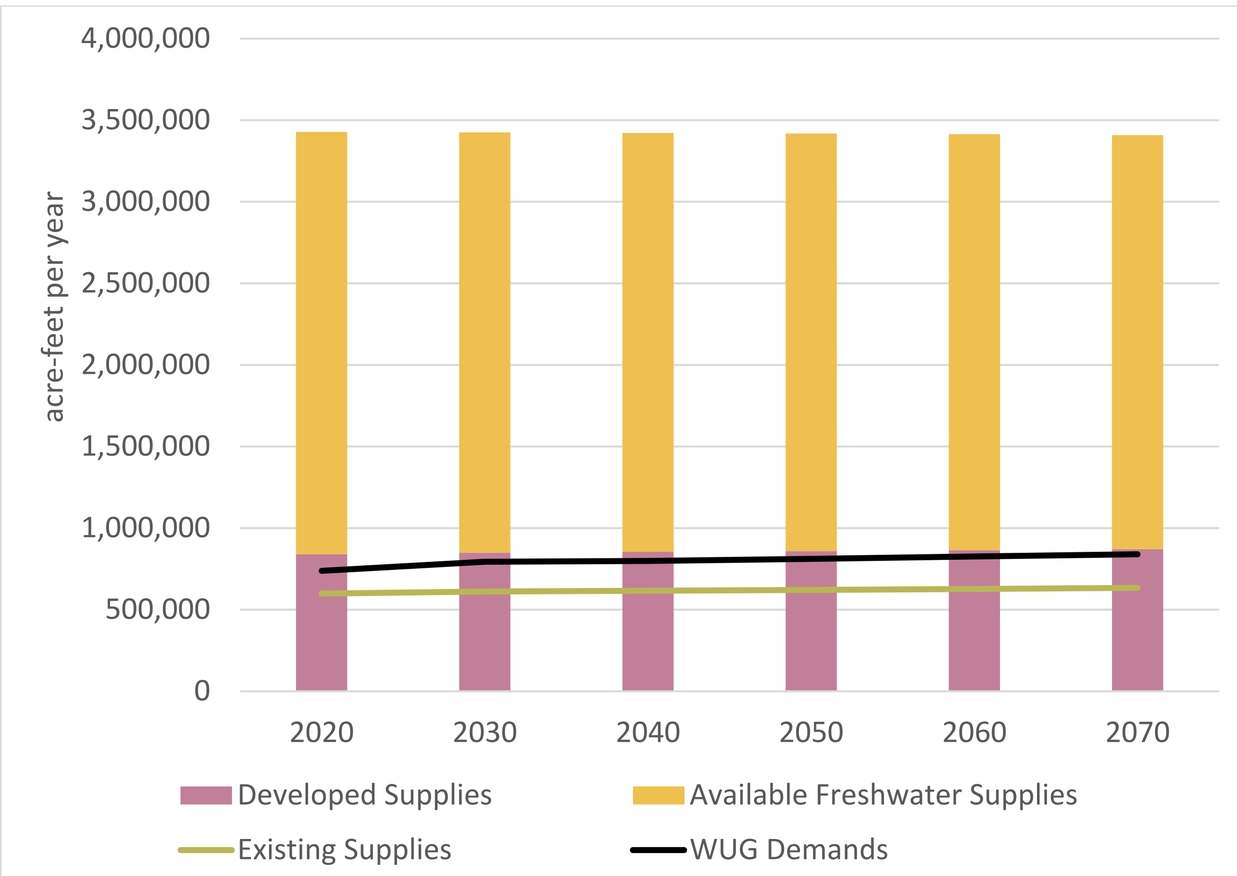

Figure 4.1 Comparison of Regional Water Supplies to Demands

Table 4.2 and Figure 4.2 summarize regional water needs by category of water use. On a regional basis, there are needs for each water use type. By far, the greatest needs are identified for manufacturing. Lesser needs are identified for municipal, livestock, steam electric power, mining, and irrigation categories. Most of the manufacturing needs are the result of considerable growth in demands and supplies that are limited to existing contract amounts. The steam electric power needs are for projected growth that currently does not have an identified source or infrastructure. Mining needs are largely associated with new mining demands associated with natural gas development and mining demands that have not been realized to date and do not have a current water supply.

Table 4.2 Summary of Projected Regional Needs by Water Use Type (ac-ft/yr)

Water Use Type	2020	2030	2040	2050	2060	2070
Municipal	-501	-877	-2,551	-5,832	-9,265	-13,590
Manufacturing	-102,587	-145,222	-145,206	-145,188	-145,171	-145,155
Mining	-8,413	-5,281	-903	-468	-308	-207
Steam Electric Power	-3,494	-3,494	-3,494	-3,494	-3,494	-3,494
Irrigation	-526	-526	-526	-526	-556	-576
Livestock	-23,708	-26,613	-30,128	-34,381	-39,483	-40,666
Total	**-139,299**	**-182,083**	**-182,884**	**-189,970**	**-199,235**	**-205,755**

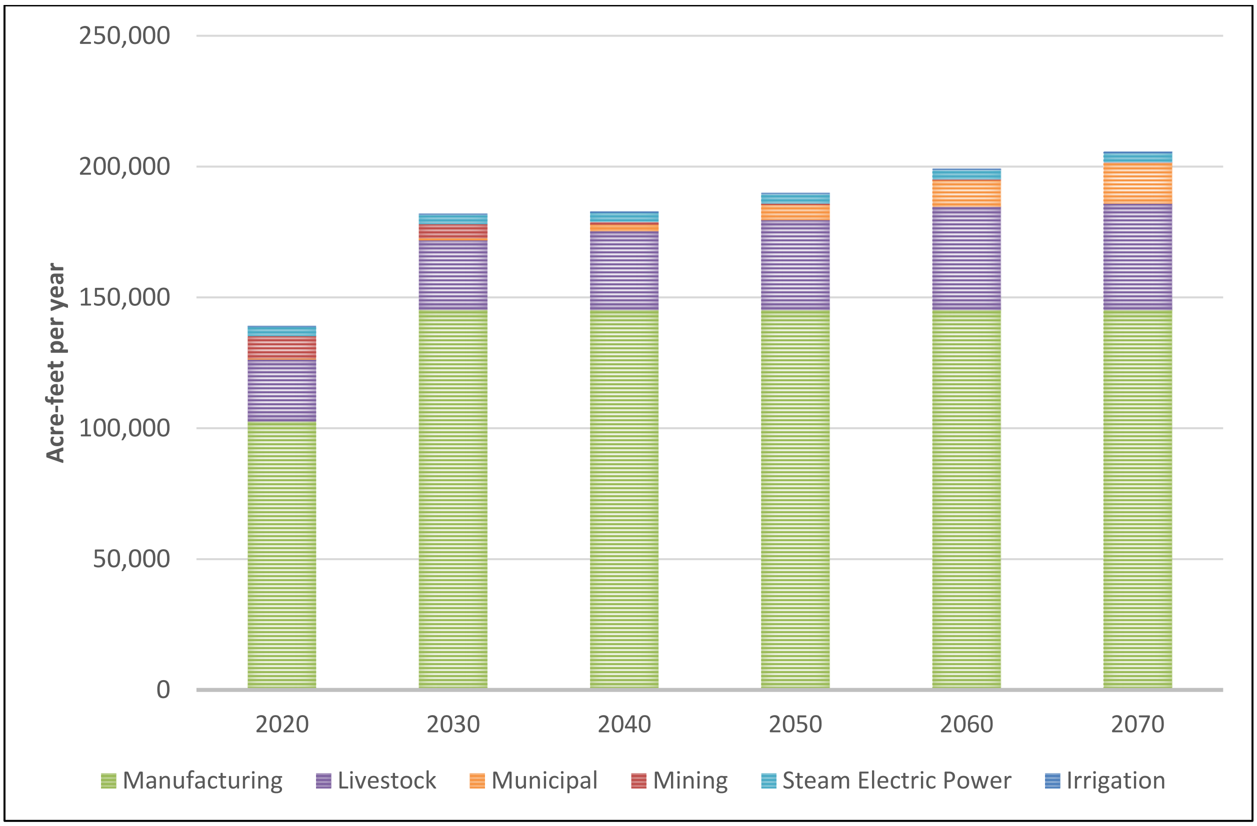

Figure 4.2 Projected Regional Needs by Water Use Type (ac-ft/yr)

4.2 First-Tier Water Needs by County

First-Tier water needs are identified by comparing the current supplies allocated to water users from Chapter 3 to the projected demands from Chapter 2, in accordance with TWDB rules. Table 4.3 shows the projected First-Tier water needs by county for each decade of the planning period in acre-feet per year and Table 4.4 shows this information as a percentage of demand. In general, some shortages exist throughout the region. Fourteen counties are identified with needs over the planning horizon, with Jasper, Jefferson, Nacogdoches, San Augustine and Shelby counties having the largest projected needs by volume in 2070. As discussed previously, the region has sufficient developed supplies to meet these shortages, however, some of these supplies are unallocated due to existing constraints of individual entities. Figure 4.3 shows the amount of unallocated supplies by county in the region. The "Source-Balance" data table in Appendix ES-A, Report 09 lists each water source and the amount of water that is available for future use.

Table 4.3 Summary of Projected First-Tier Water Needs by County (ac-ft/yr)

County	2020	2030	2040	2050	2060	2070
Anderson	0	0	0	0	0	0
Angelina	-1,922	-2,197	-2,022	-1,924	-1,849	-1,792
Cherokee	-238	-247	-210	-237	-292	-476
Hardin	0	0	0	0	0	0
Henderson*	-89	-114	-123	-132	-246	-493
Houston	0	0	0	0	0	-201
Jasper	-8,932	-8,932	-8,932	-8,932	-8,932	-8,932
Jefferson	-103,529	-145,904	-147,135	-149,713	-153,065	-157,006
Nacogdoches	-11,445	-9,374	-7,046	-7,607	-8,390	-9,517
Newton	-115	-59	0	0	0	0
Orange	-526	-526	-526	-526	-526	-526
Panola	-982	-982	-982	-982	-982	-982
Polk*	0	0	0	0	0	0
Rusk	-1,169	-1,530	-1,468	-1,417	-1,496	-1,613
Sabine	0	0	0	0	0	0
San Augustine	-3,555	-2,746	-1,866	-2,137	-2,438	-2,438
Shelby	-6,556	-8,836	-11,609	-14,992	-19,113	-19,123
Smith*	-241	-635	-965	-1,371	-1,906	-2,657
Trinity*	0	0	0	0	0	0
Tyler	0	0	0	0	0	0
Total	**-139,299**	**-182,083**	**-182,884**	**-189,970**	**-199,235**	**-205,755**

*The counties marked with an asterisk are split between two water planning regions. The data presented in this table represents only the portion of those counties that are within the boundaries of Region I.

Table 4.4 Summary of Projected First-Tier Water Needs by County (Percentage of Demand)

County	2020	2030	2040	2050	2060	2070
Anderson	0%	0%	0%	0%	0%	0%
Angelina	9%	10%	9%	9%	8%	8%
Cherokee	2%	2%	1%	1%	2%	3%
Hardin	0%	0%	0%	0%	0%	0%
Henderson*	0%	1%	1%	1%	2%	5%
Houston	0%	0%	0%	0%	0%	2%
Jasper	15%	12%	12%	12%	12%	12%
Jefferson	29%	38%	38%	38%	38%	39%
Nacogdoches	37%	31%	24%	25%	26%	28%
Newton	1%	1%	0%	0%	0%	0%
Orange	1%	1%	1%	1%	1%	1%
Panola	7%	7%	7%	8%	8%	8%
Polk*	0%	0%	0%	0%	0%	0%
Rusk	2%	2%	2%	2%	2%	2%
Sabine	0%	0%	0%	0%	0%	0%
San Augustine	50%	43%	37%	43%	48%	51%
Shelby	30%	37%	44%	51%	58%	58%
Smith*	1%	2%	2%	3%	4%	5%
Trinity*	0%	0%	0%	0%	0%	0%
Tyler	0%	0%	0%	0%	0%	0%
Total	19%	23%	23%	23%	24%	24%

*The counties marked with an asterisk are split between two water planning regions. The data presented in this table represents only the portion of those counties that are within the boundaries of Region I.

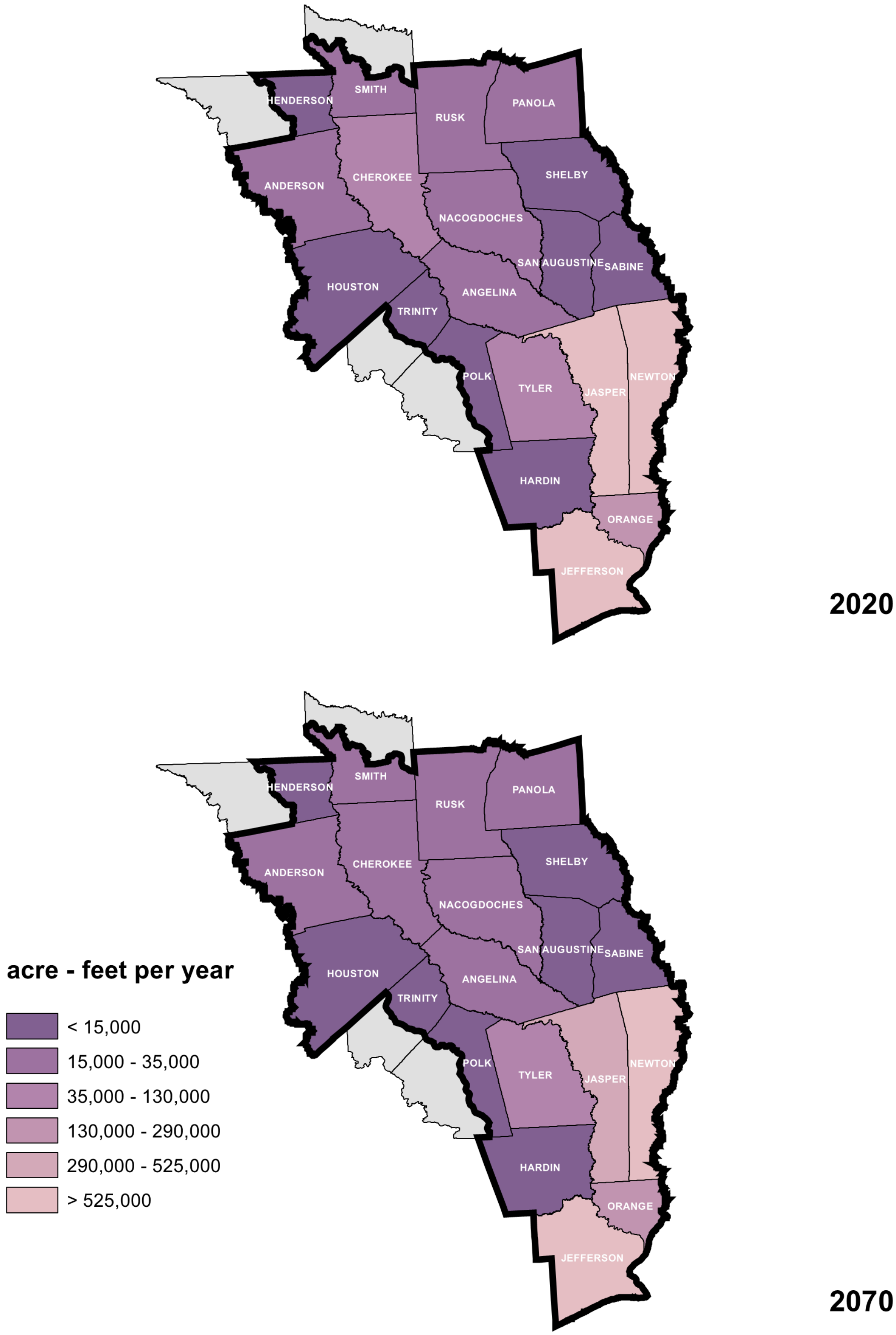

Figure 4.3 Unallocated Supplies

4.3 First-Tier Water Needs by Water User Group

The comparison of First-Tier water needs by water user group is presented in Table 4.5. There are 42 different WUGs across 14 counties in the ETRWPA with identified needs that cannot be met by existing infrastructure and supply. These projected needs total nearly 206,000 acre-feet per year by 2070. This is approximately 40 percent of the projected needs identified in the 2016 East Texas Regional Water Plan. Specific needs are addressed in subsequent subsections.

Table 4.5 Water User Groups with Projected Needs (ac-ft/yr)

Water User Group	County	2020	2030	2040	2050	2060	2070
Manufacturing	Angelina	-1,449	-1,625	-1,625	-1,625	-1,625	-1,625
Mining	Angelina	-473	-572	-397	-299	-224	-167
County Total	**Angelina**	**-1,922**	**-2,197**	**-2,022**	**-1,924**	**-1,849**	**-1,792**
Alto Rural WSC	Cherokee	0	0	0	-65	-137	-215
Rusk	Cherokee	0	0	0	0	0	-122
Wright City WSC	Cherokee	0	0	0	-25	-71	-99
Mining	Cherokee	-238	-247	-210	-147	-84	-40
County Total	**Cherokee**	**-238**	**-247**	**-210**	**-237**	**-292**	**-476**
Athens	Henderson	-26	-25	-24	-24	-30	-40
Chandler	Henderson	0	0	0	0	0	-118
Edom WSC	Henderson	-2	-3	-4	-5	-7	-9
Moore Station WSC	Henderson	0	0	0	0	-38	-111
R P M WSC	Henderson	0	-7	-16	-27	-38	-48
Irrigation	Henderson	-51	-60	-69	-76	-133	-167
Mining	Henderson	-10	-19	-10	0	0	0
County Total	**Henderson**	**-89**	**-114**	**-123**	**-132**	**-246**	**-493**
Livestock	Houston	0	0	0	0	0	-201
County Total	**Houston**	**0**	**0**	**0**	**0**	**0**	**-201**
Livestock	Jasper	-8,932	-8,932	-8,932	-8,932	-8,932	-8,932
County Total	**Jasper**	**-8,932**	**-8,932**	**-8,932**	**-8,932**	**-8,932**	**-8,932**
Beaumont	Jefferson	0	0	-1,248	-3,843	-6,357	-9,218
County-Other	Jefferson	0	0	0	0	-855	-1,950
Manufacturing	Jefferson	-101,138	-143,513	-143,496	-143,479	-143,462	-143,447
Steam Electric Power	Jefferson	-2,391	-2,391	-2,391	-2,391	-2,391	-2,391
County Total	**Jefferson**	**-103,529**	**-145,904**	**-147,135**	**-149,713**	**-153,065**	**-157,005**
Cushing	Nacogdoches	0	0	0	0	-8	-30
D & M WSC	Nacogdoches	0	0	-32	-135	-251	-374
Livestock	Nacogdoches	-5,970	-6,399	-6,896	-7,472	-8,131	-9,113
Mining	Nacogdoches	-5,475	-2,975	-118	0	0	0
County Total	**Nacogdoches**	**-11,445**	**-9,374**	**-7,046**	**-7,607**	**-8,390**	**-9,517**
Mining	Newton	-115	-59	0	0	0	0
County Total	**Newton**	**-115**	**-59**	**0**	**0**	**0**	**0**

Water User Group	County	2020	2030	2040	2050	2060	2070
Irrigation	Orange	-526	-526	-526	-526	-526	-526
County Total	**Orange**	**-526**	**-526**	**-526**	**-526**	**-526**	**-526**
Livestock	Panola	-982	-982	-982	-982	-982	-982
County Total	**Panola**	**-982**	**-982**	**-982**	**-982**	**-982**	**-982**
Jacobs WSC	Rusk	0	0	0	0	0	-22
Overton	Rusk	-66	-122	-177	-241	-310	-384
Wright City WSC	Rusk	0	0	0	0	0	-21
Livestock	Rusk	0	0	-20	-51	-83	-83
Mining	Rusk	0	-305	-168	-22	0	0
Steam Electric Power	Rusk	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103
County Total	**Rusk**	**-1,169**	**-1,530**	**-1,468**	**-1,417**	**-1,496**	**-1,613**
San Augustine	San Augustine	-120	-105	-92	-89	-89	-89
Livestock	San Augustine	-1,333	-1,539	-1,774	-2,048	-2,349	-2,349
Mining	San Augustine	-2,102	-1,102	0	0	0	0
County Total	**San Augustine**	**-3,555**	**-2,746**	**-1,866**	**-2,137**	**-2,438**	**-2,438**
Sand Hills WSC	Shelby	-65	-75	-85	-96	-107	-117
Livestock	Shelby	-6,491	-8,761	-11,524	-14,896	-19,006	-19,006
County Total	**Shelby**	**-6,556**	**-8,836**	**-11,609**	**-14,992**	**-19,113**	**-19,123**
Bullard	Smith	-141	-332	-526	-739	-956	-1,182
Crystal Systems Texas	Smith	0	0	0	-52	-164	-291
Lindale	Smith	-25	-136	-259	-384	-535	-696
Overton	Smith	-4	-7	-12	-18	-25	-32
R P M WSC	Smith	0	-2	-5	-11	-13	-17
Southern Utilities	Smith	-71	-74	-79	-83	-90	-98
Whitehouse	Smith	0	0	0	0	-39	-257
Manufacturing	Smith	0	-84	-84	-84	-84	-84
County Total	**Smith**	**-241**	**-635**	**-965**	**-1,371**	**-1,906**	**-2,657**
Total Regional Shortage		**-139,299**	**-182,083**	**-182,884**	**-189,970**	**-199,235**	**-205,755**

Note: The Total Regional Needs are the sum of all shortages in the Region.

4.3.1 Identified Needs for Manufacturing

Manufacturing water needs in Jefferson county are projected to comprise around 80 percent of the region's First-Tier water needs throughout the planning horizon (2020-2070), with shortages ranging from over 101,000 ac-ft per year in 2020 to over 143,000 ac-ft per year in 2070. The large manufacturing needs in Jefferson county are due to increased demands associated with potential future liquid natural gas facilities. Water needs are also shown for manufacturing entities in Angelina and Smith counties due to increased demands above the current facilities' supplies.

4.3.2 Identified Needs for Municipal

A total of 21 municipal water user groups are shown to have a water shortage at some point during the planning horizon. WUGs in Jefferson county, such as the City of Beaumont and Jefferson county-Other, are projected to have the most greatest municipal water needs with those needs occurring in the latter half of the planning horizon. These municipal needs in Jefferson county are due a lack of developed supply, e.g., the City of Beaumont's current surface water treatment capacity limits the supply for projected future water demands. Municipal water needs over 100 ac-ft per year are also identified for the Cities of Athens, Bullard, Chandler, Lindale, Overton, San Augustine, Rusk, and Whitehouse. Other municipal users identified with needs exceeding 100 ac-ft per year include: Alto Rural WSC, D & M WSC, Crystal Systems Texas, Moore Station WSC, Sand Hills WSC, and Wright City WSC. All other municipal WUGS that show water shortages are below 100 ac-ft per year.

4.3.3 Identified Needs for Mining

Mining water needs over 2,000 ac-ft per year are identified in Nacogdoches and San Augustine counties in 2020; however, these needs diminish through the planning horizon as mining demands decrease. Additionally, mining needs are projected in five other counties (Angelina, Cherokee, Newton, Henderson, and Rusk). Most of these mining needs are also expected to decline over time. Several of these near-term mining needs are associated with renewed interest in natural gas exploration in the Haynesville/ Bossier Shale in East Texas.

4.3.4 Identified Needs for Livestock

Livestock water needs over 2,000 ac-ft per year are projected in Shelby, Nacogdoches, Jasper, and San Augustine counties. Many livestock water needs are expected to increase over time, particularly in Shelby county, where water needs are projected to increase from nearly 6,500 ac-ft per year in 2020 to over 19,000 ac-ft per year in 2070.

4.3.5 Identified Needs for Steam Electric Power

Steam electric power water needs exceeding 1,000 ac-ft per year are projected to occur in Jefferson and Rusk counties. Steam electric power shortages are primarily due to increases in demand above generation capacities of current facilities. Some of this demand is predicated on power facilities that are not going forward at this time but have the potential for development in the future.

4.3.6 Identified Needs for Irrigation

Irrigation water needs are only projected in Orange and Henderson counties.

4.4 First-Tier Water Needs by Major Water Provider

The comparison of First-Tier water needs for each MWP is presented in Appendix 4-A. Four MWPs were identified with projected needs in the ETRWPA over the planning cycle, while the rest of the MWPs have either no needs or surplus of water above their demands. The MWPs with needs within the region are shown in Table 4.6 and discussed below. MWPs with surpluses within the region are shown in Table 4.7. The table values were determined using existing supplies and existing contract demands but exclude potential future customers.

In addition to these providers, several MWPs are planning WMSs to increase the reliability of their supplies and to meet the needs of potential future customers. These providers and the recommended strategies are discussed in Chapter 5B.

Table 4.6 Major Water Providers with Projected Regional Needs for Current Customers (ac-ft/yr)

Water Provider	2020	2030	2040	2050	2060	2070
Angelina and Neches River Authority	-44,464	-44,464	-44,464	-44,464	-44,464	-44,464
Athens Municipal Water Authority	1,565	1,101	787	367	-2,386	-5,566
Beaumont	1	1	0	0	0	-1,938
Upper Neches River Municipal Water Authority	-12,537	-14,114	-15,592	-17,174	-18,859	-21,159
Total	**-55,435**	**-57,476**	**-59,269**	**-61,271**	**-65,709**	**-73,127**

Note: The needs (shortages) shown above are only for current customers in Region I. Potential future customers may place additional demands on these providers. Positive values indicate a surplus, while negative values indicate a need.

Table 4.7 Major Water Providers with Projected Regional Surpluses for Current Customers (ac-ft/yr)

Water Provider	2020	2030	2040	2050	2060	2070
Angelina-Nacogdoches WCID No. 1	15,340	14,635	5,601	4,861	3,426	2,761
Carthage	11,007	10,967	10,935	10,898	10,820	10,779
Center	1,620	1,507	1,406	1,299	1,191	1,090
Houston County WCID No. 1	715	652	652	652	652	652
Jacksonville	7,028	6,733	6,435	6,015	5,530	4,993
Lower Neches Valley Authority	778,140	748,496	746,550	744,367	742,299	741,562
Lufkin	10,392	10,056	9,809	9,528	9,219	8,933
Nacogdoches	21,412	20,345	19,282	18,114	16,841	15,517
Panola Co. Fresh Water Supply District No. 1	4,365	3,719	3,525	3,312	3,020	2,148
Port Arthur	19,122	19,151	19,372	19,417	19,436	19,437
Sabine River Authority	988,083	984,442	980,754	977,149	973,414	969,647
Tyler	66,150	64,624	63,249	61,599	59,772	57,863
Total	**1,923,374**	**1,885,327**	**1,867,570**	**1,857,211**	**1,845,620**	**1,835,382**

Note: The surpluses shown above are only for current customers in Region I. Potential future customers may place additional demands on these providers.

4.4.1 Angelina and Neches River Authority (ANRA)

ANRA is projected to have a water need of 44,464 ac-ft per year by Year 2070 for current customers. ANRA has contractual demands for water from Lake Columbia that are estimated to begin by 2030 (assuming that Lake Columbia is completed by 2030). ANRA has no currently available water supply to meet these contractual demands. The potential management strategy to meet this shortage is the construction of Lake Columbia.

4.4.2 Athens Municipal Water Authority (AMWA)

The maximum projected need for AMWA is 5,566 ac-ft per year in Year 2070. Most of this need is associated with operational constraints of Lake Athens for the Athens Fish Hatchery. Several water management strategies are being considered for AMWA to meet this need, including reuse from return flows from the Athens Fish Hatchery and developing groundwater supplies from the Carrizo-Wilcox aquifer.

4.4.3 City of Beaumont

The City of Beaumont is projected to have a water need under drought-of-record conditions of 1,938 ac-ft per year in Year 2070. Much of the projected needs are associated with increased demands for manufacturing needs and local growth.

4.4.4 Upper Neches River Municipal Water Authority (UNRMWA)

The UNRMWA has contractual demands that exceed the reliable supply from its Lake Palestine system. The long-term strategy to meet these demands and other potential future demands is to develop additional supplies in the Neches River basin.

4.5 Second-Tier Water Needs Analysis

The Second-Tier water needs analysis compares the currents and projects supplies and demands after reductions from conservation and direct reuse. Conservation and direct reuse are both characterized as water management strategies (WMS), which will be further discussed in Chapter 5B and Chapter 5C. Appendix ES-A, Report 07 contains listings of the second-tier water needs by water user group and major water provider.

Figure 4.4 illustrates the reduction of water needs within the region after applying conservation and direct reuse strategies. Conservation was applied to all municipal WUGs with a reported per-capita usage above 140 gallons per capita per day (GPCD), whether there was a need or not, therefore, needs were only reduced if an entity had a need. Overall, conservation and direct reuse decreased the total needs within the region by over 100 ac-ft per year (~0.1 percent) in 2020 and nearly 7,900 ac-ft per year (~3.9 percent) by 2070. A large portion of this reduction is attributed to the City of Beaumont's municipal conservation strategy.

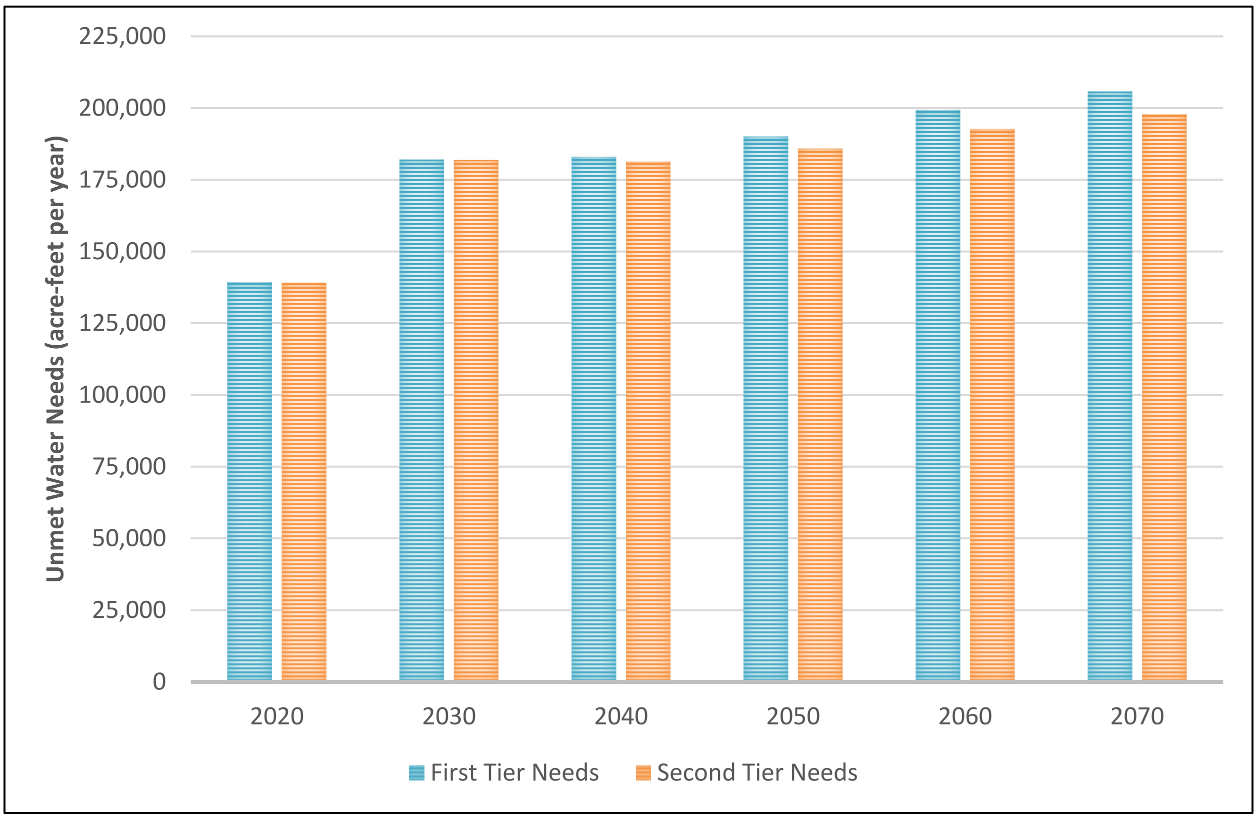

Figure 4.4 Regional Secondary Needs Comparison

Chapter 5A

Identification of Potentially Feasible Water Management Strategies

This Chapter reviews the types of water management strategies (WMS) considered for the East Texas Regional Water Planning Area (ETRWPA) and the approach for identifying potentially feasible water management strategies for water user groups (WUGs) and wholesale water providers (WWPs) with a water need, as identified in Chapter 4. In addition, evaluation criteria are considered, and the viability of each WMS type is assessed. Once a list of potentially feasible strategies has been identified, the most feasible strategies are recommended for implementation. An alternative strategy may also be identified as potentially feasible in the event a recommended strategy becomes unfeasible.

The recommended and alternative water management strategies identified for individual WUGs and WWPs are presented in Chapter 5B. Chapter 5C discusses the conservation strategies and the application of each strategy to meet ETRWPA needs. WMSs to meet potential future demands that are not presently approved by the Texas Water Development Board are not included in this chapter.

Identification of a supply source as a potentially feasible strategy depends on the availability of the source, the accessibility of the source to the WUG or WWP developing the WMS, and the feasibility of developing a strategy from the source of supply. It should be noted that there can be potentially feasible strategies that are not identified as recommended or alternative WMS for an entity.

The types of WMSs considered in this chapter include water conservation, water reuse, expanded use of existing supplies, new supply development, and drought management. A comprehensive list of the potentially feasible strategy types identified is included below.

- Water conservation
    - Water Loss Control
- Water reuse
    - Expanded use of existing supplies
    - Management of existing supplies
    - Conjunctive use of groundwater and surface water
    - Acquisition of available existing supplies
    - Development of regional water supply or regional management of water supply facilities
    - Voluntary redistribution of water resources (regional water banks, sales, leases, options, subordination agreements, and financing agreements)
    - Emergency transfer of water under Texas Administrative Code §11.139
    - System optimization, reallocation of reservoir storage to new uses, contracts, water marketing, enhancement of yield, improvement of water quality

    - Interbasin transfers
- New supply development
    - Surface water resources
    - Groundwater resources
    - Brush control; precipitation enhancement
    - Aquifer storage and recovery
    - Cancellation of water rights
    - Desalination of marine seawater or brackish groundwater
    - Rainwater harvesting
- Drought Management
    - Demand management

Drought management measures are not generally a reliable source of additional supplies to meet growing demands. For this reason, the East Texas Regional Water Planning Group (ETRWPG) does not use drought management measures as potentially feasible WMSs for regional water planning. Chapter 7 includes an analysis and summary of drought response data, activities, and drought management recommendations in the ETRWPA.

Desalination (marine seawater or brackish groundwater) and aquifer storage and recovery (ASR) were considered as WMSs by the ETRWP on a case-by-case basis. For the 2021 ETRWP, no Major Water Providers (MWPs), Water User Groups (WUGs), or other entities in Region I are planning on sponsoring desalination or ASR as a recommended or alternative strategy. In future planning cycles, if any Region I entities would like to include a desalination or ASR project in the ETRWP, the ETRWPG will evaluate these project(s) in accordance with the screening criteria identified in Texas Administrative Code Title 31 Chapter 357.34.

While several strategy types were considered by the ETRWPA, not all were determined as viable options for addressing water needs in the region. The few subcategories within each strategy type that were determined as potentially feasible strategies for entities within the ETRWPA include: 1) water conservation 2) water reuse 3) expanded use of existing supplies (groundwater supplies, local supplies, and voluntary redistribution) and 4) new supply development (surface water resources: new reservoirs).

The sections below include a detailed discussion of each one of these four strategy types and the specific application of these strategies to WUGs and WWPs in the ETRWPA. Each strategy type is evaluated using screening criteria identified in Texas Administrative Code Title 31 Chapter 357.34. These criteria include the net quantity, reliability, cost, environmental factors, impacts to agricultural resources, threats to natural resources, and impacts on key parameters of water quality. The screening criteria also consider issues associated with interbasin transfers and socio-economic impacts associated with voluntary redistribution of supplies, where applicable. A detailed list of the screening criteria used for selecting these strategies is included in Appendix 5A-A.

5A.1 Water Conservation

Water conservation is defined as methods and practices 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 water supply is made available for future or alternative uses. A detailed evaluation of conservation water management practices, trends, plans, and strategies in the ETRWPA is included in Chapter 5C in section 5C.3; this section also includes discussions on WUGs with water needs that do not have recommended WMSs.

Water Conservation Environmental Issues. No substantial environmental impacts are anticipated, as water conservation is typically not a capital-intensive alternative associated with direct physical impacts to the natural environment. A summary of the few environmental issues that might arise for this strategy type are presented in Table 5A.1.

Table 5A.1 Potential Environmental Issues Associated with Water Conservation

Environmental Issue	Evaluation Result
Implementation Measures	Requires voluntary participation from the public.
	Issue can be minimized by enhanced public and school education.
	May include water conservation pricing, and enhanced water loss control programs.
Environmental Water Needs/Instream Flows	No substantial impact identified, assuming relatively low reduction in diversions and return flows.
	Substantial water conservation could 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 (see Environmental Water Needs/Instream Flows, above).
Fish and Wildlife Habitat	No substantial impact identified (see Environmental Water Needs/Instream Flows, above).
	Possible low to moderate positive impact to aquatic and riparian habitats with substantial reductions as more stream flow would be available to these habitats.
Cultural Resources	No substantial impact anticipated.
Threatened and Endangered Species	No substantial impact identified (see Environmental Water Needs/Instream Flows, above).
	Possible low to moderate positive impact to aquatic and riparian threatened and endangered species (where they occur) with substantial diversion reductions.

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

Water Conservation Cost Considerations. Typical unit costs were used to develop opinions of probable cost for each recommended water conservation strategy. Other costs, such as the cost of hiring a water conservation coordinator, were not considered. The school and public education and enhanced water control program strategies create direct costs for the water user groups for which these strategies are recommended.

Water Conservation Implementation Issues. Water conservation as a water supply option has been compared to the plan development criteria, as shown in Table 5A.2. Based on the table, it is evident that water conservation meets the evaluation criteria.

Table 5A.2 Comparison of Water Conservation

Impact Category	Comment(s)
A. Water Supply: 1. Quantity 2. Reliability 3. Cost	 1. Limited 2. Variable, dependent on public acceptance 3. Reasonable
B. Environmental Factors 1. Environmental Water Needs 2. Habitat 3. Cultural Resources 4. Bays and Estuaries	 1. None or low impact 2. No apparent negative impact 3. None 4. None or low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial water needs
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Not applicable

SOURCE: TEXAS WATER DEVELOPMENT BOARD

5A.2 Water Reuse

Water reuse utilizes treated wastewater effluent as either a replacement for a potable water supply (direct reuse) or utilizes treated wastewater that has been returned to a water supply resource for non-potable reuse or additional treatment at a later time for potable or non-potable purposes (indirect reuse).

Currently, there is one recommended reuse strategy defined for the ETRWPA in the 2021 Plan, a transmission system transferring City of Center's return flows from the wastewater treatment plant to Lake Center. Water reuse is most feasible for larger municipal water users or industrial users that have access to a source of municipal effluent. In the ETRWPA, small quantities of wastewater are currently being reused where it is economically viable. The ETRWPG identified only a few additional reuse opportunities within the region because the generators of the wastewater effluent were not generally interested in developing this type of project due to the lack of need or to excessive cost compared to other alternatives.

Water reuse is considered as a potentially feasible strategy in the 2021 Plan for Athens Municipal Water Authority (AMWA). Athens MWA has received a reuse permit that allows the City of Athens to discharge its wastewater effluent to Lake Athens, the City and the AMWA have decided not to pursue this strategy at this time due to the cost. However, AMWA is pursuing entering into a contract with the Athens Fish Hatchery to return water that is passed through its facility back to Lake Athens. Currently, the hatchery does return this water as part of its operations, but it is under no contractual obligation to do so. Therefore, the volume of water from the hatchery is not considered a water supply for the purposes of regional water planning.

5A.3 Expanded Use of Existing Supplies

Expanded use of existing supplies includes additional use from existing groundwater and local sources and voluntary redistribution of water resources. Most of the potentially feasible strategies for the ETRWPA are associated with the expanded use of existing supplies. The introduction to this chapter includes a comprehensive list of sub-categories identified within the expanded use of existing supplies strategy type. However, not all subcategories were deemed viable as potentially feasible strategy types for ETRWPA. The few subcategories within this strategy type determined as potentially feasible strategies for entities within the ETRWPA are: 1) expanded use of groundwater supplies, 2) expanded use of local supplies, and 3) voluntary redistribution. Subsections 5A.3.1 – 5A.3.3 include a detailed discussion on each one of the subcategories.

As a water-rich region, the water needs experienced by WUGs and WWPs within the region can generally be addressed by expanding the usage from the existing sources of supplies (both groundwater and surface water), adding or updating infrastructure to access an existing source of supply, and voluntary redistribution of the existing supplies. Table 5A.3 below includes a region-wide summary of undeveloped freshwater supplies that can be utilized for potential WMSs. The undeveloped supplies shown in the table below do not include brackish run-of-river rights granted to users in ETRWPA. It is understood demands associated (primarily manufacturing users) with the use of brackish run-of-river rights are not included in the manufacturing demands approved by Texas Water Development Board for the ETRWPA. Therefore, it is assumed brackish run-of-river rights are not available for identifying potential strategies for meeting needs in ETRWPA.

Table 5A.3 Summary of Unallocated Supplies in the East Texas Regional Water Planning Area

Source of Supply	2020	2070
Groundwater Supplies		
Carrizo Wilcox Aquifer	202,248	202,248
Gulf Coast Aquifer	211,627	211,627
Queen City Aquifer	91,509	91,509
Yegua-Jackson Aquifer	29,980	29,597
Other Aquifer	9,612	9,612
Sparta Aquifer	3,682	3,682
Surface Water Supplies		
Lakes/Reservoirs	2,654,204	2,613,499
Fresh Run-of-River	588,603	594,258
Total Supplies	**3,791,465**	**3,756,032**

SOURCE: TEXAS WATER DEVELOPMENT BOARD

5A.3.1 Expanded Use of Groundwater

Groundwater is a viable and cost-effective supply source for the ETRWPA. Approximately 60 percent of WUGs with an identified need during the planning period are expected to continue using groundwater as a source of new supplies. The supplies established in Chapter 3 were used to evaluate the ability to meet demands for the ETRWPA. Counties that are near capacity in utilizing the available groundwater resources, according to the Texas Water Development Board's Modeled Available Groundwater projections, are Angelina, Cherokee, Nacogdoches, Orange, Shelby, and Smith. An evaluation of the expanded use of groundwater is presented by aquifer and county in Table 5A.4.

Table 5A.4 Water User Groups with Groundwater Water Management Strategies

County	Carrizo Wilcox Aquifer	Yegua-Jackson Aquifer
Cherokee	Alto Rural WSC	N/A
	Rusk	
Henderson	Athens MWA	N/A
	Moore Station WSC	
	Mining	
	Chandler	
Houston	N/A	Livestock
		TDCJ Eastham Unit
Jasper	N/A	Livestock
Nacogdoches	D & M WSC	None
	Livestock	
Panola	Livestock	N/A
Rusk	Jacobs WSC	N/A
	Livestock	
Smith	Bullard	N/A
	Crystal Systems Texas	
	Lindale	
	Manufacturing	
	Overton	
	Manufacturing	
	Wright City WSC	
	Whitehouse	

SOURCE: TEXAS WATER DEVELOPMENT BOARD

Expanded Use of Groundwater Environmental Issues

Under the Joint Planning effort for groundwater, the groundwater conservation districts determine the appropriate protective level through the adoption of the Desired Future Conditions. The desired future conditions are incorporated into regional planning through the Modeled Available Groundwater values. There are no recommended strategies that exceed the Modeled Available Groundwater value, thus providing the necessary environmental and water supply protections desired by the groundwater conservation districts. Other environmental considerations with expanded groundwater use are associated with increased transmission capacities. It is assumed new pipelines can be routed to minimize impacts to the environment. A summary of the few potential environmental issues that might arise are presented in Table 5A.5.

Table 5A.5 Potential Environmental Issues Associated

Environmental Issue	Evaluation Result
Implementation Measures	Local impact from development of well fields, storage facilities, pump stations and pipelines.
Environmental Water Needs/Instream Flows	Potential increase in return flows to streams from increased water use.
	Potential decrease in groundwater-surface water nexus, which could reduce base flows.
Bays and Estuaries	No substantial impact identified.
Fish and Wildlife Habitat	No substantial impact identified.
Cultural Resources	No substantial impact anticipated.
Threatened and Endangered Species	No substantial impact identified.

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

Expanded Use of Groundwater Cost Considerations

Cost considerations are affected by the distance from development of wells to the need for the water. Facilities requiring capital investment include wells, pipelines, pump stations, and storage. Some water from wells may require minor treatment.

Expanded Use of Groundwater Implementation Issues

This water supply option has been compared to the plan development criteria, and Table 5A.6 shows how this option meets each criterion.

5A.3.2 Expanded Local Supplies

Expansion of existing local supplies involves the development of supplies currently being used near the source of demand, usually Other Aquifer groundwater or local supplies (supply ponds). Currently, no strategies are developed for this supply type.

Expanded Local Supplies Environmental Issues

The expansion of local supplies is very limited in volume and geographic area. Impacts of this WMS on the environment are expected to be negligible.

Expanded Local Supplies Cost Consideration

Costs will vary with each project. This strategy involves development of additional stock ponds for livestock and costs are generally low.

Expanded Local Supplies Implementation Issues

Implementation issues associated with expansion of local supplies are not anticipated.

Table 5A.6 Comparison of Expanded Use of Groundwater to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply: 1. Quantity 2. Reliability 3. Cost	 1. Sufficient to meet needs (except Smith County) 2. High reliability 3. Moderate
B. Environmental Factors 1. Environmental Water Needs 2. Habitat 3. Cultural Resources 4. Bays and Estuaries	 1. Low impact 2. Low impact 3. Low impact 4. Negligible impact
C. Impact on Other State Water Resources	No apparent negative impacts; no effect on navigation
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option considered to meet demands of all user groups except Steam-Electric
F. Requirements for Interbasin Transfers	None
G. Third Party Social and Economic Impacts from Voluntary Redistribution	It is assumed that expanded groundwater development is between a willing buyer and seller, therefore, there are no apparent impacts

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

5A.3.3 Voluntary Redistribution

For purposes of this Plan, "voluntary redistribution" is defined as an entity in possession of water rights or water purchase contracts freely selling, leasing, giving, or otherwise providing water to another entity. Typically, the entity providing the water has determined it does not need the water for meeting its own demand for the duration of the transfer. The transfer of water could be for a set period of years or a permanent transfer. Voluntary redistribution is essentially a water purchase.

Voluntary redistribution has many benefits over other supply options because it can be much easier than implementing a new reservoir project, it typically costs less than large capital projects, and it avoids implementation issues of new reservoir projects such as environmental and local impacts. Most importantly, redistribution of water makes use of existing resources and provides a more immediate source of water.

Entities that have the potential to meet demands through voluntary redistribution, either by having available supplies or currently providing needs through voluntary redistribution and having the ability to obtain new supplies were identified. It should be noted the ETRWPA region is a water rich region. The water needs for the WUGs and WWPs in the region primarily exist due to infrastructure limitations or due to lack of water supply availability for the WUG with the need. There are other WWPs and WUGs in the region with excess supplies that can be used to address the water needs in the region. Due to this, voluntary redistribution is an important strategy type used for identifying WMSs for the ETRWPA. It is important to remember redistribution of water is voluntary. No group or individual is required to participate. Therefore, other strategies should be identified for groups relying on redistribution where the supply would place a burden on the distributor. A discussion of entities considered as potential suppliers of voluntary redistribution is provided in Table 5A.7 below. The amounts shown in this table represent the minimum amount of supply available, during the planning period, for voluntary redistribution after all other obligations based on current contracts are met.

Table 5A.7 List of Needs Met by Voluntary Redistribution

Water Provider	Supply Available for Voluntary Redistribution* (ac-ft/yr)	Entity with Need
City of Lufkin (Lake Kurth, Sam Rayburn)	8,713	Manufacturing (Angelina)
		Mining (Angelina)
Lower Neches Valley Authority	761,573	Manufacturing (Jefferson)
		Steam-Electric (Jefferson)
		County Other (Jefferson)
		Beaumont (Jefferson)
Nacogdoches	6,966	None
Sabine River Authority of Texas	999,279	Mining (Newton)
		Irrigation (Orange)
		Steam-Electric (Rusk)
		Livestock (San Augustine)
City of Tyler	7,278	Chandler (Henderson)
		Manufacturing (Smith)
		Bullard (Smith)
		Crystal Systems Texas (Smith)
		R P M WSC (Smith)
		Mining (Smith)

*Value equal to minimum supply available over the planning period beginning in 2020 and ending in 2070.

SOURCE: TEXAS WATER DEVELOPMENT BOARD

Voluntary Redistribution Environmental Issues

No significant environmental impacts are anticipated, as available water resources identified for this option are supplied through existing reservoirs or groundwater sources. A summary of the few environmental issues that might arise for this alternative are presented in Table 5A.8.

Table 5A.8 Potential Environmental Impacts Associated with Voluntary Redistribution

Environmental Issues	Evaluation Result
Implementation Measures	Terms of contract addressed on a case by case basis.
	Potential construction of treatment and distribution infrastructure.
Environmental Water Needs/Instream Flows	No substantial impact identified.
	Increased use of a surface water source can potentially reduce instream flows, but this was considered during the permitting of the existing source.
Bays and Estuaries	Large quantities of additional water diverted from ETRWPA reservoirs could reduce current flows to bays and estuaries.
	No substantial impact identified since this strategy assumes use of currently permitted water.
Fish and Wildlife Habitat	Impact dependent on location and size of project. Impacts associated with infrastructure to transport the water could be avoided.
Cultural Resources	Impacts would be associated with infrastructure to transport the water but can generally be avoided.
Threatened and Endangered Species	Impacts would be associated with infrastructure to transport the water but can generally be avoided.

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

Voluntary Redistribution Cost Considerations

Potential costs of purchasing and using water available from voluntary redistribution are listed below:

- Cost of raw water;
- Treatment costs;
- Conveyance costs; and/or
- Additional costs required by water supplier.

Voluntary Redistribution Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 5A.9. An issue facing redistribution is proper compensation for the entity or individual that owns the water right or contract for water. If an entity has arranged through contracts to have more water than they currently need or may need in the study period, they should be compensated for the expense and upkeep of any facilities already in place.

Table 5A.9 Comparison of Voluntary Redistribution to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply: 1. Quantity 2. Reliability 3. Cost	 1. Significant quantity available in parts of the Region 2. High Reliability 3. Low to moderate
B. Environmental Factors 1. Environmental Water Needs 2. Habitat 3. Cultural Resources 4. Bays and Estuaries	 1. Minimal impact identified 2. Low impact in areas of construction 3. Possible low impact 4. Possible low impact
C. Impact on Other State Water Resources	No apparent negative impacts, no effect on navigation
D. Threats to Agriculture and Natural Resources	No impact identified
E. Equitable Comparison of Strategies Deemed Feasible	Considered to meet the needs of all user groups
F. Requirements for Interbasin Transfers	Considered on a case-by-case basis. Only required for surface water sales to users outside of the basin of the source
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Beneficial because it provides water for economic growth

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

The following issues should be considered when negotiating a voluntary redistribution agreement:

- Quantity of water to be redistributed;
- Location of excess water supply;
- Location of buyer with water need;
- Necessary water treatment and distribution facilities;
- Determination of fair market value;
- Consideration of how existing contracts will affect the sale or lease;
- Length of agreement;
- Expiration dates of agreement;
- Drought contingencies;
- Protections needed by entity providing water;
- Protections needed by entity needing water;
- Enforcement of protections, and
- Other conditions specific to buyer and seller.

5A.4 New Supply Development

New reservoirs are a type of surface water resource strategy and are the only new supply development strategies evaluated for the ETRWPA.

5A.4.1 New Reservoirs

Wholesale Water Providers (WWPs) in the ETRWPA have performed numerous studies on locations of reservoir sites. The ETRWPA possesses many features attractive to reservoir construction. The process of implementing a new reservoir is a multi-decade task of identifying, evaluating, and resolving environmental impacts associated with the reservoir as well as evaluating the economic feasibility of the project. These studies are beyond the scope of regional water planning. The process of implementation can go beyond the 50-year planning cycle in the current water planning process. The consideration of reservoir projects in the ETRWPA is based on information provided by WWPs located in the ETRWPA demonstrates their ability and willingness to serve needs in the 50-year planning cycle. For proposed reservoirs, justification and environmental impacts analyses are the responsibility of the sponsoring water provider. Information available through other studies was used to evaluate these projects for the region.

The ETRWPA has a long history of water supply planning by means of reservoir development. Numerous sites have been identified as being hydrologically and topographically ideal for reservoir development. For a site to be considered for reservoir development, it needs to be recommended by the planning group as a unique reservoir site. Two sites in the ETRWPA are currently designated as unique reservoir sites: Lake Columbia and Lake Fastrill. Lake Fastrill was designated by the 79th Legislature through 2007 Texas Legislature Senate Bill 3. Lake Columbia received its unique designation by the State Legislature, Senate Bill 1362. Lake Columbia is currently being pursued for development. The ETRWPG recommends both Lake Columbia and Lake Fastrill retain their status of unique reservoir sites. Chapter 8 provides additional discussion of unique reservoir sites.

Several reservoir sites in the ETRWPA have long been discussed as potential sources of water. The ETRWPG recognizes reservoirs can have major impacts on the environment and protection of the environment is already afforded through a process that is more thorough than the regional water planning effort. Other sites have been considered for water supply development in the past and may be considered again for future supplies. The potential reservoirs initially considered for water supply are presented below in Table 5A.10. Chapter 8 features a brief description of each of the potential reservoir sites.

In the ETRWPA, there are two sponsors of these reservoir projects shown to have needs: ANRA and UNRMWA. The LNVA and SRA, the other reservoir sponsors, are shown to have surplus water available for voluntary redistribution. Each of these water providers may choose to develop a new reservoir in the future if water demands on the provider change or if the reliability of its current supplies is impacted by drought. For this plan, the two most feasible new reservoirs are Lake Columbia and the Neches Off-Channel Reservoir (Fastrill Replacement Project).

Table 5A.10 Potential Reservoirs for Designation as Unique Reservoir Sites

Wholesale Water Provider	Reservoir Site
Angelina Neches River Authority	Lake Columbia (Unique Site)
Lower Neches Valley Authority	Rockland Reservoir
Sabine River Authority	Big Cow Creek
	Bon Weir
	Carthage Reservoir
	Kilgore Reservoir
	Rabbit Creek
	State Hwy. 322, Stage I
	State Hwy. 322, Stage II
	Stateline
	Socagee
Upper Neches River Municipal Water Authority	Neches Off-Channel Reservoir (Fastrill Replacement Project)

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

The Lake Columbia footprint is located predominantly in Cherokee County but extends into the southern portion of Smith County. The reservoir would be formed by construction of a dam on Mud Creek approximately 2.5 miles downstream of U.S. Highway 79 crossing. The dam is expected to impound water approximately 14 miles upstream with an estimated surface of 10,133 acres. The firm yield for the reservoir site is 75,700 ac-ft with a total storage volume at normal pool elevation of 315 feet, msl or 195,500 ac-ft. This project is sponsored by Angelina and Neches River Authority.

Needs that would potentially be met by the development of Lake Columbia are provided in Table 5A.11. In addition, Lake Columbia is a recommended strategy for all participants in the project. Some participants intend to replace existing groundwater supplies with water from Lake Columbia. These users may or may not show a need in the 2021 Plan.

The Neches Off-Channel Reservoir Project is located in the Neches River Basin and is sponsored by the Upper Neches River Municipal Water Authority and the City of Dallas. This strategy would include the construction of an off-channel storage reservoir, which would be located on a tributary of the Neches River in Anderson County downstream of Lake Palestine and upstream of the Weches Dam Site. The evaluation of this strategy is discussed in more detail in the 2021 Region C Water Plan.

Table 5A.11 List of Participants for the Lake Columbia Project

Entities Participating in Lake Columbia Project	Contracted Amount (ac-ft/yr)
Currently Contracted Participants	
Mining (Angelina)	474
New Summerfield	2,565
North Cherokee Water Supply Corporation (WSC)	4,275
Rusk	4,275
Rusk Rural WSC	855
Mining (Cherokee)	238
Mining (Nacogdoches)	5,475
Jackson WSC	855
Jacksonville	4,275
Mining (San Augustine)	2,102
Alto	428
County Other (Cherokee, Nacogdoches & Smith)	5,131
Nacogdoches	8,551
Arp	428
Troup	4,275
New London	855
Whitehouse	8,551
Total	**53,608**
Potential Participants	
City of Dallas	

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

Water demands that would be satisfied by the development of the Neches Off-Channel Reservoir Project are indicated in Table 5A.12.

Table 5A.12 Demands Supplied by Lake Fastrill Replacement Project

Entity	Projected Demand (ac-ft/yr)
UNRMWA	
City of Dallas*	47,250
Total	**47,250**

* Alternative Strategy

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

New Reservoirs Environmental Issues

Environmental impacts associated with the development of a new reservoir can be significant. Evaluation of such impacts is generally beyond the scope of water planning. Table 5A.13 provides a basic evaluation of issues. Environmental impacts for off-channel reservoirs may be less than on-channel reservoirs due to the flexibility in locating these facilities.

Table 5A.13 Environmental Issues Associated with Development of New Reservoirs

Environmental Issues	Evaluation Result
Implementation Measures	Dam and reservoir impact large area (10,000 acres).
	Requires land acquisition for reservoir and mitigation.
Environmental Water Needs/Instream Flows	Probable moderate to high impact.
	Mitigated through the permitting process.
Bays and Estuaries	Possible cumulative impact to limited areas of coastal marsh.
Fish and Wildlife Habitat	Possible high to moderate impact to riverine species and moderate impacts to terrestrial species.
	Possible moderate impact on State-listed species.
	Beneficial impacts to aquatic generalist and lentic species
Cultural Resources	Probable moderate impact.
Threatened and Endangered Species	Possible moderate to low impact pending identification of such species in the project area.

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

New Reservoirs Cost Consideration

As with any major reservoir project, the project costs are large. The annualized estimate of cost will include the construction of the dam, land acquisition, resolution of conflicts, environmental permitting and mitigation, and technical services.

New Reservoirs Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 5A.14. While the construction of new reservoirs is shown to have moderate to high impacts for some categories, these impacts will be adequately mitigated for during the permitting process.

Appendix 5A-B includes a table of WMSs required to be considered and evaluated by statute for every WUG with an identified need and a summary of the potentially feasible and non-feasible strategies.

Table 5A.14 Comparison of Development of New Reservoirs to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply: 1. Quantity 2. Reliability 3. Cost	1. Sufficient to meet needs 2. High reliability (Moderate reliability for river diversion) 3. Reasonable to High
B. Environmental Factors 1. Environmental Water Needs 2. Habitat 3. Cultural Resources 4. Bays and Estuaries	1. Moderate impact 2. High impact 3. High impact 4. Low to moderate impact
C. Impact on Other State Water Resources	Moderate impacts on state water resources (available water); low to moderate effect on navigation
D. Threats to Agriculture and Natural Resources	Moderate to high impact on bottomland hardwoods and habitat in reservoir area
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet water needs
F. Requirements for Interbasin Transfers	Potential interbasin transfer to Trinity Basin
G. Third Party Social and Economic Impacts from New Reservoirs	Varies: Potential for positive economic impacts

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

5A.4.2 Aquifer Storage and Recovery

Aquifer storage and recovery (ASR) involves storing water in aquifers and retrieving this water when needed. The water to be stored can be introduced through enhanced recharge or more commonly injected through a well into the aquifer. If an injection well is used, Texas law requires that the water not degrade the quality of the receiving aquifer. Source water for ASR can include excess surface water, treated wastewater, or groundwater from another aquifer.

There are several technical considerations to determine the feasibility and applicability of ASR, specifically:

- ASR requires suitable geological conditions for implementation. Since geologic conditions vary by location, studies must be performed to determine what specific locations would be suitable for ASR.
- Raw surface water and wastewater reuse most likely will require pretreatment prior to injection.
- Operation of an ASR system could significantly impact the amount of water that is retrievable.

Recent legislation passed by the 86th Texas Legislature, and signed by the Governor on June 10, 2019, requires the regional water plans to consider ASR and provide a specific assessment of this strategy if the region has significant needs. The definition of significant need is deferred to each region. The ETRWPG defined the threshold for significant needs to be 5,000 acre-feet per year. This threshold was determined after comparison of each projected need presented in Chapter 4 against the water use category's total water demand for the corresponding county as a percentage. There are seven entities that meet this significant need threshold: the Angelina & Neches River Authority (ANRA), Angelina Nacogdoches Water Control and Improvement District (AN WCID) #1, Athens Municipal Water Authority (MWA), City of Beaumont, City of Lufkin, Upper Neches River Municipal Water Authority (UNRMWA), and Jefferson County Manufacturing.

Before assessing the multitude of technical considerations required for ASR, Region I developed a set of criteria to screen out the feasibility and applicability of ASR to the entities identified with significant needs. Figure 5A.1 illustrates this screening process.

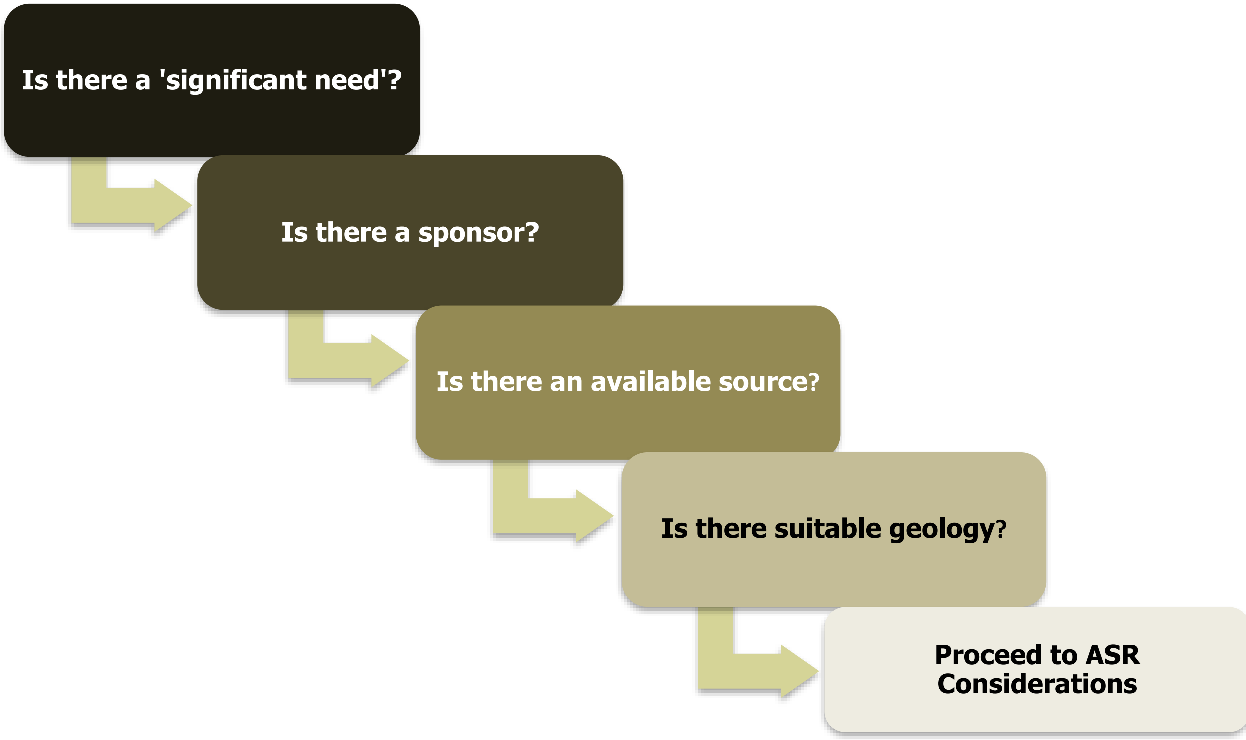

Figure 5A.1 Aquifer Storage and Recovery Screening Criteria

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

All seven entities identified with a significant need in Region I are evaluating and implementing other feasible strategies to meet these needs (see their respective sections in Chapter 5B) and are not planning on sponsoring an ASR strategy to be included in the 2021 ETRWP. As a result, each entity identified with a significant need in Region I did not pass the second criteria assessed in the screening process. Therefore, ASR was not further evaluated nor recommended as a strategy for entities identified with a significant need in the RWPA.

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Chapter 5B

Evaluation of Potentially Feasible, Recommended, and Alternative Water Management Strategies

The strategies are outlined for each water user group (WUG) by county and major water provider (MWP) that has a need identified in Chapter 4. For each WUG with a need, a summary table is provided to review the projected need and the supply delivered by the water management strategy (WMS) or strategies. A second summary table provides an evaluation of the cost (capital, annual, and unit) to deliver treated water to the user for the various strategies that were considered. Appendix 5B-A includes technical a memorandum for each strategy developed by the East Texas Regional Water Planning Group with a summary of the unit prices, general description of the project scope, and cost for each strategy. Appendix 5B-B includes a memorandum summarizing the quantification of environmental impacts of WMSs.

Four major categories of WMS are recommended: water conservation and drought management, wastewater reuse, expanded use of existing supplies (voluntary redistribution, groundwater, local supplies), and new development. Further discussion of how the strategies will be implemented in the ETRWPA is provided in Chapter 5A.

Any needs that remain after implementation of recommended WMSs included in this chapter are summarized and discussed in Chapter 6, Section 6.3 Unmet Water Need.

5B.1 Water Management Strategy Evaluation

Water management strategies identified to meet water needs during the planning period were evaluated based on the following criteria:

(1) Evaluation of the quantity, reliability, and cost of water delivered and treated for the end user's requirements, incorporating factors to be used in the calculation of costs as required by regional water planning;

(2) Environmental factors including the effects of the proposed water management strategy on environmental water needs, wildlife habitat, cultural resources, water quality and effect of upstream development on bays, estuaries, and arms of the Gulf of Mexico;

(3) Impacts on other water resources of the state including other WMSs and groundwater surface water interrelationships;

(4) Impacts of WMSs on threats to agricultural and natural resources of the regional water planning area;

(5) Impacts of the strategy on key water quality parameters;

(6) Any other factors as deemed relevant by the regional water planning group including political feasibility, implementation issues, and potential recreational impacts;

(7) Equitable comparison and consistent application of all WMSs the regional water planning groups determines to be potentially feasible for each water supply need;

(8) Consideration of the provisions in Texas Water Code § 11.085(k)(1) for interbasin transfers; and

(9) Consideration of third party social and economic impacts resulting from voluntary redistribution of water.

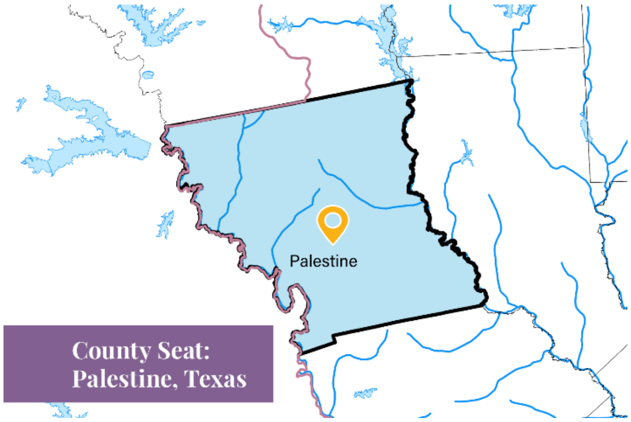
(10) Water losses associated with transmission were assumed to be negligible for regional planning purposes.

The evaluation was undertaken through the development of a matrix to rate the above consideration from most desirable (1) to least desirable (5). Rating of the Environmental Factors (item 2 above) was evaluated using a separate matrix with consideration of nine factors; total acres impacted, wetland acres, environmental water needs, habitat, threatened and endangered species, cultural resources, bays and estuaries, environmental water quality, and other noted factors. The evaluation matrices are included in Appendix 5B-A.

5B.2 Water User Groups with Water Management Strategies

WMSs were identified for WUGs in all 20 counties of the ETRWPA. Following is a county by county review of the WMSs evaluated for the 2021 Plan.

5B.2.1 Anderson County



Anderson County is located between the Trinity and Neches rivers in the northern end of the ETRWPA. The County covers an area of approximately 1,000 square miles. Average rainfall in the County is approximately 45 inches. Palestine is the county seat of Anderson County.

The largest cities in Anderson County are Palestine, Elkhart, and Frankston. Oil and gas production is a significant component of the local economy. Most of the WUG demands in Anderson County are supplied from the Carrizo-Wilcox aquifer. Minor amounts of supplies are taken from the other aquifers, including the Sparta and Queen City aquifers. The City of Palestine's demands are supplied from Lake Palestine and the Carrizo-Wilcox.

The total demand in Anderson County, including both municipal and non-municipal, is 16,428 ac-ft/yr in 2020 and decreases slightly to 16,335 ac-ft/yr in 2070. Most of these demands are municipal. During the projected planning period, there are no projected unmet needs for any WUG located within Anderson County. Following is a summary of WUGs in Anderson County, current sources of supply, and recommended WMSs.

Conservation strategies were developed for the following WUGs even though no shortages were identified as a proactive strategy.

Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Elkhart	4	6	6	7	7	8
Frankston	4	6	7	7	7	8
Norwood WSC	2	0	0	0	0	0
Palestine	81	129	140	150	161	172
Pleasant Springs WSC	2	4	5	5	5	6
TDCJ Beto Gurney & Powledge	16	27	29	30	32	34
TDCJ Coffield Michael	44	75	80	85	91	96

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Elkhart	8	$0.00	$2,000	$316	$0.97
Frankston	8	$0.00	$2,000	$308	$0.94
Norwood WSC	2	$0.00	$1,000	$500	$1.53
Palestine	172	$0.00	$30,000	$212	$0.65
Pleasant Springs WSC	6	$0.00	$2,000	$407	$1.25
TDCJ Beto Gurney & Powledge	34	$0.00	$6,000	$208	$0.64
TDCJ Coffield Michael	96	$0.00	$8,000	$102	$0.31

County Summary. Below is a summary of WUGs in Anderson County showing current water sources, maximum shortages (if any), and recommended WMSs (if any).

Water User Group Anderson County	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Anderson County Cedar Creek WSC	Carrizo-Wilcox	0	None
B S WSC	Carrizo-Wilcox	0	None
B C Y WSC	Carrizo-Wilcox	0	None
Brushy Creek WSC	Carrizo-Wilcox	0	None
The Consolidated WSC	Carrizo-Wilcox, Houston County Lake	0	None
Elkhart	Carrizo-Wilcox	0	Conservation
Four Pines WSC	Carrizo-Wilcox	0	None
Frankston	Carrizo-Wilcox	0	Conservation
Frankston Rural WSC	Carrizo-Wilcox	0	None
Neches WSC	Carrizo-Wilcox	0	None
Norwood WSC	Carrizo-Wilcox	0	Conservation
Palestine	Carrizo-Wilcox, Lake Palestine	0	Conservation
Pleasant Springs WSC	Carrizo-Wilcox	0	Conservation
Slocum WSC	Carrizo-Wilcox	0	None
TDCJ Beto Gurney & Powledge Units	Carrizo-Wilcox	0	Conservation
TDCJ Coffield Michael	Carrizo-Wilcox	0	Conservation
Tucker WSC	Carrizo-Wilcox	0	None
Walston Springs WSC	Carrizo-Wilcox	0	None
County Other	Carrizo-Wilcox, Other Aquifers	0	None
Manufacturing	Carrizo-Wilcox, Lake Palestine	0	None
Irrigation	Carrizo-Wilcox, Other Aquifers, Run-of-River Supplies	0	None
Livestock	Carrizo-Wilcox, Other Aquifers, Local Supplies	0	None
Mining	Carrizo-Wilcox, Other Aquifers	0	None
Steam Electric Power	Carrizo-Wilcox, Queen City Aquifers	0	None

5B.2.2 Angelina County

Angelina County is bounded by the Angelina River on the North and the Neches River on the South, in the central portion of the ETRWPA. The largest water body in the County is Sam Rayburn Reservoir, which extends into neighboring counties. Lufkin is the largest city and the County seat. Other major communities include Diboll, Burke, Hudson, and Huntington.

Angelina County is currently dependent on groundwater supplies for water supply; every WUG in Angelina County gets a portion, if not all, of their water from groundwater supplies. However, both the Yegua and Carrizo-Wilcox aquifers have limited capacity for expanded development. Although several rural communities and non-municipal water users will continue to rely on groundwater to meet their demands, the proposed construction of transmission lines and a surface water treatment plant at Lake Kurth by Lufkin will create a reliable surface water supply in the county. Manufacturing and Mining are the two WUGs with needs in Angelina County. Below is a discussion of WMSs identified for these WUGs.

Manufacturing. Current supplies for manufacturing water users include Lufkin and groundwater from the Yegua-Jackson and Other-Undifferentiated aquifers. Lufkin currently meets approximately 20 percent of the manufacturing demand while another 10 percent is self-supplied. This leaves approximately 70 percent of the projected manufacturing demands unmet. It is anticipated that growth in manufacturing will be supplied by Lufkin. Raw surface water is currently available from Lake Kurth for manufacturing use, but there is limited infrastructure.

The recommended strategy to meet the projected needs of Manufacturing in Angelina County is to contract for purchase of water from Lufkin. Lufkin's current supplies in Lake Kurth can only meet part of the demands. However, once Lufkin develops the supply from Sam Rayburn Reservoir to Lake Kurth, there would be enough supplies to meet the manufacturing demand in Angelina County. The strategy development and planning level cost estimate associated with development of the supply from Sam Rayburn Reservoir to Lufkin is discussed in the strategies for major water provider Lufkin. It should be noted that the Sam Rayburn supplies are available by 2030.

Angelina Manufacturing	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	1,449	1,625	1,625	1,625	1,625	1,625
Recommended Strategy ANGL-MFG: Purchase from Lufkin (Sam Rayburn) (ac-ft/yr)	1,625	1,625	1,625	1,625	1,625	1,625

Because Lufkin provides supplies to the manufacturing users in Angelina County, it is assumed that the infrastructure to supply additional manufacturing demand is already in place. Therefore, the cost estimates for this strategy only represent raw water purchase costs for Angelina County manufacturing users. Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy ANGL-MFG: Purchase from Lufkin (Sam Rayburn)	1,625	0	$530,000	$326	$1.00

Mining. Current supplies are from Other-Undifferentiated aquifers. Several private industries are under contract to purchase enough water from Angelina & Neches River Authority to meet their projected demand. Therefore, the recommended strategy for meeting the mining need projected in 2020 is to purchase raw water from Angelina & Neches River Authority.

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers. Supplies are assumed to be delivered by a 10-mile pipeline.

Angelina Mining	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	473	572	397	299	224	167
Recommended Strategy ANGL-MIN: Purchase from ANRA (Mud Creek) (ac-ft/yr)	0	572	397	299	224	167

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy ANGL-MIN: Purchase from ANRA (Mud Creek)	572	$7,927,000	$1,245,000	$2,177	$6.68

Conservation strategy was proposed as a proactive water management strategy for the following WUG even though there were no needs identified.

Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Lufkin	151	239	273	0	0	0

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Lufkin	273	$0.00	$60,000	$271.49	$0.83

County Summary. Below is a summary of WUGs in Angelina County, their current water source(s), maximum shortages (if any), and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Angelina WSC	Other Undifferentiated	0	None
Central WCID of Angelina County	Carrizo-Wilcox	0	None
County Other	All Aquifers, Lake Kurth, Sam Rayburn	0	None
Diboll	Yegua-Jackson, Carrizo-Wilcox, Lake Kurth, Sam Rayburn	0	None
Four Way SUD	Yegua-Jackson	0	None
Hudson WSC	Carrizo-Wilcox	0	None
Huntington	Carrizo-Wilcox, Yegua-Jackson	0	None
Lufkin	Carrizo-Wilcox, Lake Kurth, Sam Rayburn	0	Conservation
M&M WSC	Carrizo-Wilcox	0	None
Pollok-Redtown WSC	Carrizo-Wilcox	0	None
Redland WSC	Carrizo-Wilcox, Lake Kurth, Sam Rayburn	0	None
Upper Jasper County Water Authority	Carrizo-Wilcox	0	None
Woodlawn WSC	Carrizo-Wilcox	0	None
Zavalla	Yegua-Jackson	0	None
Manufacturing	All Aquifers, Lake Kurth, Lake Striker,	1,625	Purchase from Lufkin (Sam Rayburn (Mud Creek))
Mining	Other Undifferentiated	572	Purchase from ANRA
Irrigation	Yegua-Jackson, Lake Kurth	0	None
Livestock	All Aquifers, Local Supply	0	None
Steam Electric Power	Lake Kurth, Carrizo Wilcox	0	None

5B.2.3 Cherokee County

Cherokee County is located in northern portion of the ETRWPA. The county seat is Rusk. The county encompasses an area of approximately 1,049 square miles. Lake Jacksonville, Lake Palestine, and Lake Striker are located wholly or partially in the County. The larger municipal WUGs in the County are New Summerfield, Rusk, Rusk Rural WSC, Alto, Alto Rural WSC, and North Cherokee WSC. The Carrizo-Wilcox aquifer is the primary source of supply for the needs in Cherokee County. Some WUGs in the County also receive supplies from Lake Jacksonville and Lake Acker. There are two WUGs with shortages in Cherokee County; Alto Rural WSC and Mining. The WMSs for these WUGs are discussed below. There are approximately 5,000 ac-ft/yr of supplies in Carrizo Wilcox in 2020 that are available for WMSs. Water is also available from the Queen City aquifer and a small amount available from the Sparta aquifer, but these aquifers do not cover the entire county. Water obtained from the Queen City aquifer may be acidic and may have levels of iron and manganese greater than TCEQ secondary drinking water standards. Water obtained from the Sparta aquifer may have levels of sulfates greater than the TCEQ secondary drinking water standards, especially in far southern Cherokee County. Water quality in the Sparta aquifer is best on the outcrop. However, for planning purposes, water from the Queen City and Sparta aquifers will be allocated primarily for livestock and irrigation uses because of the unreliable supply and quantity. No proposed strategies for municipal water shortages involve the Queen City and Sparta aquifers.

Alto Rural WSC. The WUG currently obtains water supply from the Carrizo-Wilcox aquifer. The recommended strategy is to increase its supply from the Carrizo-Wilcox aquifer. Municipal conservation is the other recommended strategy for Alto Rural WSC.

Alto Rural WSC	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	65	137	215
Recommended Strategy: Conservation (ac-ft/yr)	9	16	18	21	25	28
Recommended Strategy CHE-ALT: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	0	191	191	191

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy CHE-ALT: New Wells (Carrizo-Wilcox)	191	$2,426,000	$202,000	$1,058	$3.25
Recommended Strategy: Conservation	28	0	$8,000	$316	$0.97

Mining. Current mining water needs in Cherokee County are met through groundwater from the Other-Undifferentiated aquifer and mining local supply. With the increased interest in natural gas exploration in East Texas, including Cherokee County, there are expected water shortages for mining in the near-term in the county. To meet these demands, water from Lake Columbia and/or run-of-the-river diversions from the Angelina River are recommended. It is assumed that Angelina & Neches River Authority would be the sponsor for this water.

Cherokee County Mining	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	238	247	210	147	84	40
Recommended Strategy CHER-MIN: Purchase from ANRA (Mud Creek) (ac-ft/yr)	0	247	210	147	84	40

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy CHER-MIN: Purchase water from ANRA (Mud Creek)	247	$7,013,000	$853,000	$3,453	$10.60

Rusk. The current supplies for City of Rusk are taken from Carrizo Wilcox aquifer in Cherokee County and the surface water supplies from Rusk City Lake. City of Rusk has a water right to supplies from Rusk City Lake. After adjusting for the existing supplies, the City of Rusk has a shortage of 122 ac-ft/yr in 2070. The recommended strategy to meet the shortage in 2070 is to develop new wells in the Carrizo Wilcox aquifer. An additional strategy to implement conservation measures was also proposed.

Rusk	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	0	122
Recommended Strategy CHER-RUS: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	0	0	0	122
Recommended Strategy: Conservation (ac-ft/yr)	15	26	30	34	40	46

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy CHER-RUS: New Wells (Carrizo-Wilcox)	122	$2,361,000	$192,000	$1,574	$4.83
Recommended Strategy: Conservation	46	$0	$14,000	$361	$1.11

Wright City WSC. The current supplies for Wright City WSC are taken from Carrizo Wilcox aquifer in Cherokee County. The WUG has shortages in Rusk, Smith, and Cherokee counties. The strategy to develop groundwater supplies to meet shortages in Rusk and Cherokee counties. There are no shortages in Smith County. The recommended strategy will address shortages in the two counties.

Wright City WSC	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	24	71	99
Recommended Strategy CHER-WCW: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	0	25	71	121

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy CHER-WCW: New Wells (Carrizo-Wilcox)	121	$2,361,000	$192,000	$1,574	$4.83

Conservation strategy was proposed as a proactive water management strategy for the following WUG even though there were no needs identified.

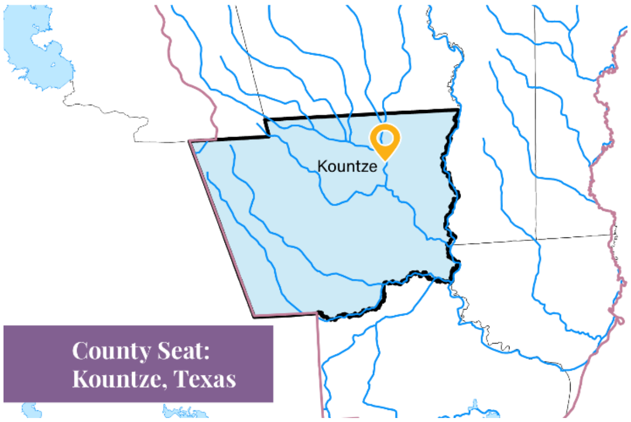
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Alto	4	6	7	7	9	10
Blackjack WSC	2	3	4	5	5	6
Jacksonville	50	85	110	129	152	178
Wells	2	0	0	0	0	0

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Alto	10	$0	$3,000	$326	$1.00
Blackjack WSC	6	$0	$2,000	$360	$1.10
Jacksonville	178	$0	$42,000	$291	$0.89
Wells	2	$0	$1,000	$500	$1.53

County Summary. Below is a summary of WUGs in Cherokee County, their current water source(s), maximum shortages (if any), and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Afton Grove WSC	Lake Jacksonville, Sales from City of Jacksonville	0	None
Alto	Carrizo-Wilcox	0	Conservation
Alto Rural WSC	Carrizo-Wilcox	215	New Wells (Carrizo-Wilcox) Conservation
Blackjack WSC	Carrizo-Wilcox	0	Conservation
Bullard	Carrizo-Wilcox	0	None
County Other	Carrizo-Wilcox	0	None
Craft Turney WSC	Carrizo-Wilcox, Lake Jacksonville	0	None
Gum Creek WSC	Carrizo-Wilcox, Lake Jacksonville	0	None
Jacksonville	Carrizo-Wilcox, Lake Jacksonville	0	Conservation
New Summerfield	Carrizo-Wilcox	0	None
North Cherokee WSC	Carrizo-Wilcox, Lake Jacksonville	0	None
Pollok-Redtown WSC	Carrizo-Wilcox	0	None
Rusk	Carrizo-Wilcox, Rusk City Lake	122	New Wells (Carrizo-Wilcox) Conservation
Rusk Rural WSC	Carrizo-Wilcox	0	None
Southern Utilities	Carrizo-Wilcox	0	None
South Rusk WSC	Carrizo-Wilcox	0	None
Troup	Carrizo-Wilcox	0	None
Wells	Carrizo-Wilcox	0	Conservation
West Jacksonville WSC	Carrizo-Wilcox	0	None
Wright City WSC	Carrizo-Wilcox	99	New Wells (Carrizo-Wilcox)
Manufacturing	Carrizo-Wilcox, Lake Jacksonville	0	None
Mining	Other Aquifers	247	Purchase from ANRA (Mud Creek)
Irrigation	All Aquifers, Lake Palestine	0	None
Livestock	Carrizo-Wilcox, Other Aquifers, Local Supply	0	None
Steam Electric Power	Lake Striker	0	None

5B.2.4 Hardin County



Hardin County is located in the southern portion of the ETRWPA and is part of the timberlands region in East Texas. The County covers an area of approximately 900 square miles. The average rainfall in the County is about 58 inches.

The County seat is Kountze and other major towns are Lumberton, Sour Lake and Silsbee. Every WUG in Hardin County gets the majority of their water from groundwater supplies. All of the groundwater supply is from the Gulf Coast aquifer. Based on the Modeled Available Groundwater used in this round of planning, the Gulf Coast aquifer supplies in Hardin County are limited to approximately 35,000 ac-ft/yr. Other sources of supply in this county include Neches River run-of-river supplies, and local supplies.

The total demand in Hardin County, including both municipal and non-municipal, is 7,113 ac-ft/yr in 2020 and grows to 7,817 ac-ft/yr in 2070. The majority of these demands are municipal. There is no projected need for any WUG located within Hardin County during the projected planning period.

Conservation strategy was proposed as a proactive water management strategy for the following WUG even though there were no needs identified.

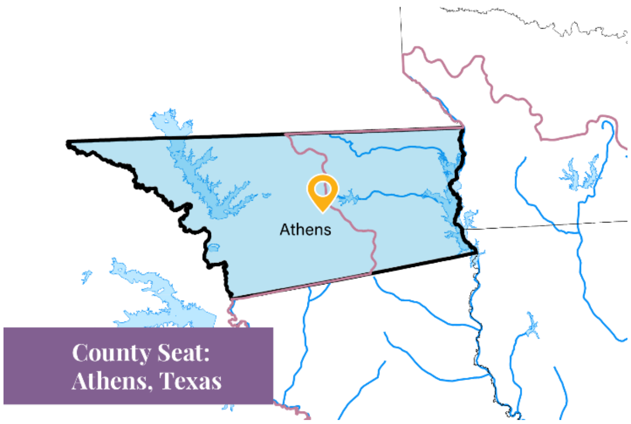
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Wildwood POA	4	6	7	7	8	8

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Wildwood POA	8	$0	$2,000	$300	$0.92

County Summary. Below is a summary of WUGs in Hardin County, their current water source(s), maximum shortages (if any), and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
County Other	Gulf Coast	0	None
Hardin County WCID #1	Gulf Coast	0	None
Kountze	Gulf Coast	0	None
Lake Livingston WSC	Gulf Coast	0	None
Lumberton MUD	Gulf Coast	0	None
North Hardin WSC	Gulf Coast	0	None
Silsbee	Gulf Coast	0	None
Sour Lake	Gulf Coast	0	None
West Hardin WSC	Gulf Coast	0	None
Wildwood POA	Gulf Coast	0	Conservation
Manufacturing	Gulf Coast	0	None
Mining	Gulf Coast, Sam Rayburn	0	None
Irrigation	Gulf Coast, Run-of-River	0	None
Livestock	Gulf Coast, Local Supply	0	None
Steam Electric Power	----	0	None

5B.2.5 Henderson County



Henderson County is located between the Neches and Trinity Rivers in the northern end of the region. Henderson County is located in both Region C and the ETRWPA. The portion of the county in the Neches River Basin is in the ETRWPA. Lake Palestine is located partially within the county. Athens Lake is also located within Henderson County.

Athens is the largest city and also the county seat for Henderson County. The county encompasses approximately 950 square miles. Athens, Bethel Ash WSC, Brownsboro, Chandler, and Berryville are the largest WUGs in the County. Much of the water supplied to users in the ETRWPA is obtained from groundwater, with water also supplied from Lake Athens and Lake Palestine.

County Other. There are no identified needs for County Other WUG located in ETRWPA but there are some needs identified in the Region C portion of the Henderson County. A discussion of the WMSs developed to meet this need in is included in the Region C regional water plan in Chapter 5D.

R P M WSC. There are shortages identified for R P M WSC in Henderson County. The strategy to meet these shortages is discussed in the Smith County strategy summary section.

Athens. The City of Athens is supplied water by Athens MWA from Lake Athens and groundwater from the Carrizo-Wilcox Aquifer. These entities are identified to have shortages in both Region C and I, particularly in later decades, due to growing demands. Shortages will be met through multiple WMS, including municipal conservation, reuse of fish hatchery return flows, and development of additional groundwater wells in the Carrizo-Wilcox aquifer. These WMS are discussed in further detail under the Athens MWA major water provider (MWP) section of Chapter 5B and in the 2021 Region C Water Plan.

Athens	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	7	13	16	20	30	40
Recommended Strategy: Conservation (ac-ft/yr)	7	13	16	20	23	27
Recommended Strategy HEND-ATH: AMWA Athens Fish Hatchery Reuse (ac-ft/yr)*	0	0	0	0	6	14
Recommended Strategy HEND-ATH: AMWA New Wells (Carrizo-Wilcox) (ac-ft/yr)*	0	0	0	0	4	10

**Region C strategy. For additional strategy information, see Region C plan.*

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	27	$786,000	$25,000	$1,156	$3.55

Irrigation. Irrigation users in Henderson County receive water from various sources, including surface water, groundwater, and purchased water from Athens MWA. Irrigation in Henderson County are shown to have shortages in Region I and C; however, these shortages will be met through Athens MWA's recommended strategies, which include reuse of fish hatchery return flows and development of additional groundwater wells in the Carrizo-Wilcox aquifer. These WMS are discussed in further detail under the Athens MWA major water provider (MWP) section of Chapter 5B and in the 2021 Region C Water Plan.

Henderson Irrigation	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	30	50
Recommended Strategy HEND-ATH: AMWA Athens Fish Hatchery Reuse (ac-ft/yr)*	0	0	0	0	10	16
Recommended Strategy HEND-ATH: AMWA New Wells (Carrizo-Wilcox) (ac-ft/yr)*	0	0	0	0	20	34

**Region C strategy. For additional strategy information, see Region C plan.*

Chandler. The City of Chandler is supplied entirely by groundwater from the Carrizo-Wilcox aquifer. Beginning in the 2070 decade, the City is projected to have an unmet need of approximately 118 ac-ft/yr. In order to meet this need, one recommended strategy for the City of Chandler is to develop additional wells in the Carrizo-Wilcox aquifer. In addition, municipal conservation is also a recommended strategy for the City of Chandler. Municipal conservation is discussed further in Chapter 5C.

Chandler	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	0	118
Recommended Strategy: Conservation (ac-ft/yr)	9	17	21	26	32	36
Recommended Strategy HEND-CHN: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	0	0	0	101

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	36	$0	$11,000	$362	$1.11
Recommended Strategy HEND-CHN: New Wells (Carrizo-Wilcox)	101	$1,397,000	$113,000	$1,119	$3.43

Moore Station WSC. Moore Station WSC is shown to have an unmet need of 38 ac-ft/yr in the 2060 decade, which then grows to 111 ac-ft/yr by the 2070 decade. Similar to other WUGs in the county, Moore Station WSC receives its supply from groundwater in the Carrizo-Wilcox aquifer. Therefore, a recommended strategy for this WUG is to develop additional wells in the Carrizo-Wilcox aquifer to meet future unmet needs.

Moore Station WSC	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	38	111
Recommended Strategy HEND-MSW: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	0	0	38	111

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy HEND-MSW: New Wells (Carrizo-Wilcox)	111	$1,417,000	$116,000	$1,045	$3.21

Mining. Mining users in Henderson County primarily use groundwater from the Carrizo-Wilcox aquifer or other undifferentiated aquifers for their supply. Due to larger mining demands in the earlier decades, there are needs for mining in Henderson County ranging from 10 to 21 ac-ft/yr from 2020 through 2040. A recommended strategy to meet these needs is to develop additional wells in the Carrizo-Wilcox aquifer. Since the unmet needs are relatively small, mining users might consider increasing the pumping rates from their current wells to meet their demands, rather than develop additional wells.

Henderson Mining	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	10	21	10	0	0	0
Recommended Strategy HEND-MIN: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	19	10	0	0	0
Recommended Strategy: Integrated Pipeline* (ac-ft/yr)	0	2	0	0	0	0

*Region C strategy. For additional strategy information, see Region C plan.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy HEND-MIN: New Wells (Carrizo-Wilcox)	19	$201,000	$15,000	$789	$2.42

Edom WSC. The water management strategy for Edom WSC was developed by Region D. ETRWPA supports and approves the strategy developed to meet the shortages in both regions. Edom WSC provides water service in Van Zandt and Henderson Counties. The WUG population is projected to be 1,395 by 2020 and increases to 2,025 by 2070. Edom WSC supplies its customers with groundwater from the Carrizo-Wilcox aquifer with water wells in Van Zandt County. Edom WSC is projected to have a total deficit of 13 ac-ft/yr in 2020 and increasing to a deficit of 64 ac-ft/yr by 2070; the shortage projected to occur in Van Zandt County is 11 ac-ft/yr in 2020 increasing to 55 ac-ft/yr by 2070. The shortage in Henderson County is 2 ac-ft/yr in 2020, increasing to 9 ac-ft/yr in 2070.

Edom WSC	2020	2030	2040	2050	2060	2070
Population	1,395	1,526	1,631	1,740	1,878	2,025
Projected Water Demand	152	160	166	176	188	203
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	139	139	139	139	139	139
Projected Supply Surplus (+) / Deficit (-)	-13	-21	-27	-37	-49	-64

Projected Supply Surplus (+) / Deficit (-) by County	2020	2030	2040	2050	2060	2070
Van Zandt (ac-ft/yr)*	-11	-18	-23	-32	-42	-55
Henderson (ac-ft/yr)	-2	-3	-4	-5	-7	-9
Total (ac-ft/yr)	**-13**	**-21**	**-27**	**-37**	**-49**	**-64**

*Region C

Evaluation of Potentially Feasible Water Management Strategies:

Four alternative strategies were considered to meet the WSC's water supply shortages as summarized in the following table. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Water reuse was not considered because the WSC does not have a demand for non-potable water. Surface water was not considered because the

WSC does not currently have surface water treatment. Groundwater has been identified as a potential strategy for Edom WSC. The recommended strategy for Edom WSC to meet their projected deficit of 2 ac-ft/yr in 2020 up to 9 ac-ft/yr in 2070 would be to construct three additional water wells similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo-Wilcox Aquifer in the Neches Basin in Van Zandt County. One well with rated capacity of 50 gpm each, pumping at an approximately depth of 560 ft., would provide approximately 27 acre-feet each.

Edom WSC	2020	2030	2040	2050	2060	2070
Recommended Strategy HSDN-EDOM: New Wells (Carrizo-Wilcox) (ac-ft/yr)	2	3	4	5	7	9

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy HSDN-EDOM: New Wells (Carrizo-Wilcox)	9	$1,088,000	$136,000	$2,125	$6.52

Conservation strategy was proposed as a proactive water management strategy for the following WUG even though there were no needs identified.

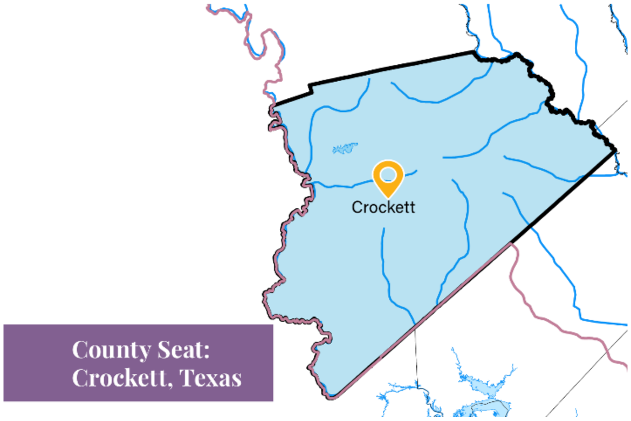
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Brownsboro	3	0	0	0	0	0

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Brownsboro	3	$0	$2,000	$667	$2.05

County Summary. Below is a summary of WUGs in the ETRWPA in Henderson County, current water supply sources, and recommended WMSs (if any).

Water User Group Henderson County	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Athens	Carrizo-Wilcox, Lake Athens	40	Conservation, Athens MWA strategies (discussed under Athens MWA MWP section)
Berryville	Carrizo-Wilcox	0	None
Bethel Ash WSC	Carrizo-Wilcox	0	None
Brownsboro	Carrizo-Wilcox	0	Conservation
Brushy Creek WSC	Carrizo-Wilcox	0	None
Chandler	Carrizo-Wilcox	118	New Wells (Carrizo-Wilcox), Municipal Conservation
County Other	Carrizo-Wilcox, Other Undifferentiated Aquifer	0	None
Edom WSC	Carrizo-Wilcox	9	New Wells (Carrizo Wilcox)
Frankston	Carrizo-Wilcox	0	None
Moore Station WSC	Carrizo-Wilcox	111	New Wells (Carrizo-Wilcox)
Murchison	Carrizo-Wilcox	0	None
Leagueville WSC	Carrizo-Wilcox	0	None
R P M WSC	Carrizo-Wilcox	48	See Smith County for WUG discussion
Virginia Hill WSC	Carrizo-Wilcox	0	None
Manufacturing	Carrizo-Wilcox	0	None
Mining	Carrizo-Wilcox, Other Undifferentiated Aquifer	21	New Wells (Carrizo-Wilcox)
Livestock	Carrizo-Wilcox, Local Supply, Lake Athens	0	None
Irrigation	Carrizo-Wilcox, Lake Athens, Lake Palestine, Run-of-River	50	Athens MWA strategies (discussed under Athens MWA MWP section)
Steam Electric Power	None	0	None

5B.2.6 Houston County



Water supplies in Houston County include surface water from Houston County Lake (through Houston County WCID #1), run-of-river supplies for irrigation, and groundwater from the Carrizo-Wilcox, Yegua-Jackson, Sparta, Queen City and Other-Undifferentiated aquifers. There are projected water shortages in Houston County for irrigation use. The Carrizo-Wilcox and Yegua-Jackson aquifers have adequate capacity for expanded development in this county.

Livestock. The demand for Livestock is met from local supply, groundwater supplies from Carrizo Wilcox aquifer, Sparta aquifer, Queen City aquifer, and Other-Undifferentiated aquifer. The shortages are met by developing a groundwater supply strategy in the Yegua-Jackson aquifer.

Houston Livestock	2020	2030	2040	2050	2060	2070
Need (ac-ft/ yr)	0	0	0	0	0	201
Recommended Strategy HOUS-LTK: New Wells (Yegua-Jackson) (ac-ft/yr)	0	0	0	0	0	201

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy HOUS-LTK: New Wells (Yegua-Jackson)	201	$399,000	$39,000	$194	$0.60

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

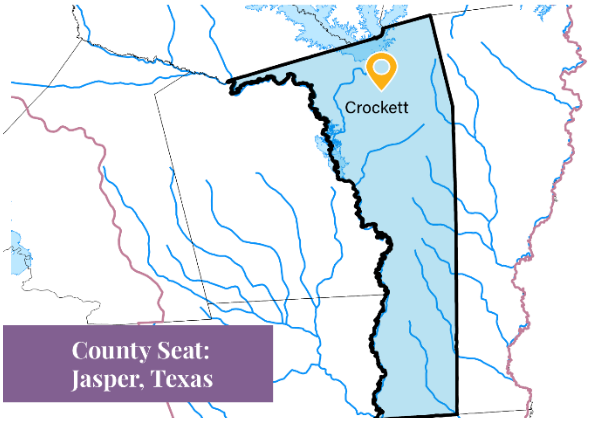
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Crockett	19	29	30	32	34	36
Lovelady	2	3	3	3	4	4
TDCJ Eastham Unit	15	25	27	29	30	32
County-Other	2	3	3	4	4	4

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Crockett	36	$0	$11,000	$367	$1.13
Lovelady	4	$0	$1,000	$316	$0.97
TDCJ Eastham Unit	32	$0	$4,000	$152	$0.47
County-Other	4	$0	$1,000	$300	$0.92

County Summary. Below is a summary of WUGs in Houston County, current sources of supply, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
County Other	All Aquifers	0	Conservation
Crockett	Carrizo-Wilcox, Houston County Lake	0	Conservation
Grapeland	Carrizo-Wilcox, Houston County Lake	0	None
Lovelady	Yegua-Jackson, Houston County Lake	0	Conservation
Pennington WSC	Yegua-Jackson	0	None
TDCJ Eastham Unit	Sparta	0	Conservation
The Consolidated WSC	Carrizo-Wilcox, Houston County Lake	0	None
Manufacturing	Carrizo-Wilcox, Houston County Lake	0	None
Mining	Other Undifferentiated	0	None
Irrigation	All Aquifers, Run-of-River	0	None
Livestock	All Aquifers, Local Supply	201	New Wells (Yegua-Jackson)
Steam Electric Power	None	0	None

5B.2.7 Jasper County



WUGs in Jasper County utilize surface water from local supplies, Sam Rayburn Reservoir, or the Neches River. Water demands are also met with groundwater from the Gulf Coast aquifer. The Gulf Coast aquifer has adequate capacity for expanded development in this county. The only WUG with a projected need in Jasper County during the planning period is livestock.

Livestock. Due to large projected demands and limited development of groundwater supplies in Jasper County, livestock is shown to have a shortage of nearly 9,000 ac-ft per year for each decade. Current supplies for livestock users in Jasper County include groundwater from the Gulf Coast aquifer and other local supplies. It is recommended that any large-scale user should obtain surface water from the Sam Rayburn Reservoir through a contract with LNVA.

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Jasper Livestock	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	8,932	8,932	8,932	8,932	8,932	8,932
Recommended Strategy JASP-LTK: Purchase from LNVA (Sam Rayburn) (ac-ft/yr)	8,932	8,932	8,932	8,932	8,932	8,932

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy JASP-LTK: Purchase from LNVA (Sam Rayburn)	8,932	$0	$2,911,000	$326	$1.00

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

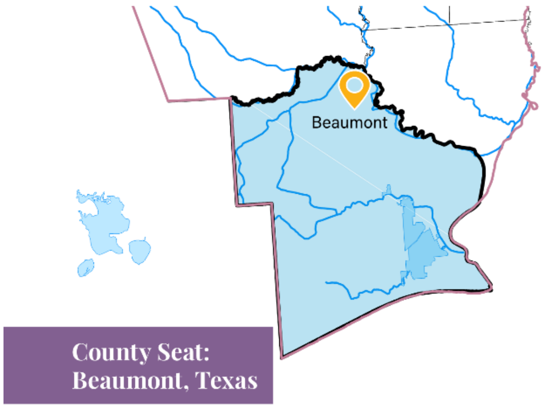
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Jasper	75	124	141	158	178	196
Kirbyville	6	9	10	11	11	12

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Jasper	196	$15,444,000	$532,000	$3,008	$9.23
Kirbyville	12	$0.00	$3,000	$305	$0.94

County Summary. Below is a summary of WUGs in Jasper County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Brookeland FWSD	Gulf Coast	0	None
County Other	Gulf Coast, Houston County Lake	0	None
Jasper	Gulf Coast	0	Conservation
Jasper County WCID 1	Gulf Coast	0	None
Kirbyville	Gulf Coast	0	Conservation
Mauriceville SUD	Gulf Coast	0	None
Rayburn Country MUD	Gulf Coast	0	None
Rural WSC	Gulf Coast	0	None
South Jasper County WSC	Gulf Coast	0	None
Upper Jasper County Water Authority	Gulf Coast	0	None
Irrigation	Local Supply	0	None
Livestock	Gulf Coast, Local Supply	8,932	Purchase from LNVA (Sam Rayburn)
Manufacturing	Gulf Coast, Run-of-River, Sam Rayburn	0	None
Mining	Gulf Coast Aquifer	0	None
Steam Electric Power	None	0	None

5B.2.8 Jefferson County



Water supply is Jefferson County is largely provided by LNVA with surface water from the Sam Rayburn/BA Steinhagen system and the Neches River. The exception to this is Beaumont, which has a supply from their own water rights on the Neches River in Jefferson County and Hardin County groundwater wells in the Gulf Coast aquifer. There are four WUGs with a projected need during the planning period. Beaumont should be able to meet its shortages with conservation, and LNVA has adequate supply to provide water to the remaining three WUGs.

Beaumont. The current supply sources for the City of Beaumont are the Neches River, Gulf Coast Aquifer, and Sam Rayburn/BA Steinhagen system (LNVA). Beaumont's supply is limited by their water treatment plant capacity of 64 MGD, and the City is projected to have a water shortage beginning in 2040. The City had an average per capita consumption of 219 gpcd in 2011. This value is well over the statewide goal of 140 gpcd. The City has begun a meter replacement program, which may help reduce the per capita use rate somewhat. In addition, after performing a conservation cost analysis, the ETRWPG believes a water conservation strategy for the City is economically achievable and is therefore recommended. This strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce Beaumont's demand; therefore, municipal conservation is one recommended WMS for the City. Municipal conservation is further discussed in Chapter 5C.

After municipal conservation, the City of Beaumont is still shown to have a need in the 2060 and 2070 decades. Consequently, a recommended strategy is to add an amendment to their supplemental contract with LNVA to obtain additional supplies to meet the rest of their needs. This strategy is further discussed in Section 5B.3.4.

Beaumont	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	1,248	3,843	6,357	9,218
Recommended Strategy: Conservation (ac-ft/yr)	2,027	3,425	4,202	5,112	6,171	7,382
Recommended Strategy JEFF-BEA: Amendment to Supplemental Contract with LNVA (ac-ft/yr)	0	0	0	0	228	2,249

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	7,382	$60,175,000	$2,076,000	$371	$1.14
Recommended Strategy JEFF-BEA: Amendment to Supplemental Contract with LNVA	2,249	$0	$2,199,000	$977	$3.00

County-Other. Current supply is the Gulf Coast aquifer, Neches River (Beaumont), and Sam Rayburn/BA Steinhagen system (LNVA and Port Arthur) for Jefferson County-Other. Approximately 80 percent of County-Other demand is met by the City of Beaumont. In addition, LNVA has the water available to meet the County-Other water shortage and has expressed interest in providing more water Jefferson County-Other. Purchasing water from Sam Rayburn Reservoir (LNVA) is the only recommended WMS for County-Other.

County Other	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	855	1,950
Recommended Strategy: Conservation (ac-ft/yr)	34	0	0	0	0	0
Recommended Strategy JEFF-CTR: Purchase from LNVA (Sam Rayburn) (ac-ft/yr)	0	0	0	0	855	1,950

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	34	$0	$20,000	$588	$1.80
Recommended Strategy JEFF-CTR: Purchase from LNVA (Sam Rayburn)	1,950	$21,665,000	$2,402,000	$1,232	$3.78

Manufacturing. Current supply for manufacturing users in Jefferson County includes the Gulf Coast aquifer, Neches River (Beaumont and LNVA), Sabine River (SRA), and Sam Rayburn/BA Steinhagen system (Beaumont, LNVA, and Port Arthur). Manufacturing in Jefferson County is projected to have a water supply shortage beginning in 2020 that spans throughout the planning horizon. Much of the Manufacturing demand is currently met by LNVA. In addition, LNVA has the water available to meet the water shortage and has expressed interest in providing more water for Jefferson County Manufacturing. Therefore, purchasing water from Sam Rayburn/BA Steinhagen system (LNVA) is the only recommended WMS for manufacturing.

Jefferson Manufacturing	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	101,138	143,513	143,497	143,479	143,462	143,446
Recommended Strategy JEFF-MFG: Purchase from LNVA (Sam Rayburn) (ac-ft/yr)	0	143,513	143,497	143,479	143,462	143,446

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy JEFF-MFG: Purchase from LNVA (Sam Rayburn)	143,513	$279,210,000	$69,673,000	$485	$1.49

Steam Electric Power. This WUG is a proposed facility and does not currently have a supply. The projected demands are based on several proposed facilities in Jefferson County that have been delayed or cancelled since the development of water projections. It is anticipated that as the need for electric power increases, these facilities will be constructed. The proposed strategy to meet this need is to purchase water from LNVA. Sam Rayburn Reservoir (LNVA) has sufficient supplies to meet the projected steam electric power needs. The actual source of water will be negotiated once the facilities are constructed.

Jefferson Steam Electric Power	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	2,391	2,391	2,391	2,391	2,391	2,391
Recommended Strategy JEFF-SEP: Purchase from LNVA (Sam Rayburn) (ac-ft/yr)	0	2,391	2,391	2,391	2,391	2,391

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy JEFF-SEP: Purchase from LNVA (Sam Rayburn Reservoir)	2,391	$32,302,000	$3,464,000	$1,449	$4.45

There are no shortages for Port Arthur; however, a conservation strategy was proposed as a proactive water management strategy.

Conservation Strategy	2020	2030	2040	2050	2060	2070
Port Arthur (ac-ft/yr)	2,708	4,449	5,222	6,029	6,844	7,664

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Port Arthur	7,664	$51,618,000	$1,981,000	$295	$0.91

County Summary. Below is a summary of WUGs in Jefferson County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Beaumont	Gulf Coast, Run-of-River, Sam Rayburn	9,218	Conservation, Amendment to Supplemental Contract with LNVA
Bevil Oaks	Gulf Coast	0	None
China	Gulf Coast	0	None
County Other	Gulf Coast, Run-of-River, Sam Rayburn	1,950	Conservation, Purchase from LNVA (Sam Rayburn)
Groves	Sam Rayburn	0	None
Jefferson County WCID 10	Carrizo-Wilcox, Houston County Lake	0	None
Meeker MWD	Run-of-River, Gulf Coast	0	None
Nederland	Sam Rayburn	0	None
Port Arthur	Sam Rayburn	0	Conservation
Port Neches	Sam Rayburn	0	None
West Jefferson County MWD	Sam Rayburn, Run-of-River	0	None
Irrigation	Gulf Coast, Run-of-River, Sam Rayburn	0	None
Livestock	Gulf Coast, Local Supply	0	None
Manufacturing	Sam Rayburn, Gulf Coast, Run-of-River, Toledo Bend	143,513	Purchase from LNVA (Sam Rayburn)
Mining	Gulf Coast, Local Supply, Run-of-River	0	None
Steam Electric Power	None	2,391	Purchase from LNVA (Sam Rayburn)

5B.2.9 Nacogdoches County

Surface water, groundwater and local livestock supplies provide water to users in Nacogdoches County. Lake Nacogdoches and Striker Lake provide the majority of surface water, while groundwater is the primary source for rural water supplies. Lake Naconiche has recently been completed. This lake was built by NRCS for flood storage and recreation, but there are plans to develop water supply from the lake for rural communities. A 1992 study evaluated a potential regional water system using water from Lake Naconiche. This regional system is a recommended strategy to provide water to Nacogdoches County-Other users and several rural WSCs. A brief description of the proposed strategy is presented below.

County Other – Lake Naconiche Regional Water Supply System. Lake Naconiche is located in northeast Nacogdoches County on Naconiche Creek. It is permitted to store 9,072 ac-ft of water. To use water from Lake Naconiche for water supply, the County must seek a permit amendment to allow diversions for municipal use. It is assumed that the regional water system would serve Appleby WSC, Lily Grove WSC, Swift WSC, and County-Other entities in Nacogdoches County (including Caro WSC, Lilbert-Looneyville WSC, Libby WSC, and others). Nacogdoches County is the current sponsor of this water management strategy.

The project is initially sized for 3.0 MGD. This includes a lake intake, new water treatment plant located near Lake Naconiche, pump station and a distribution system of pipelines in the northeast part of the county. Costs are summarized below. The costs for each participant are based on the unit cost of water for the strategy and capital costs are proportioned by strategy amounts. Actual costs would be negotiated as the project is developed.

County Other	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	0	0
Recommended Strategy NACN-LK: Lake Naconiche Regional Water System (ac-ft/yr)	0	1,700	1,700	1,700	1,700	1,700

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy NACN-LK: Lake Naconiche Regional Water System	1,700	$42,117,000	$5,363,000	$3,155	$9.68

D & M WSC. D & M WSC currently relies on groundwater from the Carrizo-Wilcox aquifer. The recommended strategy is to expand development of supplies from Carrizo-Wilcox. Municipal conservation was considered for this WUG but not recommended as D & M WSC's average per capita consumption of is below the statewide goal of 140 gpcd.

D & M WSC	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	32	135	251	374
Recommended Strategy NACW-DMW: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	32	135	251	374

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy NACW-DMW: New Wells (Carrizo-Wilcox)	374	$4,567,000	$373,000	$997	$3.06

Livestock. Local supply provides over half of current livestock needs for Nacogdoches County, with the remainder supplied from groundwater sources. Local supplies may not be adequate to cover the projected shortages and further expansion of groundwater from Carrizo Wilcox aquifer is proposed as the recommended strategy.

Nacogdoches Livestock	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	5,970	6,399	6,896	7,472	8,131	9,113
Recommended Strategy NACW-LTK: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	6,399	6,896	7,472	8,131	9,113

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy NACW-LTK: New Wells (Carrizo-Wilcox)	9,113	$26,677,000	$2,695,000	$296	$0.91

Mining. Current mining water needs in Nacogdoches County are met through local surface water supplies. As a result of increased interest in natural gas exploration in East Texas, there are projected water shortages for mining in Nacogdoches County. Nacogdoches has recently negotiated a contract with Angelina & Neches River Authority to provide water for the County's mining needs. The recommended water management strategy to meet these needs is run-of-the-river diversions from the Angelina River. It is assumed that Angelina & Neches River Authority would be the sponsor for this strategy.

Nacogdoches Mining	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	5,475	2,975	118	0	0	0
Recommended Strategy NACW-MIN: Purchase water from ANRA (Mud Creek) (ac-ft/yr)	0	2,975	118	0	0	0

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
NACW-MIN: Purchase water from ANRA (Mud Creek)	2,975	$14,557,000	$4,159,000	$1,398	$4.29

Cushing. Currently the demands for Cushing are met from groundwater supplies in the Carrizo Wilcox aquifer in Nacogdoches county. There are shortages in decades 2060 and 2070 and these shortages are met by means of implementation of conservation measures.

Cushing	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	8	30
Recommended Strategy: Conservation (ac-ft/yr)	10	19	24	30	37	45

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	45	$1,030,000	$42,000	$1,083	$3.32

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

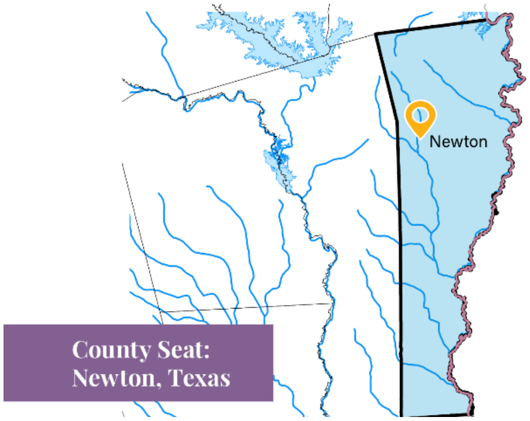
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Appleby WSC	9	17	20	23	27	32
Garrison	4	6	8	9	10	12
Nacogdoches	247	426	532	656	802	966

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Appleby WSC	32	$0.00	$9,000	$336	$1.03
Garrison	12	$0.00	$3,000	$286	$0.88
Nacogdoches	966	$27,720,000	$986,000	$1,349	$4.14

County Summary. Below is a summary of WUGs in Nacogdoches County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Appleby WSC	Carrizo-Wilcox, Lake Nacogdoches	0	Conservation
Caro WSC	Carrizo-Wilcox	0	None
County Other	All aquifers, Lake Nacogdoches	0	Lake Naconiche Regional Water System
Cushing	Carrizo-Wilcox	30	Conservation
D & M WSC	Carrizo-Wilcox, Lake Nacogdoches	374	Additional GW Wells in Carrizo Wilcox aquifer
Etoile WSC	Carrizo-Wilcox	0	None
Garrison	Carrizo-Wilcox	0	Conservation
Lily Grove SUD	Carrizo-Wilcox	0	None
Melrose WSC	Carrizo-Wilcox	0	None
Nacogdoches	Carrizo-Wilcox, Lake Nacogdoches	0	Lake Columbia Transmission System (Discussion Included in the MWP Summary for Nacogdoches), Conservation
Swift WSC	Carrizo-Wilcox	0	None
Woden WSC	Carrizo-Wilcox	0	None
Irrigation	Carrizo-Wilcox, Run-of-River	0	None
Manufacturing	Carrizo-Wilcox, Lake Nacogdoches	0	None
Livestock	All aquifers, Local Supply	9,113	New Wells (Carrizo-Wilcox)
Mining	Other Undifferentiated, Local Supply	5,475	Purchase from ANRA (Mud Creek)
Steam Electric Power	Lake Striker	0	None

5B.2.10 Newton County



Most of the WUGs in Newton County use groundwater from the Gulf Coast aquifer. According to the Groundwater Availability Model estimates for 2020, there are approximately 34,000 ac-ft/yr of groundwater available from the Gulf Coast aquifer in Newton County. As a part of this round of planning, approximately 3,000 ac-ft/yr has been allocated to WUGs in Newton County. There is also a significant amount of surface water available from the SRA system. Some of this water is contracted for steam electric power. Based on the available groundwater and proximity of surface water to users in Newton County, there is substantial water available for development to meet projected demands for mining and steam electric power. The only unmet need in Newton County is for mining.

Mining. Current supplies are from local surface water supplies and the Gulf Coast aquifer. The mining demand in Newton County is very low compared to the other demands in this county, but mining is projected to have a water shortage for 2020 and 2030. The recommended strategy to meet this demand is to purchase surface water from SRA. SRA currently provides water for existing mining demands in Newton County.

Newton Mining	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	115	59	0	0	0	0
Recommended Strategy NEWT-MIN: Purchase from SRA (Toledo Bend) (ac-ft/yr)	115	59	0	0	0	0

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy NEWT-MIN: Purchase from SRA (Toledo Bend)	115	$0	$111,000	$965	$2.96

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

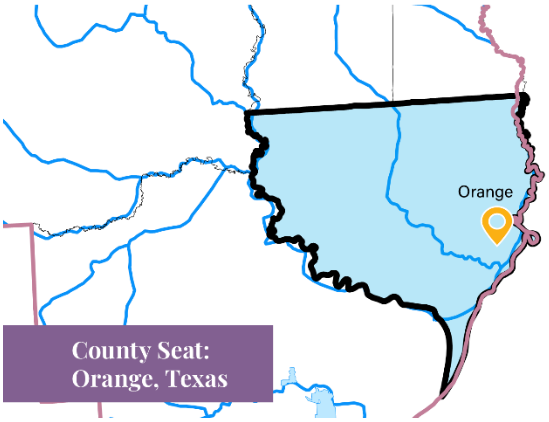
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Newton	6	10	10	11	12	12

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Newton	12	$0.00	$4,000	$393	$1.21

County Summary. Below is a summary of WUGs in Newton County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Brookeland FWSD	Gulf Coast	0	None
County Other	Gulf Coast	0	None
Mauriceville SUD	Gulf Coast	0	None
Newton	Gulf Coast	0	Conservation
South Newton WSC	Gulf Coast	0	None
Irrigation	Gulf Coast, Local Supply-Run-of-River	0	None
Manufacturing	Gulf Coast, Run-of-River	0	None
Livestock	Gulf Coast, Local Supplies	0	None
Mining	Gulf Coast, Run-of-River	115	Purchase from SRA (Toledo Bend)
Steam Electric Power	SRA Canal System	0	None

5B.2.11 Orange County



The majority of the water used in Orange County comes from the Gulf Coast Aquifer and the Sabine River, with a very small portion coming from the Neches River. The total long-term sustainable groundwater availability from the Gulf Coast Aquifer in Orange County is estimated at nearly 20,000 ac-ft/yr. Current groundwater use in Orange County is around 12,500 ac-ft/yr. It is recommended that any new large-scale water needs be met with surface water. Otherwise, it is recommended that entities currently using groundwater be allowed to remain on groundwater to meet their future growth, until such a time that a salt-water intrusion or subsidence problem is encountered.

There is a significant amount of surface water available in the Sabine River in Orange County. The SRA canal system, which is located in Orange County, has a conveyance capacity of 346,000 ac-ft/yr. SRA has water rights of 147,100 ac-ft/yr associated with the canal system (100,400 ac-ft/yr for municipal and industrial use and 46,700 ac-ft/yr for irrigation). There is a significant amount of supplies in the canal system for future demands. SRA also has a large amount of uncontracted water in Toledo Bend Reservoir that could potentially be released through the dam and carried by the Sabine River for downstream use from the canal.

Irrigation. This WUG has a shortage starting 2020, however this project will not be online prior to January 2023, so it has an online decade of 2030. The current supply comes from SRA's run-of-river canal system supplies. It is recommended that the irrigation users contract with SRA for additional supplies.

Orange Irrigation	2010	2020	2030	2040	2050	2060
Need (ac-ft/yr)	526	526	526	526	526	526
Recommended Strategy ORAN-IRR: Purchase from SRA (Sabine River) (ac-ft/yr)	0	526	526	526	526	526

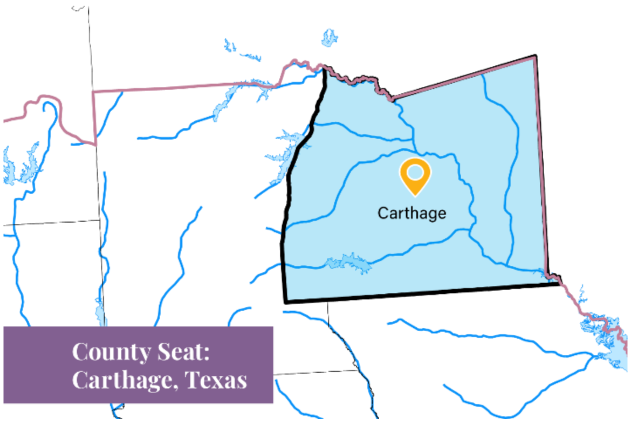
Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy ORAN-IRR: Purchase from SRA (Sabine River)	526	$14,624,000	$1,355,000	$2,576	$7.91

County Summary. Below is a summary of WUGs in Orange County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Bridge City	Gulf Coast	0	None
County Other	Gulf Coast	0	None
Kelly G Brewer	Gulf Coast	0	None
Mauriceville SUD	Gulf Coast	0	None
Orange	Gulf Coast	0	None
Orange County WCID 1	Gulf Coast	0	None
Orange County WCID 2	Gulf Coast	0	None
Orangefield WSC	Gulf Coast	0	None
Pinehurst	Gulf Coast	0	None
Port Arthur	Gulf Coast	0	None
South Newton WSC	Gulf Coast	0	None
Irrigation	Run-of-River, SRA Canal	526	Purchase from SRA (Run of River, Sabine)
Livestock	Local Supply, Gulf Coast	0	None
Manufacturing	Run-of-River, Gulf Coast	0	None
Mining	Local Supply, Gulf Coast	0	None
Steam Electric Power	SRA Canal, Gulf Coast	0	None

5B.2.12 Panola County



Panola County has only one entity with projected water shortages (livestock). Generally, demands in Panola County are expected to increase slightly and can be met through existing supplies. Both groundwater from the Carrizo-Wilcox aquifer and surface water supplies, mostly from Lake Murvaul, are used in Panola County. The Carrizo-Wilcox aquifer has a long-term availability of approximately 8,400 ac-ft/yr in Panola County. Based on historical use information and well capacities from entities in the county, the groundwater supply is fully developed. Because the long-term sustainable availability of the aquifer has been reached, it is recommended that any new (not currently identified) large-scale water needs be met with surface water. It is recommended that those entities currently on groundwater remain on groundwater to meet their future growth until such time as groundwater is no longer a reliable supply. Any entities that are willing to convert to surface water should be encouraged to do so.

Livestock. Livestock users in Panola County are shown to have a shortage of nearly 1,000 ac-ft throughout the planning horizon. Current supplies for livestock users in Jasper County include groundwater from the Carrizo-Wilcox aquifer and other local supplies. After allocations of groundwater supplies in Panola County, there is still around 3,400 ac-ft/yr of MAG. Therefore, the recommended strategy for livestock users to meet their needs is to develop additional groundwater in the Carrizo-Wilcox aquifer. Though a need is shown in the 2020 decade, this project will not be implemented prior to January 2023, due to time constraints. The strategy will come online in the 2030 decade.

Panola Livestock	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	982	982	982	982	982	982
Recommended Strategy PANL-LTK: New Wells (Carrizo-Wilcox) (ac-ft/yr):	0	982	982	982	982	982

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy PANL-LTK: New Wells (Carrizo-Wilcox)	982	$1,172,000	$122,000	$124	$0.38

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Carthage	23	39	41	44	47	50
Panola-Bethany WSC	0	0	0	0	1	2

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Carthage	50	$0.00	$11,000	$266	$0.82
Panola-Bethany WSC	2	$0.00	$0	$0.00	$0.00

County Summary. Below is a summary of WUGs in Panola County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Beckville	Carrizo-Wilcox	0	None
Carthage	Carrizo-Wilcox, Lake Murvaul	0	Conservation
County Other	Carrizo-Wilcox, Lake Murvaul	0	None
Gill WSC	Carrizo-Wilcox, Marshall	0	None
Minden Brachfield WSC	Carrizo-Wilcox	0	None
Panola-Bethany WSC	Carrizo-Wilcox	0	Conservation
Tatum	Carrizo-Wilcox	0	None
Irrigation	Carrizo-Wilcox, Run-of-River	0	None
Livestock	Local Supply, Carrizo-Wilcox	982	New Wells (Carrizo-Wilcox)
Manufacturing	Run-of-River, Lake Murvaul, Carrizo-Wilcox	0	None
Mining	Run-of-River, Lake Murvaul, Carrizo-Wilcox, Toledo Bend	0	None
Steam Electric Power	None	0	None

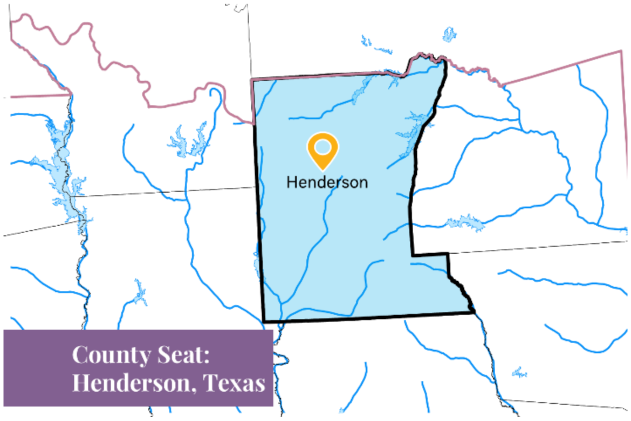
5B.2.13 Polk County

Polk County is partially located in the ETRWPA and partially in Region H. Every WUG in the county uses water from groundwater supplies. The groundwater supplies are from the Gulf Coast, Yegua-Jackson, and Other-Undifferentiated aquifers. Local surface water supplies are also used to meet demands in Polk County. There is no projected need for any WUG located within Polk County during the planning period. Based on the groundwater availability estimates included in this plan, the Gulf Coast aquifer is sufficient to provide water to future demands that are expected to develop in Polk County.

County Summary. Below is a summary of WUGs in Polk County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Chester WSC	Gulf Coast	0	None
Corrigan	Other Undifferentiated	0	None
County Other	All Aquifers	0	None
Damascus-Stryker WSC	Yegua-Jackson	0	None
Lake Livingston WSC	Other Undifferentiated	0	None
Moscow WSC	Gulf Coast	0	None
Soda WSC	Gulf Coast	0	None
Irrigation	Gulf Coast, Local Supply	0	None
Livestock	All Aquifers, Local Supply	0	None
Manufacturing	Gulf Coast, Other Undifferentiated	0	None
Mining	Local Supply, Gulf Coast, Other Undifferentiated	0	None
Steam Electric Power	None	0	None

5B.2.14 Rusk County



Surface water and groundwater are used for water supply in Rusk County. The water sources used by most WUGs in Ruck County include the Neches and Sabine Rivers, the Carrizo-Wilcox, Queen City, and Other-Undifferentiated aquifers, and local supplies. Otherwise, the City of Henderson receives water from Lake Fork (SRA), while steam electric power users have a permit in Martin Lake and receive water from the Toledo Bend Reservoir (SRA). During the duration of the planning horizon, there are projected water shortages for multiple WUGs in Rusk County, including Jacobs WSC, Wright City WSC, livestock, mining, and steam electric power; however, there are sufficient supplies available to meet these identified needs.

Rusk County Refinery is a potential manufacturing water user that has approached Angelina & Neches River Authority for a water supply contract. The contract amount for this entity is approximately 5,600 ac-ft/yr. It should be noted that the overall projections for manufacturing demand in Rusk County are at a maximum amount of 34 ac-ft/yr. It is believed that the Rusk County Refinery demands were not accounted for the regional water planning demand projections. WMSs for Rusk County Refinery are not discussed in this section because the demand is not included in the regional water planning demand projections. However, Angelina & Neches River Authority is identified as the seller to this entity and a WMS is discussed in the WMS discussion for major water providers.

Jacobs WSC. All water supplies in Jacobs WSC are from groundwater in the Carrizo-Wilcox aquifer. Beginning in 2070, there is a need of 22 ac-ft shown due to slightly increasing demands over the planning horizon. The recommended strategy for Jacobs WSC to meet their need is to develop additional groundwater in the Carrizo-Wilcox aquifer. Since the need is relatively minimal (less than 10 percent of demand), rather than drilling new wells, this WUG could also consider increasing the pumping rate of their current well system to meet their future demands if there are no infrastructure limitations

Jacobs WSC	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	0	22
Recommended Strategy RUSK-JAW: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	0	0	0	22

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy RUSK-JAW: New Wells (Carrizo-Wilcox)	22	$1,795,000	$140,000	$6,364	$19.53

Overton. The strategy to meet the shortages for Overton in Rusk County are discussed in the Smith County strategy summary section.

Wright City WSC. Wright City WSC is split across three counties in Region I (Cherokee, Rusk, Smith). All current supplies for this WUG are from wells in the Carrizo-Wilcox aquifer, most of which are located in

Smith County. All of Wright City WSC's demands in Smith County are met by their groundwater supplies, however, needs are shown in Cherokee and Rusk Counties. The recommended strategy for Wright City to meet these needs is to develop additional groundwater in the Carrizo-Wilcox aquifer. The strategy is discussed in the Cherokee County strategy summary section.

Wright City WSC	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	0	21
Recommended Strategy RUSK-WRC: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	0	0	0	22

Livestock. Current supplies for livestock users in Rusk County include groundwater from the Carrizo-Wilcox and Queen City aquifers, as well as other local supplies. There is an unmet need for livestock of 20 ac-ft beginning in 2040 that increases to 83 ac-ft by 2070. The recommended strategy for livestock users to meet this need is to develop additional groundwater in the Carrizo-Wilcox aquifer.

Rusk Livestock	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	20	51	83	83
Recommended Strategy RUSK-LTK: New Wells (Carrizo-Wilcox) (ac-ft/yr):	0	0	20	51	83	83

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy RUSK-LTK: New Wells (Carrizo-Wilcox)	83	$283,000	$24,000	$289	$0.89

Mining. Rusk County Mining is supplied by groundwater from the Carrizo-Wilcox and Other-Undifferentiated aquifers and surface water from local supplies. Several private industries have undergone negotiations with Angelina & Neches River Authority and are currently under contract to purchase water from Angelina & Neches River Authority to meet their projected demands. Therefore, the recommended strategy for meeting the mining needs for Rusk County 2020 is to purchase raw water from Angelina & Neches River Authority.

Rusk Mining	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	305	168	22	0	0
Recommended Strategy RUSK-MIN: Purchase from ANRA (Mud Creek) (ac-ft/yr)	0	305	168	22	0	0

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers. It is assumed that the mining customers will construct a raw water transmission system to transfer supplies from the Run-of-River diversion location. Cost estimates include capital cost for a pipeline, pump stations, and storage tanks.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy RUSK-MIN: Purchase from ANRA (Mud Creek)	305	$14,808,000	$1,291,000	$4,233	$12.99

Steam Electric Power. The current supply for steam electric power users in Rusk County are the Carrizo-Wilcox aquifer, Martin Lake, and Toledo Bend Reservoir (SRA). The demands for steam electric power are based on projected demands for two existing power plants that have existing supplies: Luminant's Martin Lake plant and the Tenaska Gateway facilities. Martin Lake has a firm yield of 25,000 ac-ft/yr. The Tenaska Gateway facility uses water from Toledo Bend Reservoir and has a contract for 17,922 ac-ft/yr. Based on the projected demands for steam electric power in Rusk County, there is a projected shortage of approximately 1,100 ac-ft throughout the planning horizon. For planning purposes, it is assumed that this demand will be at the Tenaska facility and can be met through additional supplies from SRA with little to no infrastructure improvements. Because SRA has water supplies available to meet the projected water shortage from this WUG, it is recommended that a contract be implemented to secure water from Toledo Bend Reservoir (SRA). Since this project will not be completed prior to January 2023, due to time constraints, it will be pushed to come online in the 2030 decade to comply with TWDB planning requirements.

Rusk Steam Electric Power	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	1,103	1,103	1,103	1,103	1,103	1,103
Recommended Strategy RUSK-SEP: Purchase from SRA (Toledo Bend) (ac-ft/yr)	0	1,103	1,103	1,103	1,103	1,103

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy RUSK-SEP: Purchase from SRA (Toledo Bend Reservoir)	1,103	$30,008,000	$2,795,000	$2,534	$7.78

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

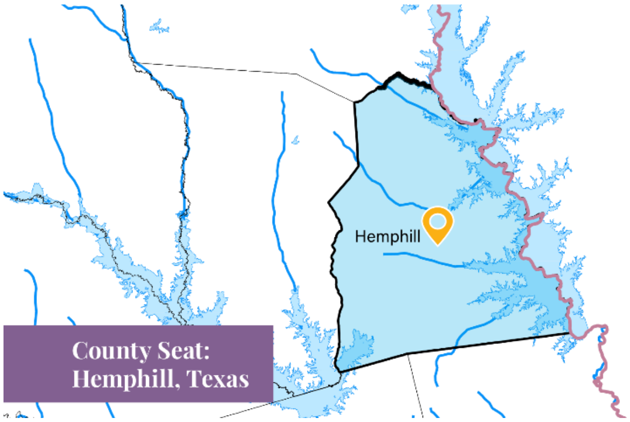
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Henderson	83	148	179	235	283	334
Kilgore	10	19	21	25	28	32
Mt. Enterprise WSC	4	8	0	0	0	0
New London	13	22	26	30	36	40
Tatum	4	8	9	10	12	14

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Henderson	334	$9,900,000	$370,000	$1,431	$4.39
Kilgore	32	$0.00	$8,000	$289	$0.89
Mt. Enterprise WSC	8	$0.00	$3,000	$500	$1.53
New London	40	$0.00	$6,000	$174	$0.53
Tatum	14	$0.00	$4,000	$316	$0.97

County Summary. Below is a summary of WUGs in Rusk County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Chalk Hill SUD	Carrizo-Wilcox	0	None
County Other	Carrizo-Wilcox, Other Undifferentiated	0	None
Cross Roads SUD	Carrizo-Wilcox, Lake Fork (Kilgore)	0	None
Crystal Farms WSC	Carrizo-Wilcox	0	None
Ebenezer WSC	Carrizo-Wilcox	0	None
Elderville WSC	Lake Cherokee, Lake Fork	0	None
Gaston WSC	Carrizo-Wilcox	0	None
Goodsprings WSC	Carrizo-Wilcox	0	None
Henderson	Lake Fork, Carrizo-Wilcox	0	Conservation
Jacobs WSC	Carrizo-Wilcox	22	New Wells (Carrizo-Wilcox)
Kilgore	Lake Fork, Carrizo-Wilcox	0	Conservation
Minden Brachfield WSC	Carrizo-Wilcox	0	None
MT Enterprise WSC	Carrizo-Wilcox	0	Conservation
New London	Carrizo-Wilcox	0	Conservation
New Prospect WSC	Carrizo-Wilcox	0	None
Overton	Carrizo-Wilcox	384	New Wells (Carrizo Aquifer) See Smith County for Discussion
South Rusk WSC	Carrizo-Wilcox	0	None
Southern Utilities Inc.	Carrizo-Wilcox, Tyler Carrizo, Lake Tyler, Lake Palestine	0	None
Tatum	Carrizo-Wilcox	0	Conservation
West Gregg SUD	Carrizo-Wilcox	0	None
Wright City WSC	Carrizo-Wilcox	21	New Wells (Carrizo-Wilcox)
Irrigation	Carrizo-Wilcox, Run-of-River, Other Undifferentiated	0	None
Manufacturing	Carrizo-Wilcox, Run-of-River	0	None
Livestock	Carrizo-Wilcox, Queen City, Local Supply	83	New Wells (Carrizo-Wilcox)
Mining	Carrizo-Wilcox, Run-of-River, Other Undifferentiated	305	Purchase from ANRA (Mud Creek)
Steam Electric Power	Carrizo-Wilcox, Martin Lake, Toledo Bend Reservoir	1,103	Purchase from SRA (Toledo Bend)

5B.2.15 Sabine County



Water supply sources currently used in Sabine County include the Carrizo-Wilcox, Yegua-Jackson and Other-Undifferentiated aquifers, Toledo Bend Reservoir, and local surface supplies. The total available supply from groundwater in Sabine County is 11,690 ac-ft/yr. Of this amount, about 1,500 ac-ft/yr is currently being used. This leaves considerable groundwater for future supplies. In addition, Toledo Bend Reservoir, which is located along the eastern border of Sabine County, has available supply (through contracts with SRA). Currently, there are no shortages for WUGs in Sabine County.

G-M WSC. G-M WSC is a WUG in Sabine County. Currently G-M WSC has sufficient supplies to meet the projected needs over the planning period. However, G-M WSC wanted the WMSs from their five-year water plan incorporated into the 2021 Plan. Below is a discussion on the supplies and WMSs based on the information provided by G-M WSC.

The current and future customers for G-M WSC are 1) G-M WSC, 2) Pendleton Harbor 3) El Camino 4) Dogwood Estates 5) Frontier Park 6) Cypress point. The existing sources of supply for G-M WSC are 1) groundwater wells 2) potable water from City of Hemphill 3) potable water from City of Pineland. G-M WSC would like to be independent of City of Hemphill purchases in five years. The WSC recently completed the construction of a WTP at a capacity of 1 MGD, and a 10-inch waterline from the WTP to FM 3121.

In terms of future projects, G-M WSC is planning some improvements and updates to distribution system infrastructure, expansion of the existing WTP to 2 MGD to potentially sell water to City of Hemphill, replacing water meters and constructing an elevated storage tank. Following is a summary of the list of water supply projects and the cost estimates provided by G-M WSC.

Strategy	Opinion of Probable Costs
Waterline Improvements	
Water Plant to Highway 83 Plant	$ 917,200
FM 3121 to City Limits	$ 535,800
North Bypass Loop around Hemphill	$ 454,200
South Bypass Loop around Hemphill	$ 773,200
Total	**$ 2,680,400**
Water System Expansion	
Pendleton Harbor and Frontier Park Areas	-
Dogwood Estates and Other Areas of FM 2928	$ 514,750
El Camino, Millionaire Point, and Apache Drive	$ 881,040
Unserved Areas of East FM 2928	$ 594,700
Total	**$ 1,990,490**
Surface Water Plant Improvements	$ 2,483,000
Highway 83 Plant – Elevated Tank	$ 745,500

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

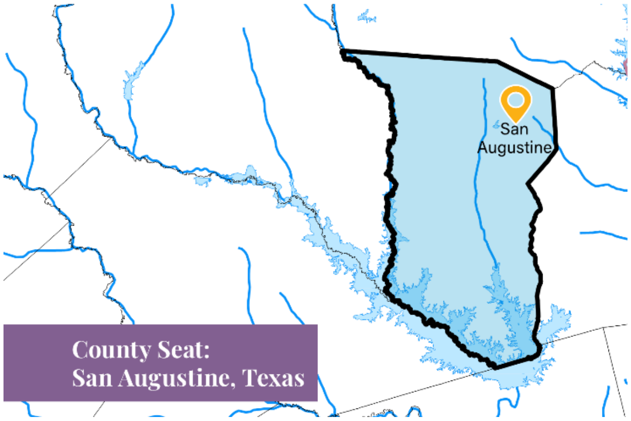
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Hemphill	4	8	7	7	8	8

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Hemphill	8	$0.00	$2,000	$286	$0.88

County Summary. Below is a summary of WUGs in Sabine County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Brookeland FWSD	Yegua-Jackson, Gulf Coast	0	None
County Other	All Aquifers, Toledo Bend Reservoir	0	None
G-M WSC	Carrizo-Wilcox, Toledo Bend Reservoir	0	Infrastructure Improvements
Hemphill	Toledo Bend Reservoir	0	Conservation
Pineland	Carrizo-Wilcox, Yegua-Jackson	0	None
Irrigation	None	0	None
Livestock	All Aquifers, Local Supply	0	None
Manufacturing	Yegua-Jackson, Reuse, Run-of-River Neches	0	None
Mining	Yegua-Jackson, Toledo Bend Reservoir, Other Undifferentiated	0	None
Steam Electric Power	None	0	None

5B.2.16 San Augustine County



San Augustine County is in the Neches and Sabine River Basins. Current water supplies for the county include groundwater from the Carrizo-Wilcox, Sparta, and Yegua-Jackson aquifers and surface water from San Augustine Lake and local supplies. Available supplies to meet projected shortages include nearly 2,700 ac-ft/yr of unallocated groundwater and a small amount of surface water from San Augustine.

San Augustine. Current supplies for San Augustine include surface water supplies from San Augustine Lake. There are shortages for this WUG owing to the limitations of supplies in the San Augustine Lake. The recommended strategy for San Augustine to meet future shortages is to install new wells in Carrizo Wilcox aquifer to meet any unmet needs. Though San Augustine has a need in 2020, the new wells will not be completed prior to January 2023 due to time constraints, so the strategy must have an online decade of 2030 according to TWDB planning requirements.

San Augustine	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	120	105	92	89	89	89
Recommended Strategy SAUG-SAG: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	105	92	89	89	89
Recommended Strategy: Conservation (ac-ft/yr)	10	17	18	20	22	23

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SAUG-SAG: New Wells (Carrizo-Wilcox)	105	$1,045,000	$88,000	$838	$2.57
Recommended Strategy: Conservation	23	$2,297,000	$79,000	$3,661	$11.23

Livestock. Current supplies for livestock users in San Augustine County include groundwater from the Carrizo-Wilcox, Sparta, and other undifferentiated aquifers, as well as other local surface water supplies. Due to high demands and limitations of developed groundwater supplies for livestock users, increasing needs above 1,000 ac-ft are shown throughout the planning horizon. The recommended strategy for livestock users is to purchase additional water from SRA to meet any unmet needs. Though there is a need in 2020, this project will not be completed prior to January 2023 due to time constraints, so the online decade for this project will be 2030 because of TWDB planning requirements.

San Augustine Livestock	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	1,333	1,539	1,774	2,048	2,349	2,349
Recommended Strategy SAUG-LTK: Purchase from SRA (Toledo Bend) (ac-ft/yr)	0	1,539	1,774	2,048	2,349	2,349

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SAUG-LTK: Purchase from SRA (Toledo Bend)	2,349	$41,302,000	$4,121,000	$1,754	$5.38

Mining. There is a shortage in mining needs in San Augustine County for decades 2020 through 2030. San Augustine mining users have negotiated a contract with Angelina & Neches River Authority of purchase of water from Angelina & Neches River Authority's run-of-river supplies on Angelina River. Though there is a need in 2020, this project will not be completed prior to January 2023 due to time constraints, so the online decade for this project will be 2030 because of TWDB planning requirements.

San Augustine Mining	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	2,102	1,102	0	0	0	0
Recommended Strategy SAUG-MIN: Purchase from ANRA (Mud Creek) (ac-ft/yr)	0	1,102	0	0	0	0

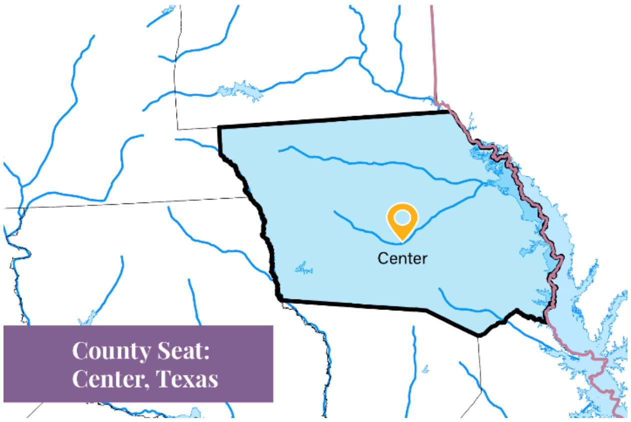
Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SAUG-MIN: Purchase from ANRA (Mud Creek)	1,102	$35,769,000	$3,911,000	$3,549	$10.89

County Summary. Below is a summary of WUGs in San Augustine County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
County Other	All Aquifers, San Augustine Lake	0	None
G-M WSC	Carrizo-Wilcox, Toledo Bend Reservoir	0	None
San Augustine	Carrizo-Wilcox, San Augustine Lake	120	New Wells (Carrizo-Wilcox), Conservation
San Augustine Rural WSC	Carrizo-Wilcox, Sales from City of San Augustine	0	None
Irrigation	Carrizo-Wilcox	0	None
Livestock	Carrizo-Wilcox	2,349	Purchase from SRA (Toledo Bend)
Manufacturing	Carrizo-Wilcox	0	None
Mining	All Aquifers, Local Supply	2,102	Purchase from ANRA (Mud Creek)
Steam Electric Power	None	0	None

5B.2.17 Shelby County



Shelby County, which is located in the northeastern part of the region, uses groundwater from the Carrizo-Wilcox aquifer and surface water from Toledo Bend Reservoir, Lake Pinkston, and Center Lake. The largest water user in the county is livestock, and this demand is expected to nearly triple by 2070. The other major demand center is the City of Center and its customers. The total projected shortage for the county is 8,215 ac-ft/yr. The Carrizo-Wilcox aquifer has a long-term availability of 6,000 ac-ft/yr, and its estimated current use is approximately 4,500 ac-ft/yr. There is some groundwater available for development and considerable supply available from Toledo Bend Reservoir. However, a Toledo Bend Reservoir strategy would require infrastructure development to treat and deliver the water to areas with needs. A long-term shift of water supply to surface water may be needed to address future water needs.

Livestock. Livestock water demands are projected to increase significantly in Shelby County, partially due to the growing poultry industry. Current supply is from Carrizo-Wilcox aquifer and local surface water supplies. It is recommended that any large-scale user should obtain surface water from Toledo Bend Reservoir through a contract with SRA.

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Shelby Livestock	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	6,491	8,761	11,524	14,896	19,006	19,006
Recommended Strategy SHEL-LTK: Purchase from SRA (Toledo Bend) (ac-ft/yr)	6,491	8,761	11,524	14,896	19,006	19,006

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SHEL-LTK: Purchase from SRA (Toledo Bend)	19,006	-	$18,582,000	$978	$3.00

Sand Hills WSC. The current supplies for Sand Hills WSC are taken from Carrizo Wilcox aquifer, Lake Center and Lake Pinkston. The shortages for future decades are met by means of two strategies. One recommended is to purchase additional supplies from Sabine River Authority. The other recommended strategy is to implement conservation measures.

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Sand Hills WSC	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	65	76	85	95	107	117
Recommended Strategy SHEL-SHW: Purchase from Center (ac-ft/yr)	61	68	77	87	97	105
Recommended Strategy: Conservation (ac-ft/yr)	4	8	8	9	10	12

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SHEL-SHW: Purchase from Center	117	-	$102,000	$971	$2.98
Recommended Strategy: Conservation	12	-	$3,000	$353	$1.08

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

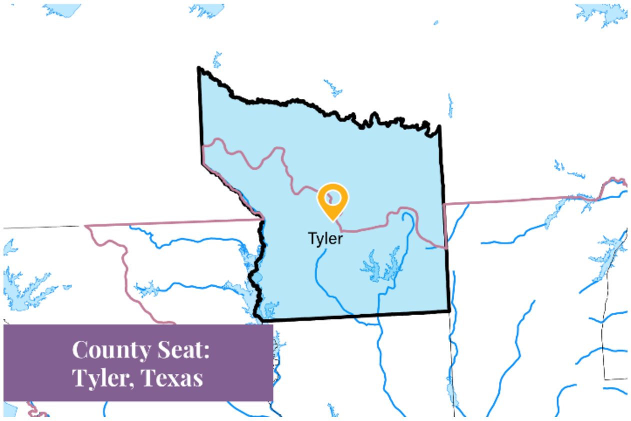
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Center	26	45	52	57	64	70
Tenaha	4	6	6	7	8	8

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Center	70	$0.00	$11,000	$188	$0.58
Tenaha	8	$0.00	$2,000	$308	$0.94

County Summary. Below is a summary of WUGs in Shelby County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Center	Carrizo-Wilcox, Lake Pinkston, Lake Center	0	Reuse Pipeline to Center Lake, Toledo Bend Pipeline to Center Lake (Discussion included in the MWP Summary), Conservation
Choice WSC	Carrizo-Wilcox	0	None
County-Other	Carrizo-Wilcox, Lake Pinkston, Lake Center, Toledo Bend (LA)	0	None
East Lamar WSC	Carrizo-Wilcox	0	None
Five Way WSC	Carrizo-Wilcox	0	None
Flat Fork WSC	Carrizo-Wilcox	0	None
Huxley	Toledo Bend Reservoir	0	None
Joaquin	Toledo Bend (LA)	0	None
McClelland WSC	Carrizo-Wilcox	0	None
Sand Hills WSC	Carrizo-Wilcox, Lake Center, Pinkston Reservoir	117	Purchase from Center, Conservation
Tenaha	Carrizo-Wilcox	0	Conservation
Timpson	Carrizo-Wilcox	0	None
Irrigation	Carrizo-Wilcox, Reuse	0	None
Livestock	Carrizo-Wilcox, Local Supply	19,006	Purchase from SRA (Toledo Bend)
Manufacturing	Carrizo-Wilcox, Lake Pinkston, Lake Center	0	None
Mining	Carrizo-Wilcox, Toledo Bend	0	None
Steam Electric Power	None	0	None

5B.2.18 Smith County



Smith County is located partially in the ETRWPA and partially in Region D. Almost all of the supplies in Smith County in the ETRWPA come from City of Tyler sources and from groundwater supplies. A small amount of water is supplied from Lake Jacksonville through the Cherokee WSC. The City of Tyler currently utilizes surface water from Lakes Tyler and Tyler East, Bellwood Lake and Lake Palestine. About 10 percent of Tyler's current supply is from the Carrizo-Wilcox aquifer.

The groundwater in Smith County is heavily used for water supply. Current use from the Carrizo-Wilcox aquifer, the county's largest groundwater supply, exceeds the Modeled Available Groundwater. Allocation of the current supplies resulted in an over-allocation of the Modeled Available Groundwater capacity. Therefore, current supplies in Smith County were reduced to cut back uniformly for all water users in Smith County to avoid over-allocation. In the allocation process, it was assumed that there is no additional Carrizo-Wilcox water available at this time. There is water available from the Queen City aquifer, but water quality concerns limit its potential use. The most likely sources for municipal water needs include surface water supplies from the City of Tyler and voluntary transfers from other users. The City of Tyler has indicated that it could provide potable water to most of the municipal WUGs with needs, with limited infrastructure in most cases. Irrigation and mining needs are shown to be supplied by the Queen City aquifer.

Bullard. Bullard's current supply is from the Carrizo-Wilcox aquifer. Due to competition for water from this source, the City is projected to have a shortage of nearly 1,128 ac-ft/yr by 2070. It is recommended that Bullard purchase water from City of Tyler. Municipal conservation is another recommended strategy for Bullard. A potentially feasible strategy is to purchase water from North Cherokee WSC, which would be supplied from the WSC's participation in Lake Columbia project.

Another potentially feasible strategy for Bullard is to drill additional wells in the Carrizo Wilcox aquifer. A groundwater strategy was not proposed as a recommended strategy because the Carrizo Wilcox aquifer in Smith County is over-allocated based on the Modeled Available Groundwater (MAG) supplies projected. When the MAG values are updated to address the over-allocation issues, Bullard can consider a strategy to drill additional wells in the Carrizo Wilcox aquifer.

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers. It is assumed that the Bullard will construct a raw water transmission system to transfer supplies from the City of Tyler supply sources. Cost estimates include capital cost for a pipeline, pump stations, and storage tanks. Though there is a need in 2020, this project will not be completed prior to January 2023 due to time constraints, so the online decade for this project will be 2030 because of TWDB planning requirements.

Bullard	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	141	332	526	739	956	1,182
Recommended Strategy SMTH-BLD: Purchase from City of Tyler (ac-ft/yr)	0	322	511	718	928	1,145
Recommended Strategy: Conservation (ac-ft/yr)	11	22	28	36	44	54

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SMTH-BLD: Purchase from City of Tyler	1,145	$14,264,00	$1,615,000	$1,410	$4.33
Recommended Strategy: Conservation	54	$0	$14,000	$297	$0.91

Crystal Systems Texas. Crystal Systems Texas serves multiple counties in Regions C and D and Smith County in the ETRWPA. Water supplies to Crystal Systems in Smith County are from the Carrizo-Wilcox aquifer. The Crystal Systems Texas, Inc. system is located in northwestern Smith County and serves the un-incorporated area surrounding Hideaway Lake. In 2018, the system had 2050 residential connections. The population is projected to increase from 4,343 persons in 2020 to 8,881 persons in 2070. The System is included as a WUG in Smith County. The system's current water supply consists of five water wells from the Carrizo-Wilcox Aquifer. The total rated capacity of these wells is 3,560 GPM, or 1,914 ac-ft/yr. The system is bounded on the north and southeast by the Lindale Rural WSC and on the east by the City of Lindale. The System does have a water conservation plan. The System is projected to have a water supply surplus of 169 ac-ft/yr in 2020 decreasing to a deficit of 291 ac-ft/yr in 2070. Region D is the primary region for managing the water strategy evaluation for Crystal Systems Texas. The strategies to address shortages for Crystal Systems Texas were developed by Region D for meeting shortages in all regions. ETRWPA approves and supports the strategies developed by Region D for this WUG.

Crystal Systems Texas	2020	2030	2040	2050	2060	2070
Population	4,343	5,041	5,812	6,696	7,708	8,881
Projected Water Demand (ac-ft/yr)	1,356	1,557	1,791	2,061	2,370	2,730
Current Water Supply (ac-ft/yr)	1,525	1,674	1,833	2,009	2,206	2,439
Projected Supply Surplus (+)/Deficit(-) (ac-ft/yr)	169	117	42	-52	-164	-291

Four alternative strategies were considered to meet the Crystal System's water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcd threshold set by the planning group. Water reuse was not considered because the system does not have a sewer collection system. Surface water alternatives were omitted since there is not a supply source within close proximity to the system and surface water treatment is not economically feasible for a system of this size. Wells in the Carrizo-Wilcox Aquifer (Sabine and Neches River Basins) were identified as a potentially feasible strategy for the WUG.

The recommended strategy for Crystal Systems to meet their projected deficit of 78 ac-ft/yr in 2040 and 816 ac-ft/yr in 2070 would be to construct four additional water wells similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo Wilcox Aquifer in Smith County. Four wells with rated capacity of 500 gpm each would provide approximately 269 acre-feet each. The Carrizo Wilcox Aquifer in Smith County is projected to have a more than ample supply availability to meet the needs of Crystal Systems for the planning period. During the planning period two wells will be drilled in the Carrizo Wilcox formation of the Sabine River Basin while two wells will be drilled into the Carrizo Wilcox formation of the Neches River Basin.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

In addition to this, conservation was also proposed as a strategy for the WUG. Below the details of the conservation strategy.

Crystal Systems Texas	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	52	164	291
Recommended Strategy: Conservation (ac-ft/yr)	18	38	52	71	92	118
New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	78	192	310	538

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	118	$953,000	$39,000	$471	$1.45
Drill New Wells (Carrizo-Wilcox)	538	$2,531,000	$231,000	$ 429	$1.32

Lindale. Lindale is a WUG in both Region D and ETRWPA. Lindale has shortages both in ETRWPA and Region D. ETRWPA approves and supports the strategies developed in Region D to meet the shortages for Lindale in both regions. Below is a description of the WUG needs and strategies to meet shortages for Lindale.

The City of Lindale is located in northern Smith County and serves the incorporated city limits and an area immediately northwest of the City of Lindale. The population is projected to increase from 5,806 persons in 2020 to 13,985 persons in 2070. The City is included as a WUG in Smith County. The system's current water supply consists of four water wells from the Carrizo-Wilcox Aquifer. The total rated capacity of these wells is 2,320 gpm, or 1,247 ac-ft/yr. The system is bounded on the west, north, and east by the Lindale Rural WSC and on the south by the City of Tyler. The City does have a water conservation plan. The City of Lindale is projected to have a water supply deficit of 70 ac-ft/yr in 2020 increasing to a deficit of 1,833 ac-ft/yr in 2070.

Lindale (Sabine River Basin)	2020	2030	2040	2050	2060	2070
Population	3,707	4,499	5,396	6,107	7,280	8,674
Projected Water Demand	841	1,005	1,195	1,347	1,607	1,910
Current Water Supply	796	779	773	756	762	773
Projected Supply Surplus (+)/Deficit(-)	-45	-226	-422	-591	-842	-1,137

Lindale (Neches River Basin)	2020	2030	2040	2050	2060	2070
Population	2,099	2,704	3,311	3,964	4,629	5,311
Projected Water Demand	476	604	733	875	1,020	1,170
Current Water Supply	451	468	474	491	485	474
Projected Supply Surplus (+)/Deficit(-)	-25	-136	-259	-384	-535	-696

Four alternative strategies were considered to meet the City of Lindale's water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcd threshold set by the planning group. Water reuse was not considered because the City does not have a demand for non-potable water. Surface water alternatives were omitted since there is not a supply source within close proximity to the City and surface water treatment is not economically feasible for a system of this size. Groundwater wells in the Carrizo-Wilcox Aquifer in the Neches Basin were identified as a potentially feasible strategy for the City.

The recommended strategy for the City of Lindale to meet their projected deficit of 70 ac-ft/yr in 2020 and 1,833 ac-ft/yr in 2070 would be to construct six additional water wells similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo Wilcox Aquifer in Smith County. Six wells with rated capacity of 600 gpm each would provide approximately 322 acre-feet each. The Carrizo Wilcox Aquifer in Smith County (Neches River Basin) is projected to have a more than ample supply availability to meet the needs of the City of Lindale for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Lindale	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	25	136	259	384	535	696
Recommended Strategy SMTH-LIN (ac-ft/yr): Drill New Wells (Carrizo-Wilcox) (ac-ft/yr)	25	136	259	384	535	696

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
New Wells (Carrizo-Wilcox)	696	$ 7,592,000	$ 714,000	$ 370	$1.13

In addition to this conservation was also proposed as a strategy for the WUG. Below the details of the conservation strategy.

Lindale	2020	2030	2040	2050	2060	2070
Recommended Strategy: Conservation (ac-ft/yr)	7	14	18	23	29	36

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	36	$0.00	$8,000	$259	$0.80

Manufacturing. Manufacturing is expected to have shortages beginning in 2030 at 84 ac-ft/yr and increasing to 84 ac-ft/yr by 2070. It is recommended that the manufacturing shortage be met through the purchase of additional supplies from the City of Tyler. This strategy will address the shortages for the manufacturing WUG both in ETRWPA.

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers. It is assumed that the potential manufacturing customers will construct a raw water transmission system to transfer supplies from the City of Tyler supply sources. Cost estimates include capital cost for a pipeline, pump stations, and storage tanks.

Smith Manufacturing	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	84	84	84	84	84
Recommended Strategy SMTH-MFG: Purchase from City of Tyler (ac-ft/yr)	0	84	84	84	84	84

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SMTH-MFG: Purchase from City of Tyler	84	$6,198,000	$545,000	$6,488	$19.91

Overton. The current supply for the City of Overton is the Carrizo-Wilcox aquifer. The City's supply is limited by well capacities and water shortages are projected beginning in 2050. The City had an average per capita consumption of 200 gpcd in 2011. This value is well over the statewide goal of 140 gpcd. After performing a conservation cost analysis, the ETRWPG believes a water conservation strategy for the City is economically achievable and is therefore recommended. This strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce Overton's demand by more than their projected need; therefore, municipal conservation is the only recommended WMS for the City. It should be noted that this WMS will address the shortage for City of Overton WUG in ETRWPA.

Overton	2020	2030	2040	2050	2060	2070
(Rusk) Need (ac-ft/yr)	66	122	177	241	310	384
(Smith) Need (ac-ft/yr)	4	7	12	18	25	32
Recommended Strategy: Conservation (ac-ft/yr)	8	15	18	21	25	28
(Rusk) Recommended Strategy SMTH-OVN: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	122	177	241	310	384
(Smith) Recommended Strategy SMTH-OVN: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	7	12	18	25	32

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	28	$0	$7,000	$289	$0.89
Recommended Strategy SMTH-OVN: New Wells (Carrizo-Wilcox)	416	$8,914,000	$846,000	$2,034	$6.24

Southern Utilities. The current supply for the Southern Utilities is the Carrizo-Wilcox aquifer and Lake Tyler. The City's supply is limited by well capacities and water shortages are projected beginning in 2020. The City had an average per capita consumption of 200 gpcd in 2011. This value is well over the statewide goal of 140 gpcd. After performing a conservation cost analysis, the ETRWPG believes a water conservation strategy for the City is economically achievable and is therefore recommended. This strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce Southern Utilities demand by more than their projected need; therefore, municipal conservation is the only recommended WMS for the City. It should be noted that this WMS will address the shortage for Southern Utilities WUG in ETRWPA.

Southern Utilities	2020	2030	2040	2050	2060	2070
Need (Region I) (ac-ft/yr)	71	74	79	84	90	98
Recommended Strategy: Conservation (ac-ft/yr)	514	866	1,058	1,279	1,527	1,803

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	1,803	$33,264,000	$1,249,000	$808	$2.48

R P M WSC. R P M WSC is located in both Region D and the ETRWPA. The water management strategies for R P M WSC were developed by Region D for both regions. ETRWPA supports the strategies developed by Region D.

R P M WSC provides water service in Van Zandt, Henderson, and Smith Counties. The WUG population is projected to be 2,957 by 2020 and increases to 5,530 by 2070. R P M WSC supplies its customers with groundwater from the Carrizo-Wilcox and Queen City aquifers with five water wells in Van Zandt County. R P M WSC is projected to have a total deficit of 34 ac-ft/yr in 2030 increasing to a deficit of 217 ac-ft/yr by 2070; the shortage projected to occur in Van Zandt County is 25 ac-ft/yr in 2030 increasing to 152 ac-ft/yr by 2070. The shortage in Henderson County is 7 ac-ft/yr in 2030, increasing to 48 ac-ft/yr in 2070. Shortages in Smith County range from 2 ac-ft/yr in 2030 up to 17 ac-ft/yr in 2070.

RPM WSC	2020	2030	2040	2050	2060	2070
Population	2,957	3,602	4,112	4,653	5,116	5,530
Projected Water Demand (ac-ft/yr)	323	378	423	475	519	561
Current Water Supply (Carrizo-Wilcox Aquifer) (ac-ft/yr)	344	344	344	344	344	344
Projected Supply Surplus (+) / Deficit (-) for Region D and ETRWPA (ac-ft/yr)	**21**	**-34**	**-79**	**-131**	**-175**	**-217**
Projected Supply Surplus (+) / Deficit (-) by County in the two regions (ac-ft/yr)						
Van Zandt	14	-25	-58	-93	-124	-152
Henderson	5	-7	-16	-27	-38	-48
Smith	2	-2	-5	-11	-13	-17

Four alternative strategies were considered to meet the WSC's water supply shortages as summarized in the following table. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Water reuse was not considered because the WSC does not have a demand for non-potable water. Surface water was not considered because the WSC does not currently have surface water treatment. Groundwater has been identified as a potential strategy for R P M WSC. The recommended strategy for R P M WSC to meet their projected deficit of 34 ac-ft/yr in 2030 and 217 ac-ft/yr in 2070 would be to construct nine additional water wells similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo-Wilcox Aquifer in the Neches Basin in Van Zandt County. Nine wells with rated capacity of 50 gpm each, pumping at an approximately depth of 560 ft., would provide approximately 27 ac-ft each.

R P M WSC	2020	2030	2040	2050	2060	2070
Needs	0	2	5	11	13	17
Recommended Strategy RPM-WSC: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	2	5	11	13	17

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy RPM-WSC: New Wells (Carrizo-Wilcox) (ac-ft/yr)	17	$3,469,000	$428,000	$1,972	$6.05

Whitehouse. Current supplies for City of Whitehouse are taken from Carrizo Wilcox, Lake Palestine, and Lake Tyler. The recommended strategy to meet shortages to purchase additional supplies from City of Tyler.

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers. It is assumed that the potential mining customers will construct a raw water transmission system to transfer supplies from the City of Tyler supply sources. Cost estimates include capital cost for a pipeline, pump stations, and storage tanks.

Whitehouse	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	39	257
Recommended Strategy SMTH-WTH: Purchase from City of Tyler (ac-ft/yr)	0	0	0	0	39	257

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SMTH-WTH: Purchase from City of Tyler	257	$7,666,000	$737,000	$2,868	$8.80

Conservation strategies are proposed for the following WUGs.

Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Arp	2	0	0	0	0	0
Dean WSC	11	18	0	0	0	0
Troup	6	11	12	14	17	18
Tyler	657	1,101	1,338	1,613	1,924	2,268

Conservation Strategy (ac-ft/yr)	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Arp	2	$0.00	$2,000	$1,000	$3.07
Dean WSC	18	$0.00	$7,000	$483	$1.48
Troup	18	$0.00	$5,000	$321	$0.98
Tyler	2,268	$58,766,000	$2,026,000	$1,123	$3.45

County Summary. Below is a summary of WUGs in Smith County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Algonquin Water Resources of Texas	Carrizo-Wilcox	0	None
Arp	Carrizo-Wilcox	0	Conservation
Ben Wheeler WSC	Carrizo-Wilcox	0	None
Bullard	Carrizo-Wilcox, Lake Jacksonville	1,182	Purchase from City of Tyler, Water Conservation
Carroll WSC	Carrizo-Wilcox	0	None
County Other	Carrizo-Wilcox, Lake Tyler, Lake Palestine	0	None
Crystal Systems Texas	Carrizo-Wilcox	291	New Wells in Carrizo Wilcox, Water Conservation
Dean WSC	Carrizo-Wilcox	0	Conservation
Emerald Bay MUD	Carrizo-Wilcox	0	None
Jackson WSC	Carrizo-Wilcox	0	None
Lindale	Carrizo-Wilcox	696	New Wells in Carrizo Wilcox, Water Conservation
Lindale Rural WSC	Carrizo-Wilcox	0	None
Overton	Carrizo-Wilcox	32	New Wells in Carrizo Wilcox
R P M WSC	Carrizo-Wilcox	17	Municipal Conservation, New Wells in Carrizo Wilcox
Southern Utilities	Carrizo-Wilcox, Lake Tyler, Lake Palestine	98	Conservation
Troup	Carrizo-Wilcox	0	Conservation
Tyler	Carrizo-Wilcox, Lake Tyler, Lake Palestine	0	Conservation
Walnut Grove WSC	Lake Palestine	0	None
Whitehouse	Carrizo-Wilcox, Lake Tyler, Lake Palestine	257	Purchase from Tyler
Wright City WSC	Carrizo-Wilcox	0	None
Irrigation	Carrizo-Wilcox, Lake Tyler, Lake Palestine, Other Aquifers	0	None
Manufacturing	Carrizo-Wilcox, Lake Tyler, Lake Palestine, Other Aquifers	84	Purchase from Tyler
Livestock	Carrizo-Wilcox, Queen City, Local Supply	0	None
Mining	Local Supply, Other Undifferentiated	0	None
Steam Electric Power	None	0	None

5B.2.19 Trinity County

The county is partially located in the ETRWPA and partially in Region H. Supplies include surface water from local supplies and the Neches River as well as groundwater from the Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, and Other-Undifferentiated aquifers. Municipal demands in Trinity County are less than one percent of the ETRWPA's total municipal demand. While the supplies are limited compared to supplies in other counties in the ETRWPA, there is a small volume of water available for growth not projected in this plan. No WUGs in Trinity County were identified with a need.

County Summary. Below is a summary of WUGs in Trinity County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Centerville WSC	Yegua-Jackson	0	None
County Other	Yegua-Jackson, Trinity County Regional WS	0	None
Groveton	Yegua-Jackson, Trinity County Regional WS	0	None
Pennington WSC	Yegua-Jackson	0	None
Irrigation	Yegua-Jackson	0	None
Livestock	Yegua-Jackson, Local Supply	0	None
Manufacturing	None	0	None
Mining	Yegua-Jackson	0	None
Steam Electric Power	None	0	None

5B.2.20 Tyler County

Current supplies in Tyler County include groundwater from the Gulf Coast aquifer and surface water from Sam Rayburn Reservoir (LNVA), the Neches River, and local supplies. Tyler County represents less than 2 percent of the total municipal demand in the ETRWPA and has a total county demand of approximately 5,000 ac-ft/yr. There is no projected need for any WUG located within Tyler County during the planning period. Based on the water availability estimates included in this plan, there is sufficient water to provide expected future demands in Tyler County.

Conservation strategies are proposed for the following WUGs.

Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Chester WSC	2	5	5	5	6	6
Colmesneil	4	6	6	7	7	8
Cypress Creek WSC	2	3	3	3	3	4
Woodville	17	28	30	32	34	36

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Chester WSC	6	$0.00	$2,000	$413	$1.27
Colmesneil	8	$0.00	$2,000	$315	$0.97
Cypress Creek WSC	4	$0.00	$1,000	$333	$1.02
Woodville	36	$0.00	$9,000	$305	$0.94

County Summary. Below is a summary of WUGs in Tyler County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Chester WSC	Gulf Coast	0	Conservation
Colmesneil	Gulf Coast	0	Conservation
County Other	Gulf Coast	0	None
Cypress Creek WSC	Gulf Coast	0	Conservation
Lake Livingston WSC	Gulf Coast	0	None
Moscow WSC	Gulf Coast	0	None
Tyler County WSC	Gulf Coast	0	None
Warren WSC	Gulf Coast	0	None
Wildwood POA	Gulf Coast	0	None
Woodville	Gulf Coast, LNVA	0	Conservation
Irrigation	Gulf Coast, Run-of-River	0	None
Manufacturing	Gulf Coast	0	None
Mining	Gulf Coast, Local Supply	0	None
Livestock	Gulf Coast, Local Supply	0	None
Steam Electric Power	Gulf Coast, LNVA (Woodville)	0	None

5B.3 Major Water Providers

This section provides discussions for major water providers (MWP) located in the ETRWPA that meet one of the following criteria:

- The entity has a projected shortage in supplies based on demands of current customers and current reliable supplies. These MWPs include Angelina & Neches River Authority, Angelina Nacogdoches WCID #1, Athens MWA, City of Beaumont, Houston County WCID #1, and Upper Neches River Municipal Water Authority.

- The entity has supply sources in the ETRWPA that are listed as WMSs for WUGs outside the Region. Both the UNRMWA and the SRA are included under this criterion.

- The entity is currently pursuing WMSs to increase the reliability and/or distribution of their supplies. These include the Nacogdoches, Center, Lufkin, Port Arthur, Tyler, Jacksonville, SRA and LNVA.

A management supply factor (MSF) is the ratio of an entities total volume of existing water supplies plus total volume of recommended WMS supplies to the total decadal water demand. A value over 1.0 represents an entity with a surplus of projected supplies while a value less than 1.0 represents an entity with a deficit of projected supplies, or an unmet need. Appendix 5B-C presents the MSF for each MWP for each decade in the planning period. All MWPs have an MSF of at least 1.0 with values ranging from 1.0 for the City of Beaumont in 2060 to 10.63 for Sabine River Authority in every decade.

5B.3.1 Angelina & Neches River Authority

Angelina & Neches River Authority is the sponsor for the Lake Columbia project on Mud Creek in Cherokee and Rusk Counties. Lake Columbia is a recommended strategy in the 2021 Plan. Angelina & Neches River Authority has been granted a water right permit (Permit No. 4228) by the TCEQ to impound 195,500 ac-ft and to divert 85,507 ac-ft/yr (76.3 MGD) for municipal and industrial purposes. Angelina & Neches River Authority currently has contracted customers for 53 percent of the 85,507 ac-ft/yr permitted supply of the proposed Lake Columbia. In addition, Angelina & Neches River Authority has been approached to supply water for mining purposes in Angelina, Cherokee, Nacogdoches, Shelby, San Augustine, Rusk, and Sabine counties. The mining demand will be met with run-of-the-river diversions.

The water suppliers currently under contract with Angelina & Neches River Authority for water from Lake Columbia are listed with current participation percentage in the table below. Also included below is a table showing additional contracted customers Angelina & Neches River Authority and the corresponding demand. The WMSs for Angelina & Neches River Authority were developed to address the total customer demand.

There are four recommended strategies for Angelina & Neches River Authority in the 2021 Plan. They are 1) construction of Lake Columbia, 2) Angelina & Neches River Authority treatment plant and distribution system, 3) development of 10,000 ac-ft/yr of run-of-river supplies (application process is administratively complete) and an additional 20,000 ac-ft/yr of run-of-river supplies in Cherokee County, and 4) development of groundwater supplies in Cherokee County.

Construction of Lake Columbia (Recommended). Lake Columbia is currently projected to be online by 2030. In the 2014 October Draft Long Range Water Supply Plan, the City of Dallas listed Lake Columbia as a recommended strategy for 2070. After considering the local needs in the East Texas Region, Dallas' projected share of the proposed Lake Columbia project is 56,000 ac-ft/yr by 2070. Angelina & Neches River Authority has a water right for Lake Columbia and is currently seeking a 404 permit for construction. An environmental impact study (EIS) has been prepared for Lake Columbia under the direction of the USACE.

The draft EIS was published on January 29, 2010 and public and agency comments on the draft EIS were provided on March 30, 2010. Currently, the Lake Columbia project is subject to completion of the EIS and issuance of a 404 permit from the US Army Corps of Engineers and a completion of Source Water Assessment. According to an April 2011 statement from USACE, a new Draft EIS is necessary before the EIS can be finalized. The consideration of the Draft EIS by USACE will likely involve additional studies and compliance with the USACE Mitigation Manual. Angelina & Neches River Authority and participating entities will share in the costs associated with the Lake Columbia water management strategy. For reservoir construction, unit costs are based on the WAM Run 3 yield estimate of 75,700 ac-ft/yr.

Angelina & Neches River Authority treatment plant and distribution system (Recommended). The cities of Nacogdoches, Jacksonville, and Rusk are assumed to purchase raw water from Lake Columbia and develop their own raw water transmission and treatment facilities. Most of the municipal water users (and current customers of Angelina & Neches River Authority) in Cherokee, Rusk, and Smith Counties will be purchasing treated water from Angelina & Neches River Authority. Costs for water treatment and transmission system are shared among currently contracted entities that are assumed to buy treated water from Angelina & Neches River Authority. This project will not supply any additional raw water. Rather, this project will provide treatment capacity for 22,232 ac-ft/yr of raw water from Lake Columbia.

Run-of-River Supplies (Recommended). Another recommended strategy for Angelina & Neches River Authority is to develop the run-of-river supplies. There is no construction cost to Angelina & Neches River Authority associated with the development of run-of-river supplies. Angelina & Neches River Authority will incur lawyer fees and other costs associated with the permitting process and coordination with Texas Commission on Environmental Quality. It is assumed that the mining customers will develop their own transmission systems to deliver run-of-river supplies from Mud Creek to the area of use, and those costs are included in the county summaries in Section 5B.2.

Groundwater Wells (Recommended). Angelina & Neches River Authority will be developing groundwater supplies in the Carrizo-Wilcox aquifer in Rusk/Cherokee counties to meet the manufacturing demands for the Rusk County Refinery. Angelina & Neches River Authority will be providing treated water to meet this demand. Angelina & Neches River Authority is proposing to develop groundwater wells in Carrizo-Wilcox aquifer in Cherokee and Rusk Counties to meet the needs projected for Rusk County Refinery. The project will provide a supply of 5,600 ac-ft/yr in 2030 and 2040, but the supply will reduce to 4,500 ac-ft/yr by 2070 due to lack of supply availability in the Carrizo-Wilcox aquifer. The cost estimates for developing the wells and supplying treated water are included in the summary table below.

A comparison of the water supplies versus the demands and the recommended strategies to be implemented is shown in the table below. A summary of the strategy costs is also provided below. The cost estimate reported in this section is the cost for developing the total yield of Lake Columbia, 75,720 ac-ft/yr. It is assumed that Dallas will be responsible for 70 percent of the cost for the dam, relocations, and reservoir land acquisitions and Angelina & Neches River Authority will be responsible for the remaining 30 percent. Capital costs for the dam and relocations were extracted from the cost estimates developed for the EIS (based on March 2012 dollars) and updated to reflect September 2018 dollars. Included in the relocation costs are estimates for relocating the four state highways and one railway that will be impacted by the reservoir. Annual costs for the reservoir were developed assuming a 40-year debt service with 3.5% interest rate. Annual costs for the non-reservoir infrastructure was developed for a 20-year debt service with 3.5% interest rate.

Customers for Lake Columbia

Recipient	County	Basin	Percent Participation in Columbia	Contract Amount (ac-ft/yr)
Current Contracted Customers				
Afton Grove WSC, Stryker Lake WSC	Cherokee	Neches	4.5%	3,848
Jacksonville	Cherokee	Neches	5.0%	4,275
New Summerfield	Cherokee	Neches	3.0%	2,565
North Cherokee WSC	Cherokee	Neches	5.0%	4,275
Rusk	Cherokee	Neches	5.0%	4,275
Rusk Rural WSC	Cherokee	Neches	1.0%	855
City of Alto	Cherokee	Neches	0.5%	428
Caro WSC	Nacogdoches	Neches	0.5%	428
Nacogdoches	Nacogdoches	Neches	10.0%	8,551
New London	Rusk	Sabine	1.0%	855
Troup	Smith	Neches	5.0%	4,275
Arp	Smith	Neches	0.5%	428
Blackjack WSC	Smith	Neches	1.0%	855
Jackson WSC	Smith	Neches	1.0%	855
Whitehouse	Smith	Neches	10.0%	8,551
Potential Customers				
City of Dallas		Trinity		56,050

Additional Customer Demand for ANRA

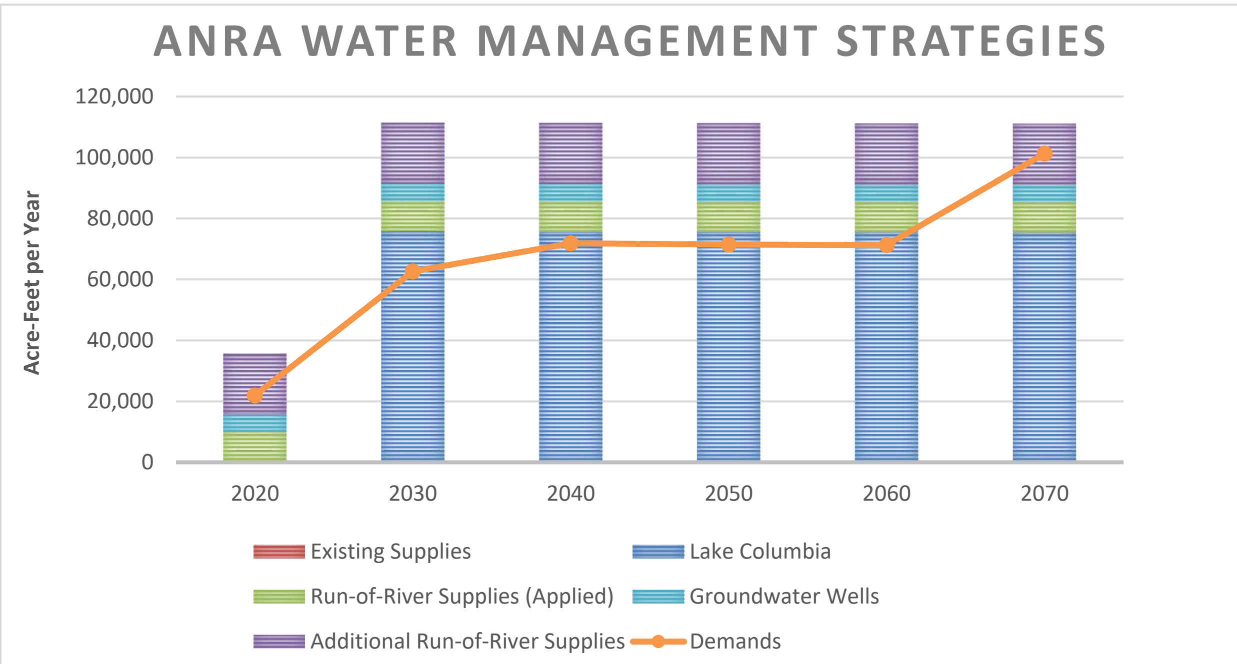
Recipient	2020	2030	2040	2050	2060	2070
Holmwood Utility	65	70	70	70	70	70
Steam Electric Demand – Cherokee	8,000	15,000	20,000	20,000	20,000	20,000
Manufacturing – Rusk County Refinery	5,600	5,600	5,600	5,600	5,600	5,600
Mining - Angelina	474	573	398	300	225	168
Mining - Cherokee	238	247	210	147	84	40
Mining - Nacogdoches	5,475	2,975	118	0	0	0
Mining – San Augustine	2,102	1,102	0	0	0	0
Mining – Rusk	0	305	168	22	0	0
Total Future Customer Demand	**21,953**	**25,871**	**26,563**	**26,138**	**25,978**	**25,877**

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Jasper Aquifer	65	70	70	70	70	70
Demands (ac-ft/yr)						
Current Demands	45,319	45,319	45,319	45,319	45,319	101,369
Potential Demands with Current and Future Customers	67,272	71,190	71,882	71,457	71,297	127,246
Potential Demands (Limited to Lake Columbia Supply)	21,953	71,190	71,882	71,457	71,297	101,277
Surplus or (Shortage)	**(21,888)**	**(71,120)**	**(71,812)**	**(71,387)**	**(71,227)**	**(101,207)**
Water Management Strategies (ac-ft/yr)						
Recommended Strategy ANRA-COL: Lake Columbia	0	75,720	75,640	75,560	75,480	75,400
Recommended Strategy ANRA-WTP: ANRA Treatment Plant and Distribution System*	0	0	0	0	0	0
Recommended Strategy ANRA-ROR: Mud Creek Run-of-River (Application in process)	10,000	10,000	10,000	10,000	10,000	10,000
Recommended Strategy ANRA-ROR: Mud Creek Run-of-River (New Application)	20,000	20,000	20,000	20,000	20,000	20,000
Recommended Strategy ANRA-GW: New Wells (Carrizo-Wilcox)	0	5,600	5,600	5,000	4,800	4,500
Total Supplies from Strategies	**30,000**	**111,320**	**111,240**	**110,560**	**110,280**	**109,900**
Surplus or (Shortage) with WMS	**8,112**	**40,200**	**39,428**	**39,173**	**39,053**	**8,693**

*Strategy will provide 22,232 ac-ft/yr of treatment capacity from Lake Columbia but will not provide any additional raw water.

Strategy	Yield (ac-ft/yr)	Capital cost	Annual Cost	Unit Cost ($/AF)	Unit Cost ($/1000 gal)
Lake Columbia Reservoir	75,720	$402,862,000	$23,509,000	$311	$0.95
ANRA-WTP: ANRA Treatment Plant and Distribution System*		$228,001,000	$49,839,000	$2,242	$6.88
Recommended Strategy ANRA-GW: New Wells (Carrizo-Wilcox)	5,600	$29,775,000	$3,185,000	$569	$1.75
Mud Creek Run-of-River	30,000	0	0	0	0

*Strategy will provide 22,232 ac-ft/yr of treatment capacity from Lake Columbia but will not provide any additional raw water.



5B.3.2 Angelina Nacogdoches WCID #1

Angelina Nacogdoches WCID#1 (AN WCID #1) is a major water provider to Steam Electric Power demands for Luminant and Nacogdoches Power in Cherokee and Nacogdoches counties, respectively. In addition to these customers, Angelina Nacogdoches WCID#1 has a contract with Henderson in Rusk County for future use. The demand for the wholesale customers is supplied from Lake Striker. Angelina Nacogdoches WCID#1 owns a water right for 20,600 ac-ft/yr from Lake Striker. The entity's supplies are not sufficient to meet the contracted demands, and Angelina Nacogdoches WCID#1 has shortages beginning in 2020. Table below includes a summary of demands and supplies for Angelina Nacogdoches WCID#1. The following recommended strategies were proposed by Angelina Nacogdoches WCID#1 for inclusion in the 2021 Plan.

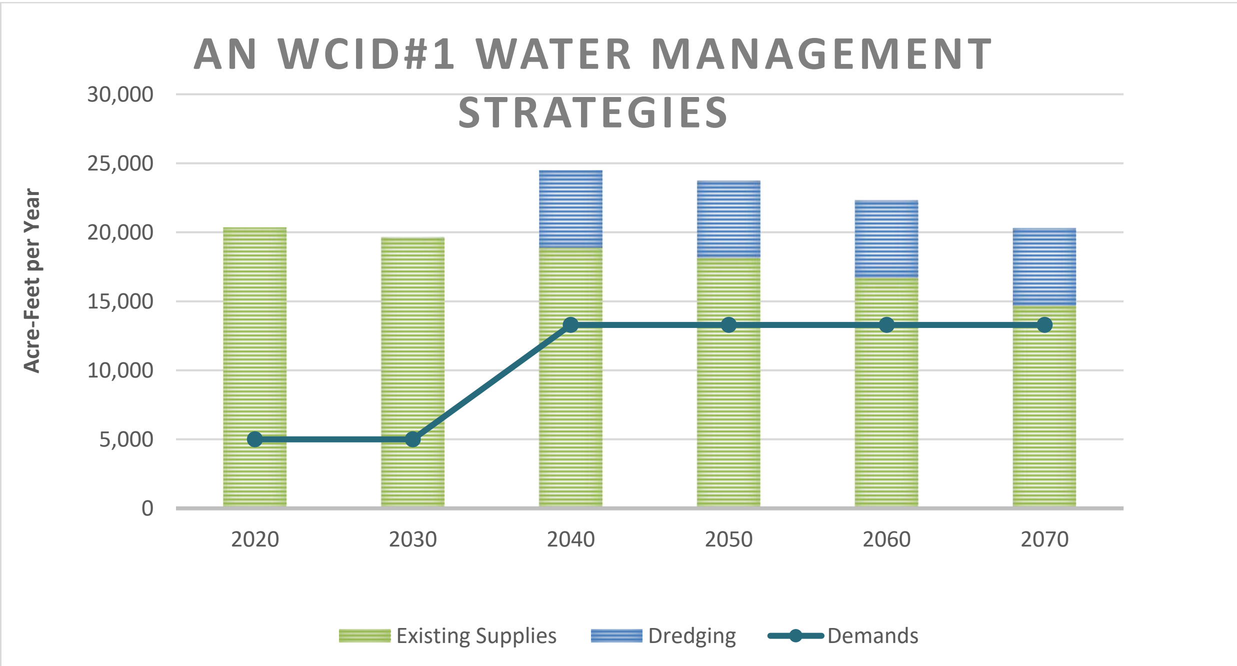
Hydraulic Dredging Operation (Recommended). Angelina Nacogdoches WCID#1 believes that the volumetric survey will result in an additional yield that will address shortages in the first two decades. To address the shortages in the later decades, a second recommended strategy was proposed. The strategy is to conduct hydraulic dredging of Lake Striker to address the Lake sedimentation issues and increase Lake yield. The timing for the dredging operation is expected to be in 2040. Angelina Nacogdoches WCID#1 provided an estimate of the total cost for this strategy. Angelina Nacogdoches WCID#1 also plans to work with TWDB on the adjustment of the normal pool elevation of Lake Striker. The additional yield associated with the normal pool elevation adjustment is not clear at this point; however, it is assumed to yield an approximate amount of 3,500.

Internal studies conducted by Angelina Nacogdoches WCID#1 resulted in higher yield estimates for Lake Striker than those obtained from the Water Availability Model. Angelina Nacogdoches WCID#1 believes that the additional yield in Lake Striker is sufficient to meet the shortages manifested for this entity in this planning cycle. To address this inconsistency, Angelina Nacogdoches WCID #1 is considering conducting volumetric survey of Lake Striker to determine the capacity of the lake and the resulting yield. Angelina Nacogdoches WCID#1 will coordinate with TWDB to schedule the volumetric survey. TWDB will charge a fee for conducting volumetric surveys. A cost estimate is not included for this strategy since this cost will be determined by Angelina Nacogdoches WCID#1 during their negotiations with TWDB.

A summary of the cost estimates for the recommended strategy is provided below. The demands for Angelina Nacogdoches WCID#1 also include a contract with City of Henderson for 8,280 acre-feet per year. While water management strategies are proposed to meet this demand, it was also noted that the contract for City of Henderson is a future demand and the supply to meet this contract is not required in the early decades of the planning cycles.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Lake Striker	20,340	19,635	18,890	18,150	16,715	14,690
Demands (ac-ft/yr)						
Demands	5,000	5,000	13,289	13,289	13,289	13,289
Surplus (Shortage)	**15,340**	**14,635**	**5,601**	**4,861**	**3,426**	**1,401**
Water Management Strategies (ac-ft/yr)						
ANCD-VOL: Hydraulic Dredging (Includes Volumetric Survey and Normal Pool Elevation Change)	0	0	5,600	5,600	5,600	5,600
Surplus or (Shortage) with WMS	**15,340**	**14,635**	**11,201**	**10,461**	**9,026**	**7,001**

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy ANCD-VOL: Hydraulic Dredging Operations (Volumetric Survey and Normal Pool Elevation Adjustment)	5,600	$23,716,000	-	$476	$1.46



5B.3.3 Athens Municipal Water Authority

Athens MWA is a wholesale provider for municipal demand in the City of Athens (Region C and ETRWPA), lakeside irrigation around Lake Athens, Livestock demand in Henderson County (ETRWPA - TPWD Fish Hatchery), and Manufacturing demand in Henderson County (Region C). Athens MWA owns and operates Lake Athens. Athens MWA also owns the Athens WTP, which is operated by the City of Athens. Athens MWA has a water right to divert 8,500 ac-ft/yr from Lake Athens. Of this amount, approximately 5,900 ac-ft/yr can be used to meet projected municipal and manufacturing demands of the City of Athens. Athens MWA also owns a groundwater well on the property of their water treatment plant (WTP) that produces approximately 886 ac-ft/yr, and the City of Athens owns three wells that altogether produce approximately 1,368 ac-ft/yr. There is also a projected local demand of 170 ac-ft/yr for lawn irrigation around the lake. The Athens Fish Hatchery, located at the lake, has a contract with Athens MWA to divert 3,023 ac-ft/yr from Lake Athens to serve the hatchery.

A summary of supplies and demands is included in the table below. The total projected shortages associated with Lake Athens for current customers are 5,567 ac-ft/yr in 2070. Based on the shortages associated with current supplies, Athens MWA has proposed the following WMSs.

Reuse of Fish Hatchery Return Flows (Recommended). A recommended strategy for Athens MWA is the indirect reuse of flows returned from fish hatchery to Lake Athens**.** Currently, approximately 95 to 100 percent of the water diverted for the Fish Hatchery is returned to Lake Athens; however, the fish hatchery is under no contractual obligation to continue this practice. To assure adequate supplies for the fish hatchery and other uses, Athens MWA should work with the fish hatchery to assure that the hatchery continues to return diverted water to Lake Athens for subsequent reuse. For purposes of this plan, it is assumed that 95 percent of the contracted water will be returned. This equates to 2,872 ac-ft/yr of additional supply.

New Groundwater Wells (Recommended). Athens MWA is currently pursuing developing groundwater from the Carrizo-Wilcox aquifer on property near Lake Athens. Based on Athens MWA's total permitted amount in the Carrizo-Wilcox aquifer, it is anticipated that seventeen new wells (with a capacity of 250 gallons per minute each) will be drilled to provide around 2.9 MGD of groundwater supply. The water would be transported directly from the well field to the distribution system.

It should be noted that although Athens MWA has permits to develop the wells, only part of the permitted amount is included in the 2021 Plan as a recommended strategy because current use in the Carrizo-Wilcox aquifer in Henderson County (both in Region C and I) is near the MAG for the county. Due to these MAG limitations, approximately 2,000 acre-feet of supply (10 wells) are included as a recommended strategy for Athens MWA in the 2021 Plan, while the rest of the supply is considered to be an alternate strategy. The strategy will be changed to a recommended strategy when the MAG volumes are updated in the near future. Even with the MAG limitations for this strategy, there are no unmet needs throughout the planning horizon for Athens MWA.

Booster Pump Station Improvements at WTP (Alternative). The firm capacity of the City of Athens' WTP high service pump station (HSPS), which is operated by Athens MWA, is limited. One strategy to address this limitation is to increase the firm capacity of the HSPS is to replace the current 1,200 gpm pump with a 1,600 gpm pump. This is expected to increase the firm capacity of the supply delivered by the HSPS by approximately 0.6 MGD (672 acre-feet per year).

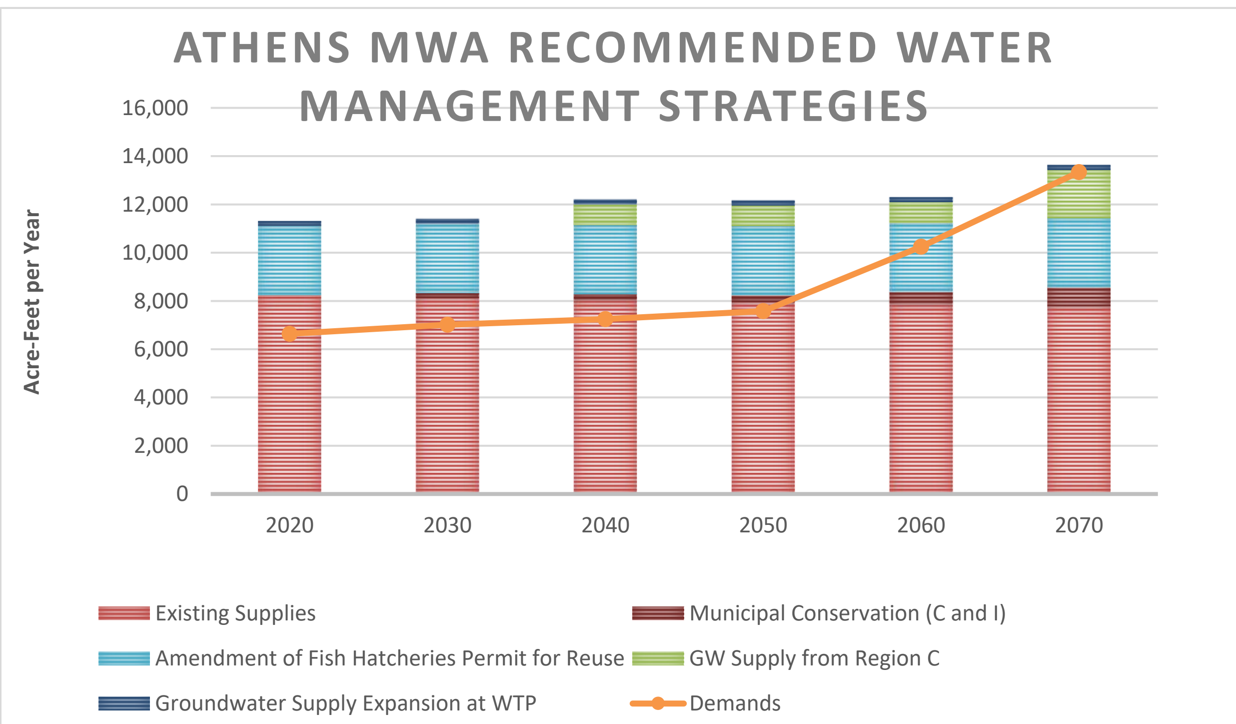
A summary of the amounts and timing of the recommended strategies is presented in the following table and figure.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Lake Athens	5,950	5,864	5,778	5,692	5,606	5,520
Groundwater Well (Athens MWA)	886	886	886	886	886	886
Groundwater Wells (City of Athens)	1,368	1,368	1,368	1,368	1,368	1,368
Total Existing Supplies	8,203	8,117	8,031	7,945	7,859	7,773
Demands (ac-ft/yr)						
Demands (ac-ft/yr)	6,639	7,017	7,245	7,579	10,246	13,340
Surplus (Shortage)	1,564	1,100	786	366	(2,386)	(5,566)
Water Management Strategies (ac-ft/yr)						
AMWA-FH: Indirect Reuse of Flows from Fish Hatcheries	2,872	2,872	2,872	2,872	2,872	2,872
AMWA-GWE: Expanded Groundwater Supply	200	200	200	200	200	200
AMWA-AGW: Athens MWA - New Well(s) in Carrizo Wilcox Aquifer*	0	0	0	0	2,000	2,000
AMWA-BSI: WTP Booster PS Improvement	*450*	*450*	*450*	*450*	*450*	*450*
*New Wells in Carrizo-Wilcox Aquifer (Alternate)**	*1,262*	*1,262*	*1,262*	*1,262*	*1,262*	*1,262*
Surplus or (Shortage) with Recommended and Alternative WMS	**4,784**	**4,784**	**4,784**	**4,784**	**6,784**	**6,784**

Italics indicate alternative strategy.
* Region C strategy.

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy AMWA-FH: Indirect Reuse of Flows from Fish Hatcheries	2,872	$ 0	$ 0	$ 0	$ 0
Recommended Strategy AMWA-GWE: Expanded Groundwater Supply	200	$2,573,000	$218,000	$1,090	$3.35
Recommended Strategy AMWA-AGW: Athens MWA - New Well(s) in Carrizo Wilcox Aquifer*	2,000	$15,151,000	$1,885,000	$943	$2.89
Recommended Strategy AMWA-BSI: WTP Booster PS Improvement	450	$65,000	$57,000	$127	$0.39
*Alternative Strategy: New Wells in Carrizo-Wilcox Aquifer**	*1,262*	*$9,207,000*	*$1,171,000*	*$413*	*$1.27*

* Region C strategy.



5B.3.4 City of Beaumont

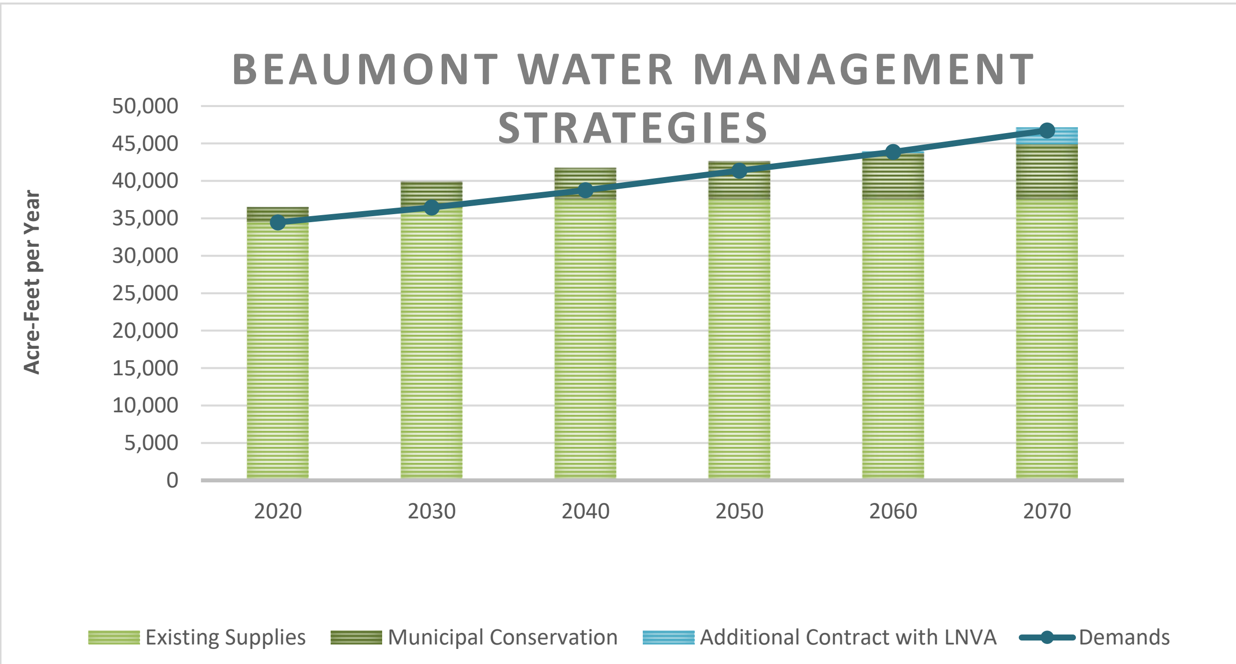
Current supplies include the Neches River, Gulf Coast aquifer, and purchases from Sam Rayburn Reservoir (LNVA); surface water supplies are limited by the City's water treatment plant capacity of 50 MGD. Infrastructure related to groundwater supplies includes three wells with a total capacity of 17 MGD. Beaumont currently supplies water to meet the demands of Jefferson County-Other, Jefferson Manufacturing, and Meeker MWD. Below is the description of the recommended strategy proposed for City of Beaumont in the 2021 Plan.

Municipal Conservation (Recommended). The City is projected to have a water shortage beginning in 2040. In 2011, the City had an average per capita consumption of 219 gpcd, well over the statewide goal of 140 gpcd. After performing a conservation cost analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. This recommended strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce Beaumont's demand by more than their projected need; therefore, municipal conservation is the only recommended WMS for the City. The description of the strategy and cost estimates are included in the discussion on WUG strategies for Jefferson County.

Additional Supplies from LNVA (Recommended). After municipal conservation, the City of Beaumont is still shown to have a need in the 2060 and 2070 decades. Consequently, a recommended strategy is to add an amendment to their supplemental contract with LNVA to obtain additional supplies to meet the rest of their needs.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Municipal Run-of-River	15,407	16,180	17,087	18,254	19,637	20,876
Industrial Run-of-River	526	552	583	623	670	712
Gulf Coast Aquifer	9,500	9,500	9,500	9,500	9,500	9,500
Sam Rayburn (Base LNVA)	6,000	6,000	6,000	6,000	6,000	6,000
Sam Rayburn (Supplemental LNVA)	3,036	4,219	5,603	6,991	8,075	7,718
Total Existing Supplies (Limited by WTP Infrastructure)	**34,469**	**36,451**	**37,525**	**37,525**	**37,525**	**37,525**
Demands (ac-ft/yr)						
Total Demand	**34,469**	**36,451**	**38,773**	**41,368**	**43,882**	**46,743**
Surplus or (Shortage) with Existing Supplies	**0**	**0**	**(1,248)**	**(3,843)**	**(6,357)**	**(9,218)**
Water Management Strategies (ac-ft/yr)						
Municipal Conservation	2,027	3,425	4,202	5,112	6,171	7,382
JEFF-BEA: Additional Contract with LNVA	0	0	0	0	228	2,249
Surplus or (Shortage) with WMSs	**2,027**	**3,425**	**2,954**	**1,270**	**42**	**412**

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	7,382	$60,175,000	$2,076,000	$371	$1.14
Recommended Strategy JEFF-BEA: Amendment to Supplemental Contract with LNVA	2,249	-	$2,199,000	$977	$3.00



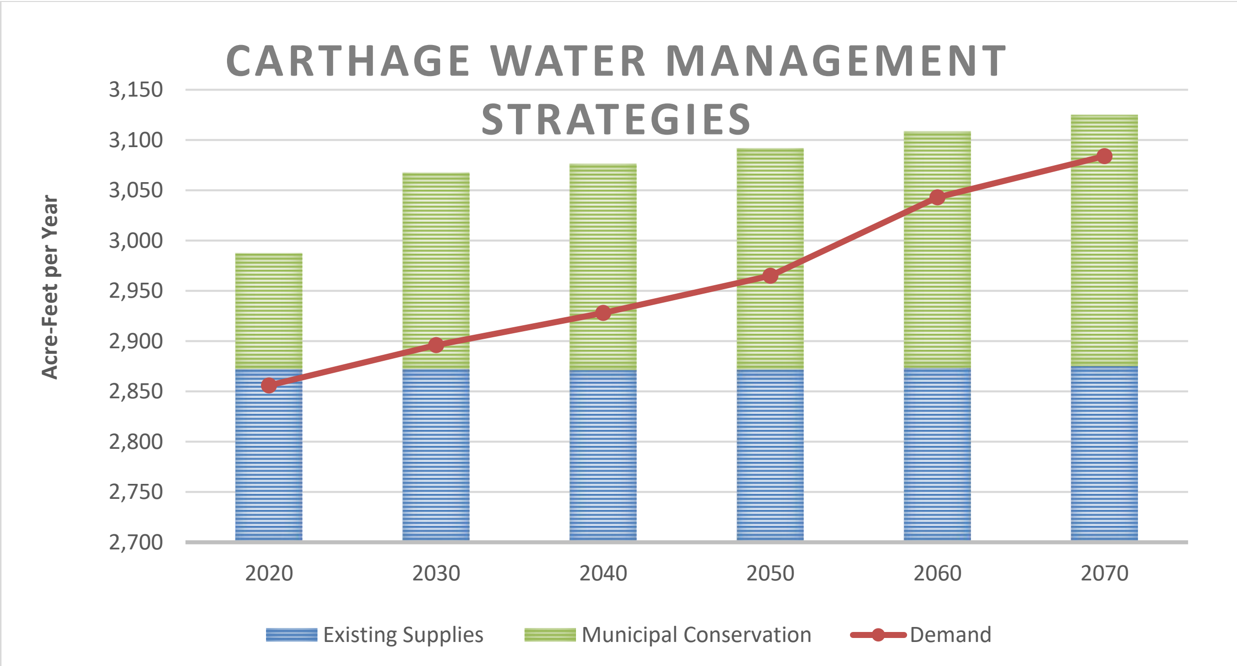
5B.3.5 City of Carthage

City of Carthage is a major water provider in Panola County. The City is the wholesale provider for the Municipal, Manufacturing, and County-Other demands in Panola County. The City owns two groundwater wells that provide approximately 411 ac-ft/yr. The City also has a contract with Panola County Fresh Water Supply District for 12 MGD (13,452 ac-ft/yr) of water from Lake Murvaul. The City's supplies are limited by treatment capacity to 5,695 ac-ft/yr. In this round of planning, City of Carthage has enough supplies to meet the projected demand for the customers in Panola County. Currently, the only water management strategy identified for the City is municipal conservation. If the City signs contracts with additional potential customers, the WMSs will be considered in the next round of planning. Table below summarizes the demands, existing supplies, surplus/deficit values, and municipal conservation volume for the City of Carthage.

Municipal Conservation (Recommended). The City of Carthage had an average per capita over the statewide goal of 140 gpcd in 2011. After performing a conservation cost analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. This recommended strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce the City's demand, increasing the surplus supply available for the City.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Carrizo Wilcox Wells	411	411	411	411	411	411
Lake Murvaul (PC FWSD)	13,452	13,452	13,452	13,452	13,452	13,452
Total Supplies	13,863	13,863	13,863	13,863	13,863	13,863
Total Supplies limited by Treatment Capacity	5,564	5,564	5,564	5,564	5,564	5,564
Demands (ac-ft/yr)						
Total Demand	2,856	2,896	2,928	2,965	3,043	3,084
Surplus or (Shortage)	**2,708**	**2,668**	**2,636**	**2,599**	**2,522**	**2,481**
Water Management Strategies (ac-ft/yr)						
Municipal Conservation	23	39	41	44	47	50
Surplus or (Shortage) with WMSs	**2,731**	**2,707**	**2,677**	**2,643**	**2,569**	**2,531**

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	50	$0	$11,000	$266	$0.82


CARTHAGE WATER MANAGEMENT STRATEGIES
Acre-Feet per Year
3,150
3,100
3,050
3,000
2,950
2,900
2,850
2,800
2,750
2,700
2020
2030
2040
2050
2060
2070
Existing Supplies
Municipal Conservation
Demand

5B.3.6 City of Center

The City of Center provides major water to Shelbyville WSC and Sand Hills WSC in Shelby County. The City also provides water to retail customers in the City of Center and most of the manufacturing demand in Shelby County. City of Center serves Flat Fork WSC, East Lamar WSC, and Five Way WSC, but these WSCs are within the City limits and hence considered as part of the City of Center demands.

City of Center owns water rights for supplies in Lake Center and Lake Pinkston. Currently the City has sufficient supplies to meet the demand in decades 2020 to 2070. The City is planning WMSs to proactively prepare for satisfying any potential additional demand in the decades. Tyson is one of the major manufacturing demand users in Shelby County. Recently Tyson has expanded its plant operations and the current demand for Tyson alone is greater than the projected manufacturing demand for Shelby County. The City noted that the manufacturing demands for Shelby County are under-projected and need to be revised in the next round of planning.

To meet the current demands and higher expected future demands, the City has proposed three WMSs for the planning period, and they are discussed below.

Reuse (Recommended). The City is permitted to use the return flows from the East Bank WWTP. The discharge point for the treated effluent from the WWTP is on a tributary to Mill Creek. The City is planning an indirect reuse project by means of a reuse pipeline from East Bank WWTP to Lake Center. The total capacity for the indirect reuse project will be approximately 1 MGD (1,121 ac-ft/yr) and the project will be online in 2030.

Toledo Bend to Lake Center (Recommended). The City is also planning to purchase water from Sabine River Authority and to transfer water from Toledo Bend Reservoir to Lake Center. The City will construct the raw water transmission pipeline from Toledo Bend Reservoir to Lake Center. At this time, it is not clear how much water Center will purchase from SRA. For planning purposes, it is assumed that the pipeline will be delivering approximately 7.5 MGD at peak capacity and an annual average of 5 MGD (5,605 ac-ft/yr).

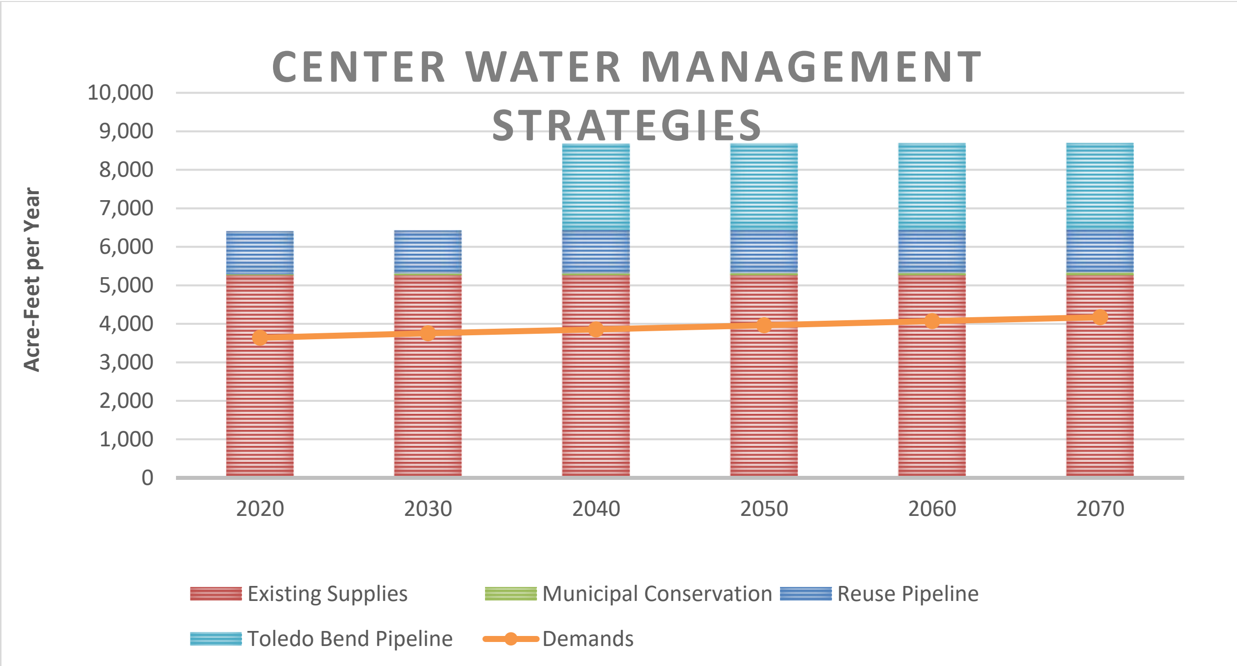
Volumetric Survey of Lake Center and Pinkston Reservoir (Recommended). The City of Center is considering a strategy to conduct volumetric surveys of Lake Center and Pinkston Reservoir to develop an accurate estimate of the capacity of the lakes and thus the yields. The City of Center will coordinate with Texas Water Development Board to get on a schedule for the lake volumetric survey. Texas Water Development Board will charge a fee for conducting volumetric surveys, which is a variable depending on the size of the Lake. This is not proposed as a recommended strategy for City of Center in the 2021 ETRWPA but listed as one of the strategies that the City is considering implementing.

Municipal Conservation (Recommended). In 2011, the City of Center had an average per capita over the statewide goal of 140 gpcd. After performing a conservation cost analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. This recommended strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce the City's demand, increasing the surplus supply available for the City.

A summary of demands, existing supplies, and supplies from WMSs is listed in the table below. A summary of cost estimates is also included in the table below. For a more detailed summary of the WMSs, see the applicable technical memorandums in Appendix 5B-A.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Lake Center	1,460	1,460	1,460	1,460	1,460	1,460
Lake Pinkston	3,800	3,800	3,800	3,800	3,800	3,800
Demands (ac-ft/yr)						
Total Demand	3,640	3,753	3,855	3,961	4,069	4,170
Surplus or (Shortage)	**1,620**	**1,507**	**1,405**	**1,299**	**1,191**	**1,090**
Water Management Strategies (ac-ft/yr)						
Municipal Conservation	26	45	52	57	64	70
CENT-REU: Reuse Pipeline from WWTP to Lake Center	0	1,121	1,121	1,121	1,121	1,121
CENT-TOL: Pipeline from Toledo Bend to Lake Center	0	0	2,242	2,242	2,242	2,242
CENT-VOL: Volumetric Surveys of Lake Center and Lake Pinkston	0	0	0	0	0	0
Total Supplies from Strategies	26	1,166	3,415	3,420	3,427	3,433
Surplus or (Shortage) with WMS	**1,646**	**2,673**	**4,820**	**4,719**	**4,618**	**4,523**

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Municipal Conservation	70	$0	$11,000	$188	$0.58
Recommended Strategy CENT-REU: Reuse Pipeline from WWTP to Lake Center	1,121	$2,456,000	$262,000	$234	$0.72
Recommended Strategy CENT-TOL: Pipeline from Toledo Bend	2,242	$27,775,000	$3,462,000	$1,544	$4.74
Recommended Strategy CENT-VOL: Volumetric Surveys of Lake Center and Lake Pinkston	0	$0	$0	$0	$0


CENTER WATER MANAGEMENT STRATEGIES
Acre-Feet per Year
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2020
2030
2040
2050
2060
2070
Existing Supplies
Municipal Conservation
Reuse Pipeline
Toledo Bend Pipeline
Demands

5B.3.7 Houston County WCID #1

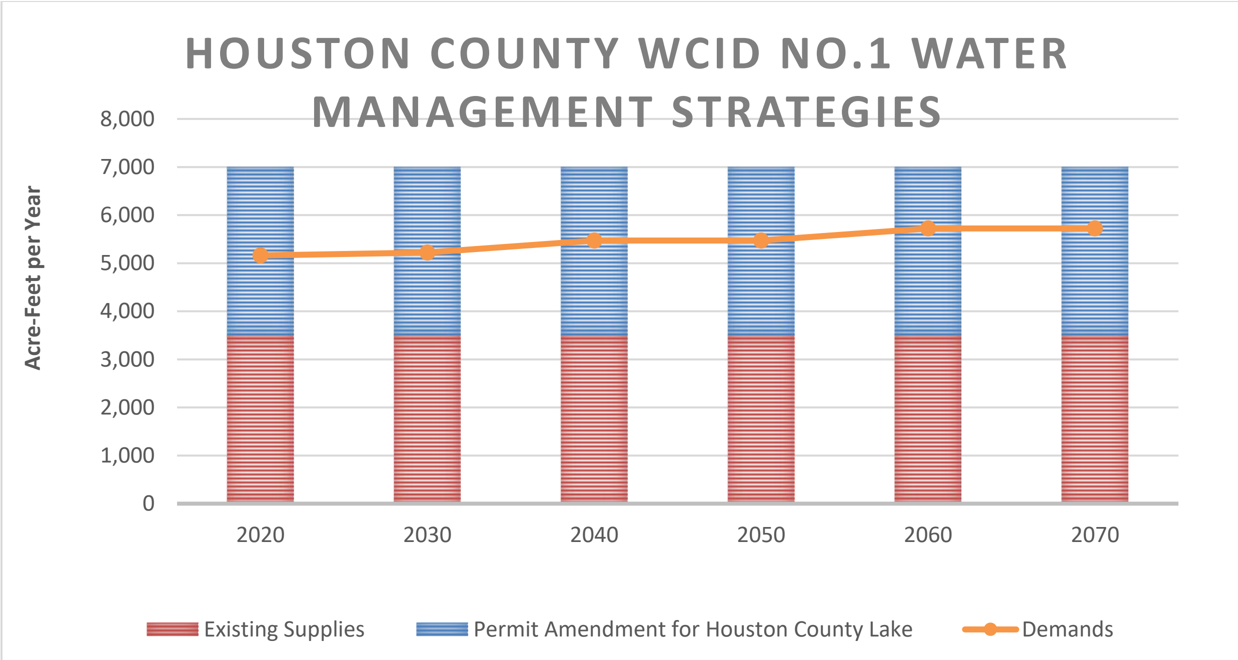
Houston County WCID #1 owns and operates Houston County Lake in the Trinity River Basin in Houston County. This reservoir was originally permitted for 7,000 ac-ft/yr; however, the TCEQ reduced the permitted diversion to 3,500 ac-ft/yr in 1987. In 2009, Houston County WCID #1 applied to the TCEQ for a permit amendment to return their permitted diversion to the firm yield of the lake and add industrial use to the permit. Houston County WCID #1 upgraded their water treatment plant capacity from 3.1 MGD to 6.2 MGD in 2010.

Permit Amendment for Houston County Lake (Recommended). Since 2007, Houston County WCID #1 has received multiple requests for additional water supplies from entities and business including the City of Crockett, the Crockett Economic & Industrial Development Corporation, The Consolidated WSC, Nacogdoches Power, LLC, and the Houston County Judge, Erin Ford. This permit amendment is essential to meet the projected demands of both existing and future customers including The Consolidated WSC, the Cities of Crockett, Grapeland, and Lovelady, Houston county-Other, Houston Manufacturing, Nacogdoches Mining, and Nacogdoches Steam Electric Power. Therefore, the permit amendment is proposed as the recommended strategy for Houston County WCID #1. Environmental flow requirements associated with the permit amendment are currently being negotiated with the TCEQ. It is assumed that there are little to no capital costs associated with the amendment (only engineering and legal costs).

Groundwater Supplies (Alternative). In the event Houston County WCID #1 is unable to reacquire all of their original water rights from the TCEQ, an alternative water management strategy is being added for this entity to develop new wells in the Carrizo-Wilcox aquifer.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Houston County Lake	3,500	3,500	3,500	3,500	3,500	3,500
Total Water Demands (ac-ft/yr)						
Demands	2,788	2,851	2,851	2,851	2,851	2,851
Surplus or (Shortage) with Existing Supplies and Demands (ac-ft/yr)						
Surplus or (Shortage)	712	649	649	649	649	649
Water Management Strategies (ac-ft/yr)						
HCWC-PA: Permit Amendment for Houston County Lake	3,500	3,500	3,500	3,500	3,500	3,500
HCWC-GW: New Wells (Carrizo-Wilcox)	3,500	3,500	3,500	3,500	3,500	3,500
Surplus or (Shortage) with WMS	**7,712**	**7,649**	**7,649**	**7,649**	**7,649**	**7,649**

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy HCWC-PA: Permit Amendment of Houston County Lake	3,500	0	0	0	0
Recommended Strategy HCWC-GW: New Wells (Carrizo-Wilcox)	3,500	$22,793,000	$1,827,000	$522	$1.60


HOUSTON COUNTY WCID NO.1 WATER MANAGEMENT STRATEGIES
Acre-Feet per Year
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2020
2030
2040
2050
2060
2070
Existing Supplies
Permit Amendment for Houston County Lake
Demands

5B.3.8 City of Jacksonville

The City of Jacksonville has sufficient raw water and treatment capacity to meet its projected customer demands for the planning period. Jacksonville has a water right to use 6,200 ac-ft/yr from Lake Jacksonville, but available supply is limited treatment plant capacity. The City has several constraints to providing treated surface water to all its customers. The City's existing surface water treatment plant is currently underutilized and could provide more surface water with the necessary infrastructure improvements. Currently, the City operates the treatment plant for only part of the day. The City may be able to treat more raw water either by implementing infrastructure improvements to the treatment system or by operating the plant for longer time each day. It is recommended that the City of Jacksonville implement infrastructure improvements to fully utilize its existing water sources. City of Jacksonville has chosen to not implement this strategy at this time.

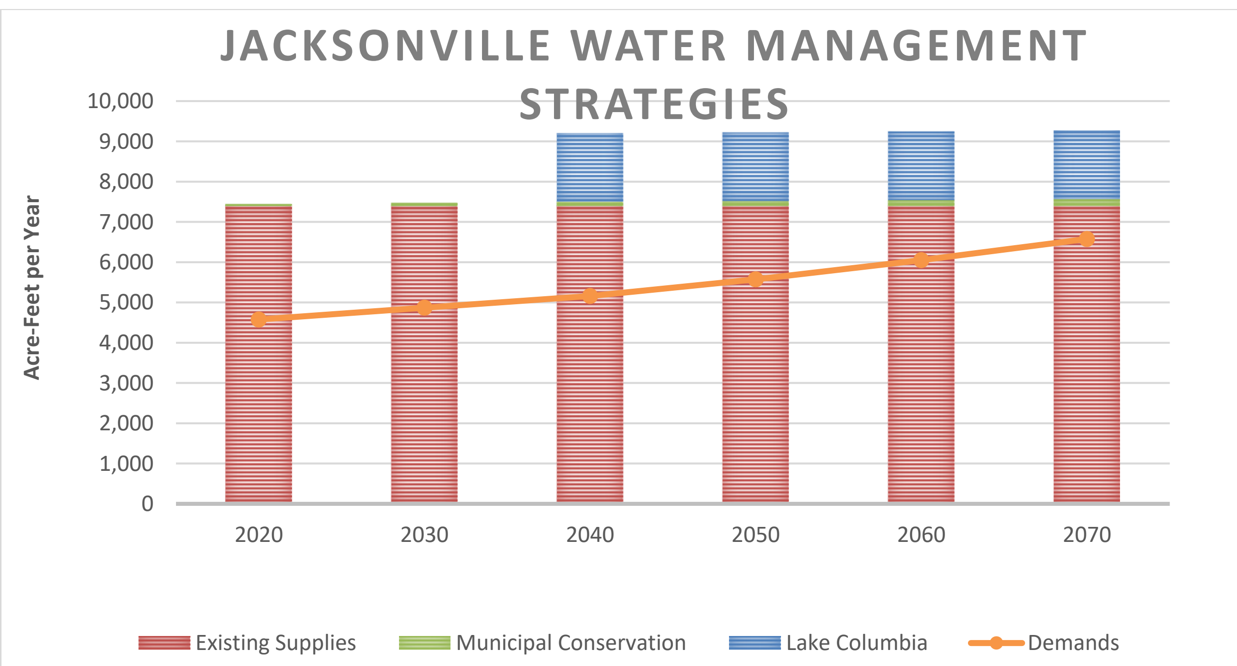
Raw Water Transmission System from Lake Columbia (Recommended). The recommended strategy for City of Jacksonville is a transmission and treatment system to access City's contracted supplies from Lake Columbia. The City of Jacksonville is a participant in the Lake Columbia project. Jacksonville has a contract with Angelina & Neches River Authority for 4,275 ac-ft/yr from Lake Columbia. Lake Columbia will provide a source of additional raw water for Jacksonville beyond this planning period or sooner if the City grows faster than projected. This strategy assumes that water would be diverted at Lake Columbia and transported to Jacksonville for treatment and distribution. It is assumed that the first phase of this project would develop 1,700 ac-ft/yr (1.6 MGD). Subsequent phases would fully develop the City's contracted amount.

Municipal Conservation (Recommended). The City of Carthage had an average per capita over the statewide goal of 140 gpcd in 2011. After performing a conservation cost analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. This recommended strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce the City's demand, increasing the surplus supply available for the City.

The Columbia to Jacksonville Raw Water Transmission System and Municipal Conservation are the recommended WMSs for City of Jacksonville. Owing to the lack of shortages in supplies to current contracted customers and the low projected growth, the transmission system from Lake Columbia is assumed to be a long-term future strategy and not current. A summary of current contracted customer demands, existing supplies, and additional supplies from future WMS is summarized in the table below. A summary of cost estimates for the recommended WMS is listed below. A detailed project summary is included in each WMS technical memorandum in Appendix 5B-A.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Lake Jacksonville	5,173	5,173	5,173	5,173	5,173	5,173
Lake Acker	0	0	0	0	0	0
Carrizo Wilcox Aquifer	2,218	2,218	2,218	2,218	2,218	2,218
Total Existing Supplies	7,391	7,391	7,391	7,391	7,391	7,391
Current Water Demands (ac-ft/yr)						
Demands	4,577	4,868	5,160	5,572	6,050	6,577
Surplus or (Shortage) with Existing Supplies and Demands (ac-ft/yr)						
Surplus or (Shortage)	2,814	2,523	2,231	1,819	1,341	814
Water Management Strategies (ac-ft/yr)						
Municipal Conservation	50	85	110	129	152	178
JACK-COL: Supply from Lake Columbia	0	0	1,700	1,700	1,700	1,700
Surplus or (Shortage) with WMS	**2,864**	**2,608**	**4,041**	**3,648**	**3,193**	**2,692**

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Municipal Conservation	178	$0	$42,000	$291	$1.00
Recommended Strategy JACK-COL: Supply from Lake Columbia	1,700	$ 29,390,000	$ 3,150,000	$ 1,853	$ 5.69



5B.3.9 Lower Neches Valley Authority

Current supplies for the Lower Neches Valley Authority include the Neches River, the B.A. Steinhagen Lake/Sam Rayburn Reservoir system (Sam Rayburn Reservoir), and a run-of-the-river diversion from the Trinity River in Region H. LNVA provides water to several WUGs in the ETRWPA and Region H. The projected water demands supplied by LNVA total over 400,000 ac-ft/yr in 2070. In addition to these demands, there are over 400,000 ac-ft/yr in potential future demands from existing and future customers by 2070. LNVA is pursuing five recommended WMSs to increase its reliable water supplies and to increase its infrastructure to provide conveyance to future customers. These include:

- Purchase from SRA (Toledo Bend Reservoir)
- Neches-Trinity Basin Interconnect
- Beaumont West Regional Reservoir

In addition to these strategies, the construction of Rockland Reservoir is recommended as an alternative water management strategy. A brief discussion of each strategy is presented below.

Purchase from Sabine River Authority (Toledo Bend Reservoir) (Recommended). The proximity of the Sabine River Basin could make the transfer of water from the Sabine River a feasible strategy. The strategy would require a contract with SRA, approximately 13 miles of pipeline, 17 miles of open canals, and 2 pump stations. The strategy is estimated to provide approximately 200,000 ac-ft/yr of supplies for LNVA's customers.

Beaumont West Regional Reservoir (Recommended). This recommended strategy involves the construction of an approximate 1,100-acre reservoir on the northwest end of Beaumont. The reservoir is anticipated to have an approximate capacity of 7,700 acre-feet, which is equivalent to approximately three (3) weeks of water supply to meet municipal and industrial demands downstream. This reservoir is located so that stored water can be sent to all industrial and municipal customers on the LNVA system. In addition, the location of the reservoir provides a significant advantage to provide water in case of an emergency fire water demand, source pollution in the Neches River or Pine Island Bayou, or losses of either of the LNVA pumping stations in severe events, such as what occurred during Hurricane Harvey.

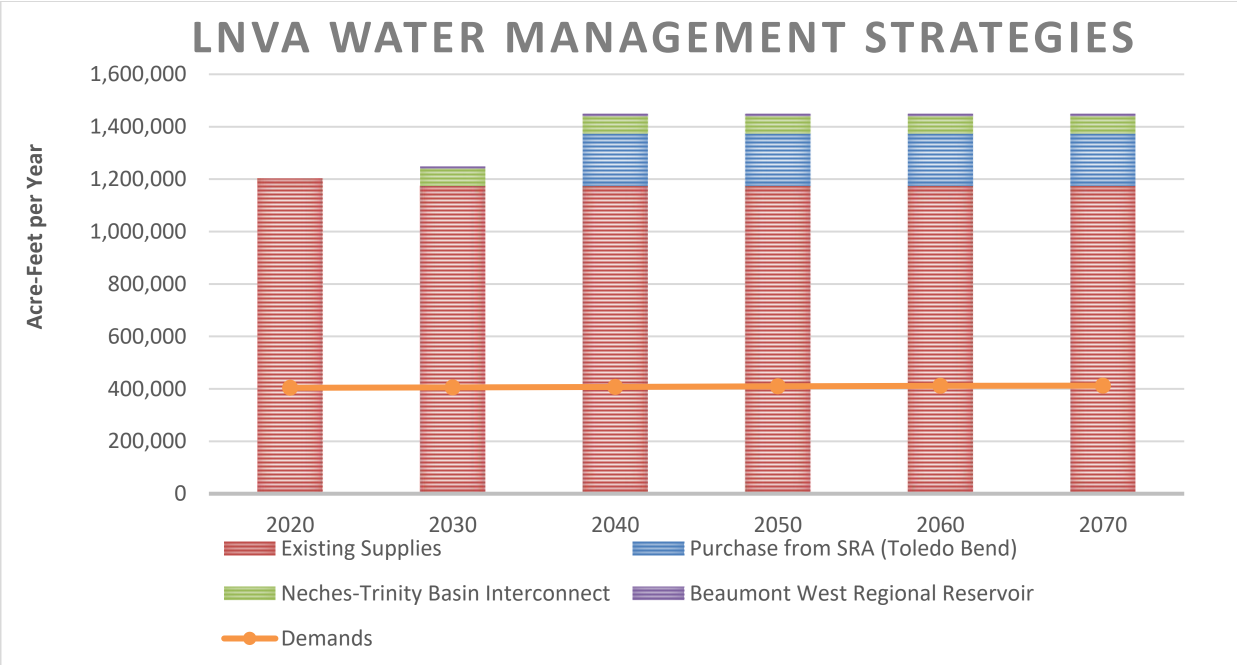
Neches-Trinity Basin Interconnect (Recommended). LNVA is planning to construct an approximate 13 mile, single 84-inch pipeline that runs in an east-west direction, as well as a 62,000 gpm pump station. The proposed pipeline enables the movement of Neches River water westward toward the upper reaches of the Devers Canal system and potentially back into the Trinity River. The water from this strategy will enable LNVA to provide water for irrigation customers in Region H, as well as to serve new industries as they emerge along the IH-10 corridor.

Rockland Reservoir (Alternative Strategy). Rockland Reservoir was authorized for construction, as a federal facility, in 1945 along with Sam Rayburn Reservoir, Lake B. A. Steinhagen and Dam A Lake. A 1947 report recommended construction of Sam Rayburn Reservoir and Lake B.A. Steinhagen with deferral of Rockland Reservoir and Dam A until such time the need develops. The Rockland Reservoir site is located on the Neches River at River Mile 160.4. The top of the flood pool would be at elevation 174 ft. msl with the conservation pool at 165 ft. msl. The Reservoir Site Protection Study updated the yield and costs for the Rockland Reservoir using ENR indexing (TWDB, 2007). No recent detailed cost data has been developed for Rockland Reservoir. Based on the TWDB study, the estimated yield of Rockland is 614,400 ac-ft/yr and the unit cost of water is $0.43 per 1000 gallons (updated to September 2013 dollars). More detailed studies are needed to confirm the yield and costs for this project.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Sam Rayburn / B.A. Steinhagen	792,000	792,000	792,000	792,000	792,000	792,000
Pine Island Bayou Run-of-River*	381,876	381,876	381,876	381,876	381,876	381,876
Lufkin (Sam Rayburn)	28,000	0	0	0	0	0
Total Existing Supplies	**1,201,876**	**1,173,876**	**1,173,876**	**1,173,876**	**1,173,876**	**1,173,876**
Demands (ac-ft/yr)						
Demand	404,039	405,656	407,380	409,518	411,566	412,303
Surplus or (Shortage)	**797,837**	**768,221**	**766,496**	**764,358**	**762,310**	**761,573**
Water Management Strategies (ac-ft/yr)						
LNVA-SRA: Purchase from SRA (Toledo Bend)	0	0	200,000	200,000	200,000	200,000
LNVA-WRR: Beaumont West Regional Reservoir	0	7,700	7,700	7,700	7,700	7,700
LNVA-RGH: Neches-Trinity Basin Interconnect	0	67,000	67,000	67,000	67,000	67,000
Total Increase in Supplies from WMSs	0	74,700	274,700	274,700	274,700	274,700
Surplus or (Shortage) with WMSs	**797,837**	**842,921**	**1,041,196**	**1,039,058**	**1,037,010**	**1,036,273**

* Pumping plants are located on the Pine Island Bayou but will draft water from the Neches River

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy LNVA-SRA: Purchase from SRA (Toledo Bend)	200,000	$529,606,000	$110,157,000	$551	$1.69
Recommended Strategy LNVA-WRR: Beaumont West Regional Reservoir	7,700	$37,538,000	$1,970,00	$256	$0.79
Recommended Strategy LNVA-RGH: Neches-Trinity Basin Interconnect	67,000	$102,375,000	$8,907,000	$133	$0.41


LNVA WATER MANAGEMENT STRATEGIES
Acre-Feet per Year
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
2020
2030
2040
2050
2060
2070
Existing Supplies
Purchase from SRA (Toledo Bend)
Neches-Trinity Basin Interconnect
Beaumont West Regional Reservoir
Demands

5B.3.10 City of Lufkin

The City of Lufkin currently relies on groundwater from the Carrizo-Wilcox aquifer and surface water from Lake Kurth and Sam Rayburn Reservoir. The City's groundwater infrastructure includes 25 wells, including 14 wells acquired from the Abitibi Bowater Corporation. Currently, twelve of the wells provide potable water. Two additional wells have been upgraded to provide potable water, but they are currently permitted for Industrial use and are being re-permitted for Municipal use. The City plans to convert two non-potable wells per year to provide potable water; these upgrades will be complete by 2020. The City provides water to Diboll, Huntington, Redland WSC, Angelina County-Other (Burke, Angelina Freshwater Supply, and Woodlawn WSC) and Manufacturing, Steam Electric Power, and Irrigation demands in Angelina County. Lufkin has a recommended WMS to expand their developed supplies and provide conveyance from Sam Rayburn Reservoir to Lake Kurth. With additional groundwater and surface water supplies, the City expects to provide up to an additional 16 MGD of water to meet industrial demands in Angelina County. In addition, municipal conservation is considered as a recommended WMS from 2020 to 2040 for the City to reduce municipal demands.

While the City of Lufkin does not show a water supply shortage within the planning period, Angelina Manufacturing does. Therefore, the ETRWPG is recommending that a portion of the supplies developed by the City of Lufkin be used to meet the projected industrial needs in the county. The City of Lufkin's recommended strategies are described below.

Develop Sam Rayburn Reservoir Water Rights (Recommended). To meet the City of Lufkin's long-term water needs, Lufkin is continuing to plan and develop a water management strategy to utilize its surface water rights in Sam Rayburn Reservoir. In the late 1960's, the City of Lufkin purchased storage and water production rights for surface water from Sam Rayburn Reservoir through contracts with the LNVA and the U.S. Army Corp of Engineers. The City has a water right to divert up to 28,000 ac-ft annually of surface water from the reservoir. This equates to an average withdrawal rate of 25 MGD.

With the acquisition of Lake Kurth, the long-range plan is to expand the surface water treatment plant near Lake Kurth and treat raw water from Sam Rayburn Reservoir at the expanded facility. For planning purposes, it is assumed that water from Sam Rayburn Reservoir will be diverted from the northern end of the Lake and transported through a 36-inch pipeline. The treatment plant proposed at Lake Kurth will be initially expanded from 16 MGD to 25 MGD with the potential for further expansions beyond this planning period. This strategy is expected to be developed in three phases, with the first phase to develop access to 10 MGD of Sam Rayburn supplies by 2020, second phase with an additional 10 MGD capacity expansion by 2030, and the final phase of 5 MGD capacity expansion by 2040. The initial size of the treatment facility will depend on the projected needs at the time.

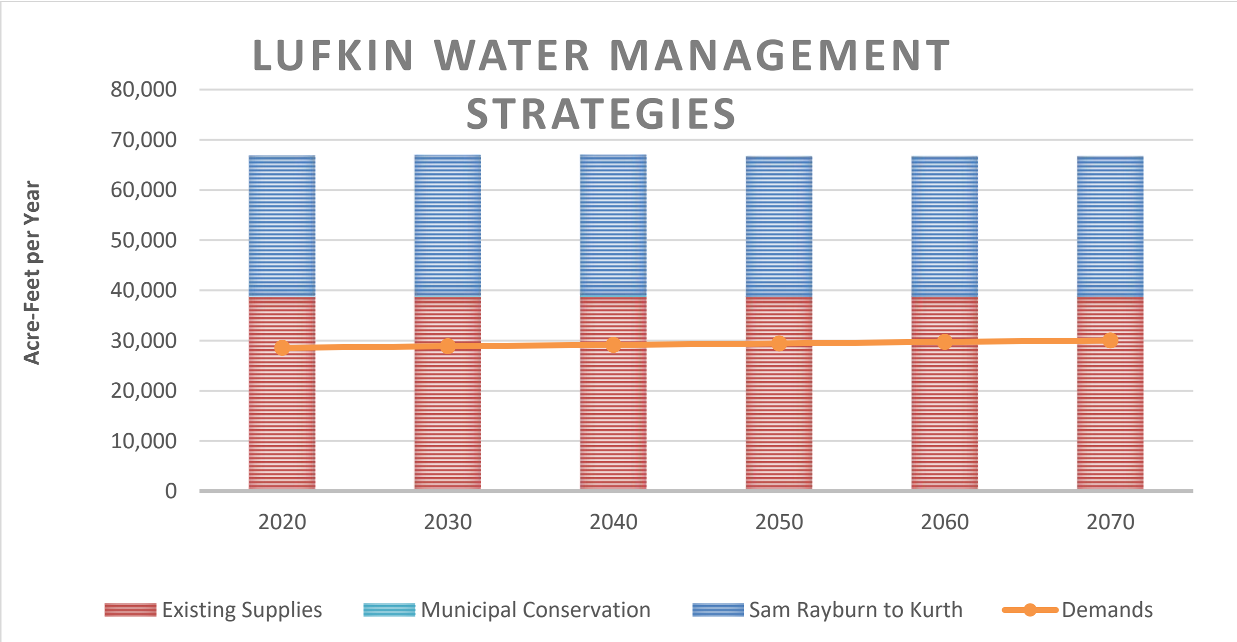
Municipal Conservation (Recommended). In 2011, the City of Lufkin had an average per capita over the statewide goal of 140 gpcd. After performing a conservation cost analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. This recommended strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce the City's demand, increasing the surplus supply available for the City.

The supplies and demands associated with the City of Lufkin are shown in the following table and figure.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Carrizo-Wilcox	20,227	20,227	20,227	20,227	20,227	20,227
Lake Kurth	18,500	18,500	18,500	18,500	18,500	18,500
Sam Rayburn Reservoir (to LNVA)	28,000	0	0	0	0	0
Total Existing Supplies	**66,727**	**38,727**	**38,727**	**38,727**	**38,727**	**38,727**
Demands (ac-ft/yr)						
Total Demand	56,555	28,891	29,138	29,419	29,728	30,014
Surplus (Shortage)	**10,172**	**9,836**	**9,589**	**9,308**	**8,999**	**8,713**
Water Management Strategies (ac-ft/yr)						
Municipal Conservation	151	239	273	0	0	0
LUFK-RAY: Conveyance from Sam Rayburn to Kurth Lake	0	11,210	22,420	28,000	28,000	28,000
Surplus or (Shortage) with WMS	**10,323**	**21,046**	**32,009**	**37,308**	**36,999**	**36,713**

Estimates of capital costs for the Lufkin strategies are included in the table below.

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Municipal Conservation	273	$0	$60,000	$271	$0.83
Recommended Strategy LUFK-RAY: Sam Rayburn Supply – Phase 1 (2030)	11,210	$78,220,000	$14,413,000	$1,286	$3.95
Recommended Strategy LUFK-RAY: Sam Rayburn Supply – Phase 2 (2040)	11,210	$78,199,000	$27,911,000	$1,255	$3.85
Recommended Strategy LUFK-RAY: Sam Rayburn Supply – Phase 3 (2050)	5,580	$8,834,000	$25,722,000	$919	$2.82


LUFKIN WATER MANAGEMENT STRATEGIES
Acre-Feet per Year
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2020
2030
2040
2050
2060
2070
Existing Supplies
Municipal Conservation
Sam Rayburn to Kurth
Demands

5B.3.11 City of Nacogdoches

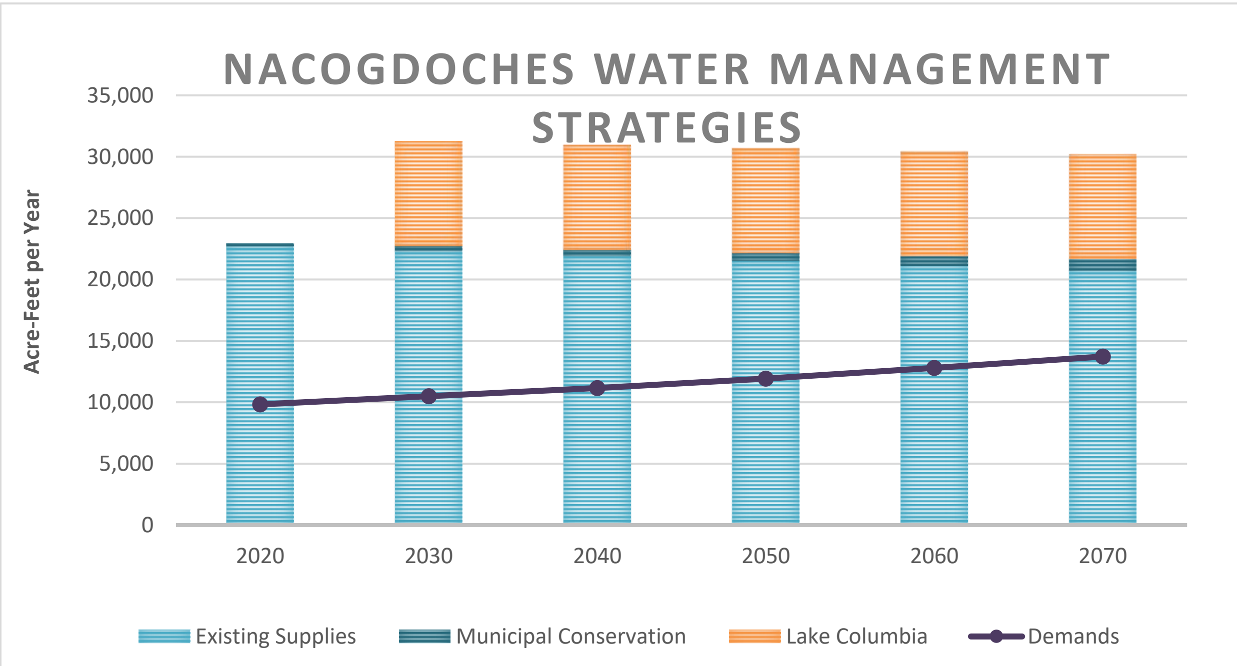
The City of Nacogdoches utilizes groundwater from the Carrizo-Wilcox aquifer and surface water from Lake Nacogdoches. In addition to the City of Nacogdoches retail customers, the City is a major water provider to Appleby WSC, D & M WSC, Nacogdoches MUD#1, Lily Grove SUD, and Melrose WSC. Most, if not all, of the manufacturing demands in the county are also supplied by the City. The Neches WAM shows the firm yield of Lake Nacogdoches to be approximately 16,200 ac-ft/yr by 2020, reducing to 14,200 ac-ft/yr by 2070. Groundwater from the Carrizo-Wilcox aquifer is used to supply much of the southern part of the city, and the City of Nacogdoches has been increasing its groundwater supplies to better serve this section of the city. The City has also developed two new wells, rehabilitated two existing wells, and is in the process of developing another new well. With the City's existing groundwater supplies, Nacogdoches has a reliable supply of approximately 21,000 ac-ft/yr. This supply is sufficient to meet the projected demands in this plan, but the City's current water planning efforts indicate greater population growth and higher demands by the commercial and manufacturing sectors than projected by the TWDB. Therefore, the City has two recommended strategies in the 2021 Regional Water Plan.

Raw Water Transmission System to Lake Columbia (Recommended). The City of Nacogdoches is pursuing one recommended WMS to increase the reliability of its supplies and provide for projected growth using surface water from Lake Columbia. The City of Nacogdoches is also among those contracted for participation in the Lake Columbia project. The City proposes to obtain raw water from Lake Columbia to transmit to Lake Nacogdoches. The existing treatment plant would be expanded to treat the additional water. Currently, there are no alternative strategies proposed for City of Nacogdoches. A summary of demands, existing supplies, and increased supplies from WMSs is provided in the table below. Cost estimates were developed for the raw water transmission system from Lake Columbia to City of Nacogdoches. A summary of cost estimates is included in the table below.

Municipal Conservation (Recommended). The City of Nacogdoches had an average per capita over the statewide goal of 140 gpcd in 2011. After performing a conservation cost analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. This recommended strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce the City's demand, increasing the surplus supply available for the City.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Carrizo-Wilcox	6,492	6,492	6,492	6,492	6,492	6,492
Lake Nacogdoches	16,200	15,800	15,400	15,000	14,600	14,200
Demands (ac-ft/yr)						
Total Demand	9,831	10,498	11,161	11,929	12,802	13,726
Surplus or (Shortage)	**12,861**	**11,794**	**10,731**	**9,563**	**8,290**	**6,966**
Water Management Strategies (ac-ft/yr)						
Municipal Conservation	247	426	532	656	802	966
NACP-COL: Lake Columbia to Nacogdoches Raw Water Transmission System	0	8,551	8,551	8,551	8,551	8,551
Surplus or (Shortage) with WMS	**13,108**	**20,771**	**19,814**	**18,770**	**17,643**	**16,483**

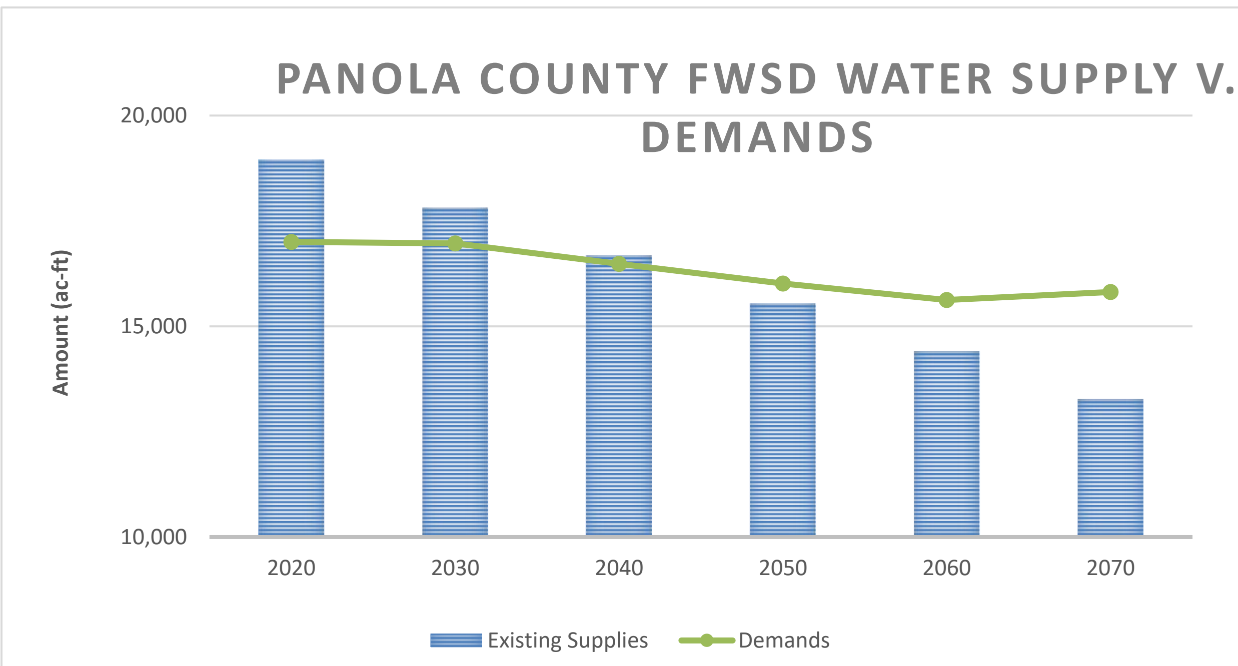
Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Municipal Conservation	966	$27,720,000	$986,000	$1,349	$4.14
Recommended Strategy NACP-COL: Lake Columbia to Nacogdoches Raw Water Transmission System	8,500	$50,754,000	$6,739,000	$788	$2.42



5B.3.12 Panola County Fresh Water Supply District

Panola County Fresh Water Supply District (PC FWSD) is a major water provider in Panola County. PC FWSD is the wholesale provider to City of Carthage and Mining demands in Panola County. PC FWSD owns and operates Lake Murvaul and has a water right for 22,400 ac-ft/yr. In this round of planning, PC FWSD has enough supplies to meet the projected customer demand for the planning period 2020-2070. Currently, no WMSs were identified for this entity. Table below summarizes the demands, existing supplies, and surplus/deficit values.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Lake Murvaul	21,367	20,686	20,006	19,325	18,644	17,963
Demands (ac-ft/yr)						
Total Demand	17,002	16,967	16,481	16,013	15,624	15,815
Surplus or (Shortage)	**4,365**	**3,719**	**3,525**	**3,312**	**3,020**	**2,148**



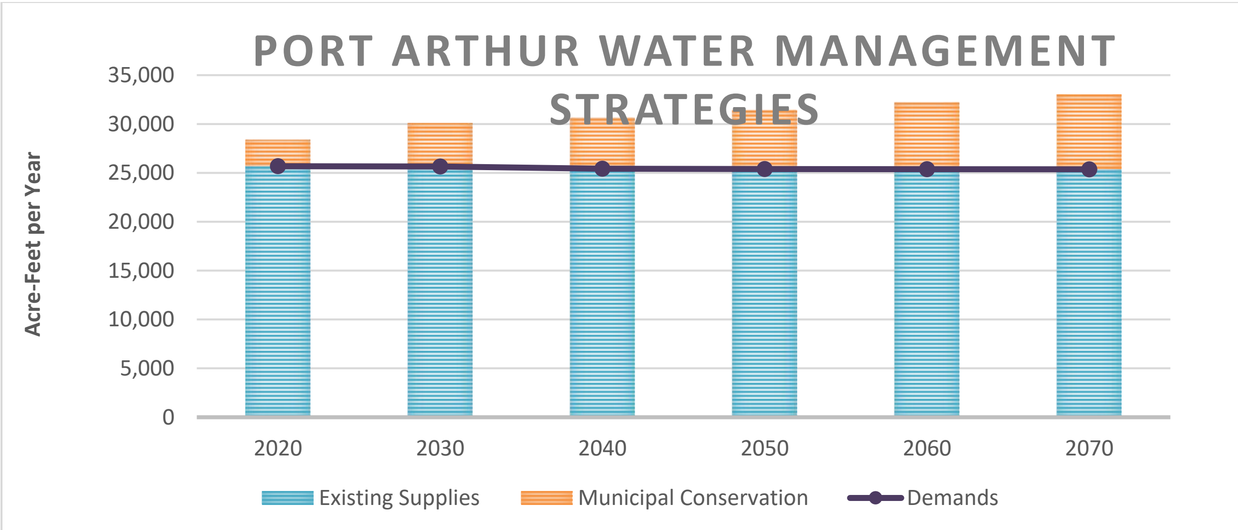
5B.3.13 City of Port Arthur

Current supplies for the City of Port Arthur include raw surface water from Sam Rayburn Reservoir (LNVA). LNVA provides 100 percent of the City's demands; this supply is limited by Port Arthur's water treatment plant capacity of 20 MGD. Construction to upgrade the treatment plant to 40 MGD began in 2014. The City provides treated water to municipal users both inside and outside the city limits and to industrial users including Cheniere LNG and Motiva Enterprises. Below is a description of the recommended WMS for Port Arthur.

Municipal Conservation (Recommended). Port Arthur is not projected to have a water shortage within the planning period. However, the City had an average per capita consumption of 320 gpcd in 2011. This value is well over the statewide goal of 140 gpcd. In addition, their 2013 Water Loss Report submitted to the TWDB had a total percent loss of over 66%. After performing a conservation analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. The recommended water management strategy for Port Arthur is water conservation, which includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Sam Rayburn/B.A. Steinhagen (LNVA)	25,682	25,653	25,432	25,387	25,368	25,367
Demands (ac-ft/yr)						
Total Demand	25,682	25,653	25,432	25,387	25,368	25,367
Existing Surplus / (Shortage)	0	0	0	0	0	0
Water Management Strategies (ac-ft/yr)						
Water Conservation	2,708	4,449	5,222	6,029	6,844	7,664
Surplus /(Shortage) with WMSs	2,708	4,449	5,222	6,029	6,844	7,664

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Municipal Conservation	7,664	$51,618,000	$1,981,000	$295	$0.91


PORT ARTHUR WATER MANAGEMENT STRATEGIES
Acre-Feet per Year
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2020
2030
2040
2050
2060
2070
Existing Supplies
Municipal Conservation
Demands

5B.3.14 Sabine River Authority

The SRA is based in the North East Texas planning area (Region D) and the ETRWPA. SRA currently provides water from its Lower Basin system (Toledo Bend Reservoir and the canal system) to water users in the ETRWPA. The SRA provides water from its Upper Basin reservoirs (Lake Tawakoni and Lake Fork) to water users in Region C and the North East Texas planning area (Region D). These sources are fully contracted and SRA has requests for additional water in the Upper Basin. The supply and demand evaluation for the Upper Basin reservoirs is not included in this plan. The upper basin supplies are discussed in Region C and Region D regional plans.

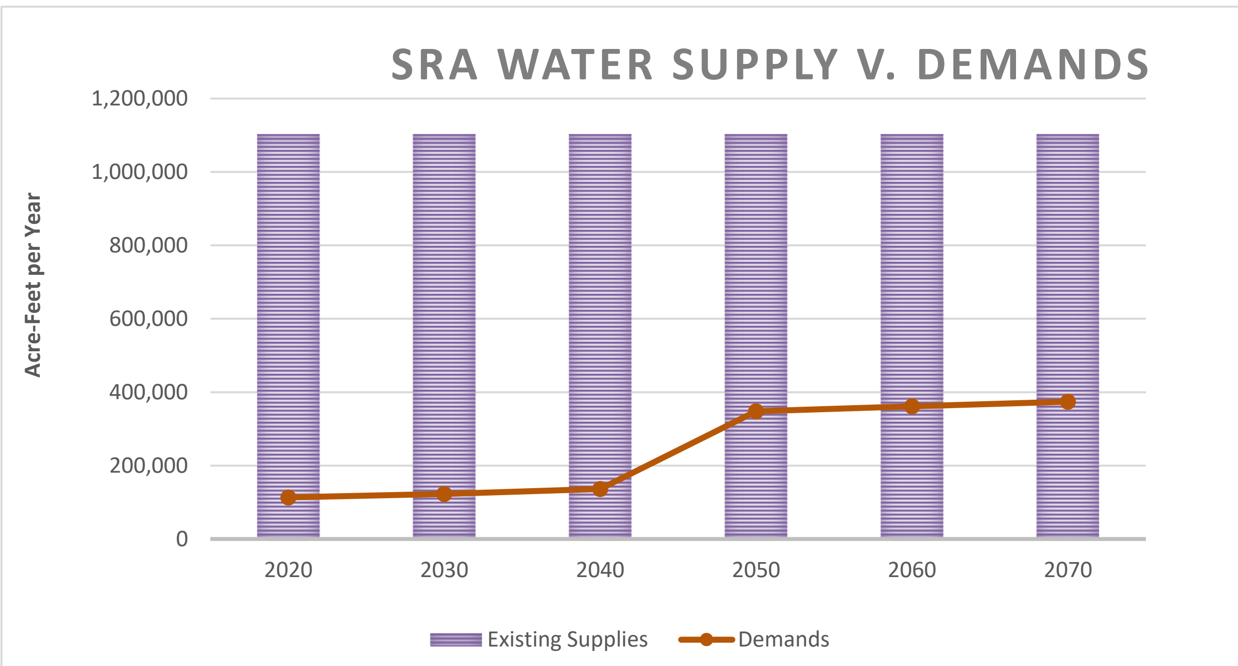
SRA supplies major water to several customers in the East Texas Regional Water Planning Area (ETRWPA) from the Lower Basin supplies (Toledo Bend Reservoir and the canal system). Municipal customers include the Cities of Hemphill, Huxley, and Rose City; Beechwood WSC, El Camino WSC, and Pendleton Harbor WSC, and G-M WSC. In addition to the municipal customers, SRA also supplies Manufacturing demand in Orange and Jefferson Counties and Steam Electric Power demand in Orange, Newton, and Rusk Counties.

SRA has sufficient supplies to meet the current contracted customer demand and surplus supplies for additional potential buyers. In addition to the current customers, several ETRWPA water suppliers have WMSs that use SRA's Toledo Bend Reservoir supplies. The ETRWPA WMSs that use supplies from Toledo Bend Reservoir include: 1) Pipeline from Toledo Bend to City of Center, 2) Transfer from Toledo Bend to Livestock demand in San Augustine County, 3) Contract to supply to Irrigation demand in Orange County, 4) Contract to supply Mining demand in Newton County, 5) Contract to supply Sand Hills WSC and Livestock demand in Shelby County, 6) Contract to supply Steam Electric Power Demand in Rusk County.

It should be noted that these strategies were identified as the recommended strategies for these entities by the *regional planning group*. None of these entities have contacted SRA regarding the potential WMSs. For the successful implementation of these strategies, these users will have to contract with SRA for supplies. The additional discussion for these strategies and the detailed cost estimates are included in the write-up for the specific entities and not included here as they are not SRA's strategies. It should be noted that the cost estimates for these potential future customers do not include the cost of purchasing the water since it is subject to negotiation between the seller (SRA) and future buyers. Informal discussions indicate that the pricing of water will be based on "replacement cost" of alternative water supplies.

A summary of the total demand for the SRA, existing supplies, and surplus is included in the table below.

	2020	2030	2040	2050	2060	2070
Existing Supplies in Lower Basin (ac-ft/yr)						
Toledo Bend Reservoir	970,067	970,067	970,067	970,067	970,067	970,067
Canal System	132,943	132,943	132,943	132,943	132,943	132,943
Demand (ac-ft/yr)						
Canal Customers	76,736	76,736	76,736	76,736	76,736	76,736
Toledo Bend Customers	26,995	26,995	26,995	26,995	26,995	26,995
Potential Future Customers for Toledo Bend Reservoir	9,650	19,206	32,687	244,336	257,898	270,371
Total Demands	113,381	122,937	136,418	348,067	361,629	374,102
Surplus (Shortage)	**999,279**	**999,279**	**999,279**	**999,279**	**999,279**	**999,279**



5B.3.15 City of Tyler

The City of Tyler currently provides wholesale supplies to retail customers, irrigation, and manufacturing demands within the City limits. The City is the wholesale provider for Whitehouse, Southern Utilities, Walnut Grove WSC, and Community Water Company. The current supplies for the City include 34 MGD from Lake Tyler, 30 MGD from Lake Palestine, 0.4 MGD from Bellwood Lake, and 12 groundwater wells in Carrizo Wilcox aquifer producing approximately 8 MGD. The City of Tyler is shown to have sufficient supplies through the planning period using the TWDB approved demand projections.

In addition, there is considerable interest from other users in Smith County in contracting with the City of Tyler for water supplies. There are recommended strategies for Tyler to provide additional water to Bullard, White House, and Manufacturing in Smith County. The City of Tyler has sufficient supplies to meet the proposed demands for the potential future customers throughout the planning horizon.

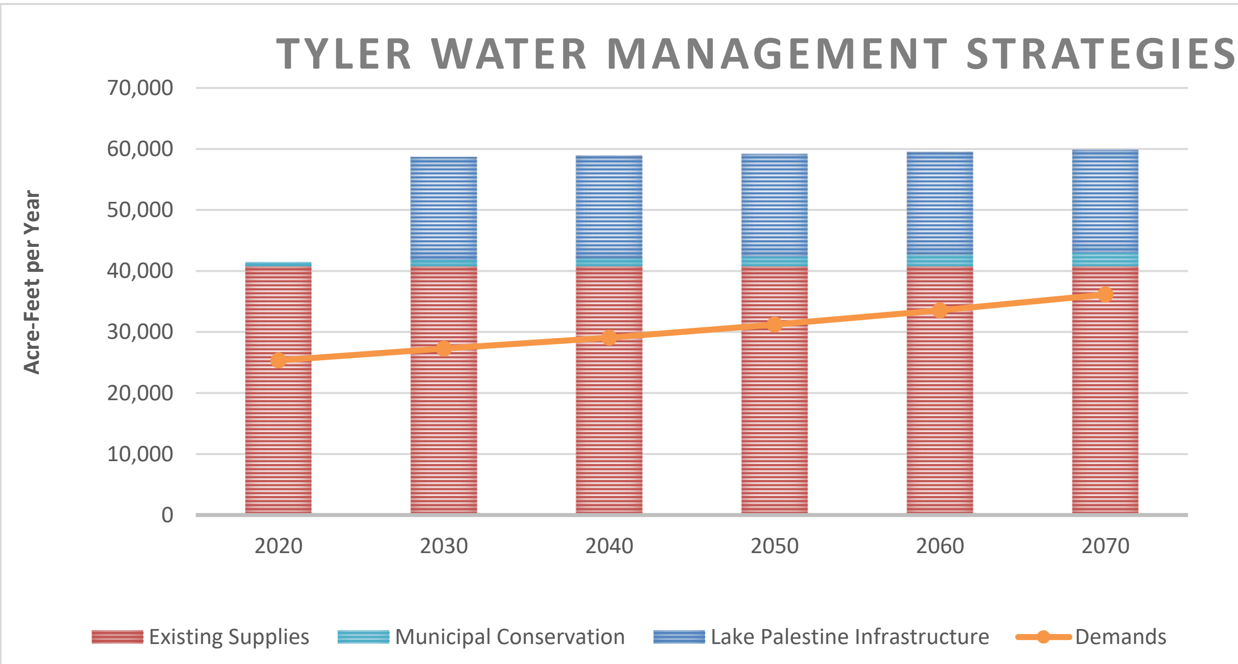
The City of Tyler has recommended strategies to develop infrastructure to develop the rest of Lake Palestine and for municipal conservation. The City's supplies, customer demands, and WMSs are summarized in the table below. Summary of the cost estimates for the recommended strategies are included in the table below.

Lake Palestine Infrastructure (Recommended). The City of Tyler proposed the following recommended strategy for the 2021 Plan. This strategy involved the City developing the additional 30 MGD of Lake Palestine water. The City has developed about half of its contracted supply in Lake Palestine and plans to develop the remaining supply by 2030, as part of its long-term water supply plan.

Municipal Conservation (Recommended). In 2011, the City of Tyler had an average per capita over the statewide goal of 140 gpcd. After performing a conservation cost analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. This recommended strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce the City's demand, increasing the surplus supply available for the City.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Lake Tyler	19,057	19,057	19,057	19,057	19,057	19,057
Bellwood Lake	400	400	400	400	400	400
Lake Palestine	16,815	16,815	16,815	16,815	16,815	16,815
Carrizo Wilcox Wells	4,484	4,484	4,484	4,484	4,484	4,484
Demand (ac-ft/yr)						
Current Customers	25,176	26,724	28,124	29,806	31,670	33,625
Potential Future Customers	166	552	947	1,399	1,885	2,515
Total Demands	25,342	27,276	29,072	31,205	33,555	36,140
Surplus (Shortage)	15,414	13,480	11,684	9,551	7,201	4,616
Water Management Strategies (ac-ft/yr)						
Municipal Conservation	657	1,101	1,338	1,613	1,924	2,268
TYLR-PAL: Lake Palestine Expansion	0	16,815	16,815	16,815	16,815	16,815
Surplus or (Shortage) with WMSs	**16,072**	**31,396**	**29,838**	**27,979**	**25,939**	**23,699**

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Municipal Conservation	2,263	$58,766,000	$2,026,000	$1,123	$3.45
Recommended Strategy TYLR-PAL: Lake Palestine Expansion	16,815	$111,190,000	$15,385,000	$915	$2.81



5B.3.16 Upper Neches River Municipal Authority

The Upper Neches River Municipal Water Authority (UNRMWA) owns and operates the Lake Palestine system in the Neches River Basin. Upper Neches River Municipal Water Authority has a water right for 238,110 ac-ft/yr from Lake Palestine and a downstream run-of-river diversion. City of Palestine, City of Tyler, and City of Dallas have contracts for supplies from Lake Palestine for amounts of 28,000 ac-ft/yr, 67,200 ac-ft/yr, and 114,337 ac-ft/yr, respectively. After supplying the contracted amounts to these three contracted customers, Upper Neches River Municipal Water Authority is expected to have 28,573 ac-ft/yr available to supply to other entities in ETRWPA. In addition to these three cities, UNRMWA is expected to have small needs from local irrigation and manufacturing users taking supplies from around the lake. The yield for Lake Palestine was estimated using the Water Availability Model for the Neches Basin in the 2021 East Texas Regional Plan. The yield estimates were not revised for the 2021 Plan because there were no changes made to the volumetric information for the lake or the Neches Basin WAM since the last round of planning. Based on the yield analysis from the 2021 East Texas Regional Plan, Lake Palestine is projected to have a yield of 197,710 ac-ft/yr in 2020, reducing to 189,010 ac-ft/yr by 2070. Based on current contracts and the available supplies from the Neches Basin WAM, the UNRMWA shows a small shortage during the planning period for Lake Palestine supplies. UNRMWA does not think the shortages to be real as the shortage is primarily associated with the reduced firm yield of Lake Palestine due to projected sediment accumulation in the lake. UNRMWA believes that the storage-area-elevation curves used in the Water Availability Models are severely under-predicting the storage volumes available in various parts of the lake, due to the data collection methodology used to develop the curves. Therefore, UNRMWA believes that the lake yield is much larger than what is projected by the Water Availability Models. UNRMWA is currently working with Texas Water Development Board to develop revised and refined volumetric information for Lake Palestine, but this information is not available for the 2021 planning cycle. The lake yield may be recomputed in the next planning cycle.

To address the shortages for the planning period UNRMWA has evaluated multiple potentially feasible WMSs and have the following recommendation for the 2021 ETRWPA Regional Plan. The UNRMWA was the sponsor the proposed Lake Fastrill project. With the current uncertainties surrounding this project, the UNRMWA in conjunction with the City of Dallas has identified the need for a Lake Fastrill replacement project. The City of Dallas is actively working with the UNRMWA to identify the best replacement project for the loss of the supply that would have been provided by Lake Fastrill. Neches River run-of-river diversion is recommended as the most feasible Lake Fastrill replacement project. Compared to the Lake Fastrill project, all Run-of-river diversion strategies provide lesser firm yield, but avoid environmental impacts and some of the permitting challenges associated with a large, main-stem reservoir on the Neches River.

UNRMWA and City of Dallas are considering development of a water supply project from the run-of-river diversions on Upper Neches River and using Lake Palestine, tributary storage, and/or groundwater as system resources. Using the run-of-river diversions operated as a system with Lake Palestine is the recommended strategy. Run-of-river diversions operated as a system with off-channel tributary storage and as conjunctive use along with groundwater are proposed as alternative strategies. All the potentially feasible WMSs for UNRMWA and City of Dallas are discussed in the 2015 Report *Upper Neches River Water Supply Project Feasibility Study*.

Neches Run-of-River Diversions with Lake Palestine (Recommended). This recommended strategy includes run-of-river diversions near SH 21 on Neches River operated as a system with storage in Lake Palestine. UNRMWA will be the project sponsor for this WMS. The run-of-river diversions will be taken from the river segment between the existing Rocky Point diversion and the Weches Dam site below the SH21 crossing, between the Neches River National Wildlife Refuge and upstream of the Weches Dam site. The run-of-the-river diversions will be authorized under a new appropriation of surface water, subject to senior water rights and environmental flows. New facilities required for this WMS include a small diversion dam on the Neches River, a river intake and pump station, and a transmission pipeline and booster pump station supporting transmission to Lake Palestine. The run-of-river diversions are an interruptible supply and the firm yield associated with the WMS is the incremental increase in the firm yield of Lake Palestine resulting from the system operation of the new diversions and the transmission facilities with the Lake Palestine.

The feasibility report includes multiple infrastructure alternatives for the recommended strategy, each resulting in a different amount of firm yield at Lake Palestine. Run-of-river diversions with a 108-inch transmission pipeline and a pump station capacity of 317 cfs was selected as the recommended transmission system to yield 68,625 ac-ft/yr of firm yield at Lake Palestine. It should be noted that the project configuration for the recommended WMS for UNRMWA in the 2021 ETRWPA Regional Plan is different from the configuration discussed in Dallas' October 2014 *Draft Long Range Water Supply Plan* (Draft LRWSP). The project configuration discussed in the City of Dallas Draft LRWSP resulted in a firm yield of 47,250 ac-ft/yr (42 MGD) that is projected to meet Dallas needs starting 2070. A project configuration with a larger firm yield was recommended in ETRWPA Regional Plan so as to meet the projected needs for City of Dallas, shortages for UNRMWA associated with reduced Lake Palestine yield due to sedimentation, and needs for other potential customers in ETRWPA. For regional planning purposes, the WMS is expected to be online in 2020 to address the shortages projected for the current contracted customers for Lake Palestine and potential steam electric power customers in Anderson County. The WMS timing can be changed to a later date if the timing of needs for the current contracted customers and steam electric power customers changes. City of Dallas is expected to use their share of supplies from this WMS starting in 2060.

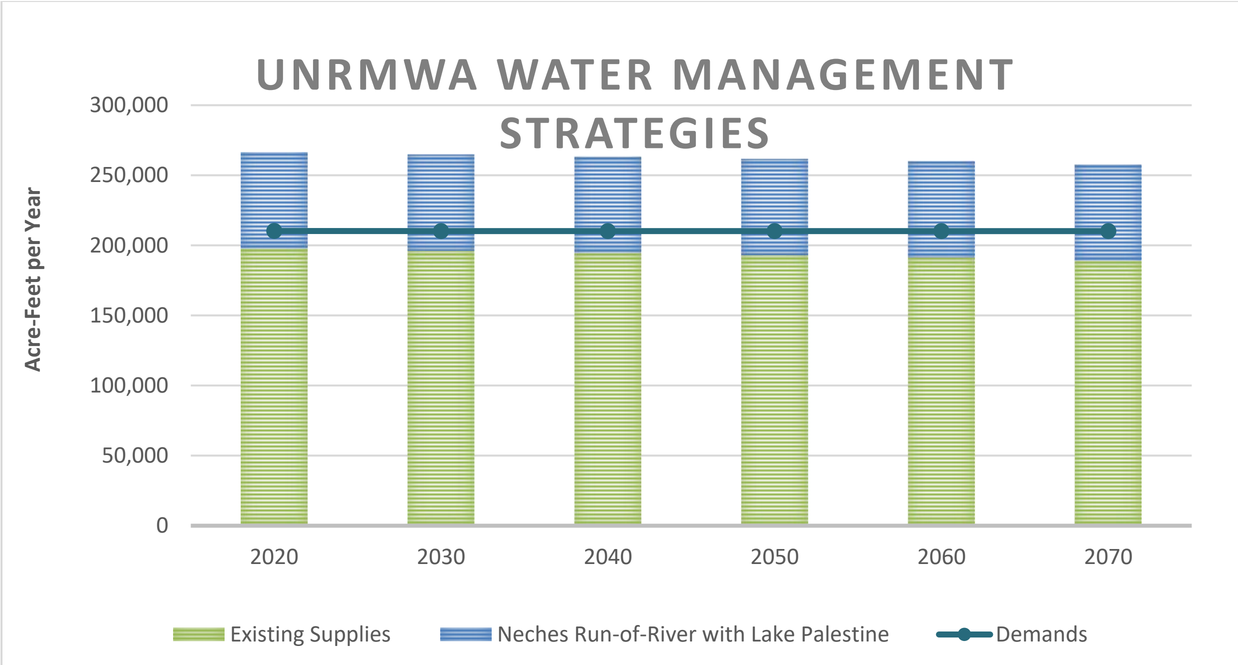
Neches Run-of-River Diversions with Tributary Storage (Alternative). The first alternative strategy for UNRMWA includes new run-of-river diversions from the Neches River segment between the existing Rocky Point diversion dam and the Weches dam site with storage in a new tributary or off-channel reservoir. This alternative strategy includes system operations with Lake Palestine. Facilities for implementation of this WMS include a small diversion dam on the Neches River, a high capacity river intake pump station, a transmission pipeline to the reservoir, and a tributary or off-channel reservoir. The interruptible run-of-river diversions will be backed up using stored water in the tributary or off-channel reservoir. Run-of-river diversions and any impoundment of local runoff in a tributary or off-channel reservoir are subject to inflow passage for senior water rights and environmental protection. The recommended infrastructure combinations for this WMS can provide a firm yield of 75,000 ac-ft/yr (67 MGD).

Neches Run-of-River Diversions with Groundwater (Alternative). A conjunctive use WMS is the second proposed alternative strategy for UNRMWA. The WMS includes new run-of-river diversions from the Neches River segment between the existing Rocky Point diversion dam and the Weches dam site with groundwater supplies from new wells in Carrizo, Wilcox, and Queen City aquifers in Anderson and Cherokee Counties. This alternative strategy includes system operations with Lake Palestine. New facilities for the implementation of this WMS include a small diversion dam on the Neches River, a river intake and pump station, wells located on properties controlled by Campbell Timberland Management, LLC and Forestar (USA) Real Estate Group, Inc., and a transmission system for the delivery of the supplies to the potential customers. The interruptible run-of-river supplies will be backed up using groundwater delivered to the run-of-river diversion point using bed and banks of the Neches River and several tributary streams. The run-of-river diversions are subject to inflow passage for senior water rights and environmental protection, but the groundwater supplies are not. The recommended infrastructure combinations for this WMS can provide a firm yield of 84,875 ac-ft/yr (76 MGD).

Planning level opinion of probable constructions costs were provided by UNRMWA for inclusion in the table below.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Palestine System	197,710	196,110	194,610	193,010	191,310	189,010
Demands (ac-ft/yr)						
Demands (With Current Contracted Customers)	210,247	210,224	210,202	210,184	210,169	210,169
Demands (With Current Contracted and Potential Customers)	210,247	210,224	210,202	210,534	257,769	260,068
Surplus (Shortage) with Current Supplies (ac-ft/yr)						
Surplus (Shortage) (With Current Contracted Customers)	(12,537)	(14,114)	(15,592)	(17,174)	(18,859)	(21,159)
Surplus (Shortage) (With Current Contracted and Potential Customers)	(12,537)	(14,114)	(15,592)	(17,174)	(66,109)	(68,409)
Water Management Strategies (ac-ft/yr)						
Recommended Strategy UNM-LP: Neches Run-of-River Diversions with Lake Palestine	68,625	68,625	68,625	68,625	68,625	68,625
Surplus or (Shortage) with WMSs for Current Contracted Customers	56,088	54,511	53,033	51,451	49,766	47,466
Surplus or (Shortage) with WMSs for Current and Potential Contracted Customers	56,088	54,511	53,033	51,451	2,516	216

Strategy	Yield (ac-ft/yr)	Capital cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy UNM-LP: Run-of-River Diversions with Lake Palestine (Recommended)	68,625	$518,977,000	$47,246,000	$688	$2.11
Alternate Strategy UNM-TS: Neches Run-of-River with Tributary Storage	75,000	$404,497,000	$26,598,000	$355	$1.09
Alternate Strategy UNM-GW: Neches Run-of-River with Groundwater	84,875	$326,646,000	$38,237,000	$451	$1.38



5B.4 Texas Water Development Board Database

The 2021 Regional Water Planning Data Web Interface (DB22) is an electronic database provided by the Texas Water Development Board which collects, maintains, and analyzes water planning data. The Regional Water Planning Groups and their contracted consultants may enter data for their respective regions in order to facilitate development of useful and relevant regional and state water plans. The DB22 Reports required by the TWDB are included as an Appendix ES-A, Report 13.

5B.5 Summary of Recommended and Alternative Water Management Strategies

The tables below (Table 5B.1 and Table 5B.2) include a summary of all recommended and alternative strategies considered for the WUGs and WWPs in the ETRWPA for the 2021 Plan.

Table 5B.1 2021 Needs, Recommended, and Alternative Water Management Strategies for Water User Groups

NEEDS RECOMMENDED STRATEGY *ALTERNATIVE STRATEGY* BALANCE (Does not include Alternative totals)

County	WUG	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Strategy Source	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
ANDERSON	ELKHART	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	6	6	7	7	8	CT	$0.00	$2,000	$316	$0.97
	FRANKSTON	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	6	7	7	7	8	CT	$0.00	$2,000	$308	$0.94
	NORWOOD WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	0	0	0	0	0	CT	$0.00	$1,000	$500	$1.53
	PALESTINE	Needs	0	0	0	0	0	0					
		Municipal Conservation	81	129	140	150	161	172	CT	$0.00	$30,000	$212	$0.65
	PLEASANT SPRINGS WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	4	5	5	5	6	CT	$0.00	$2,000	$407	$1.25
	TDCJ BETO GURNEY &	Needs	0	0	0	0	0	0					
		Municipal Conservation	16	27	29	30	32	34	CT	$0.00	$6,000	$208	$0.64
	TDCJ COFFIELD MICHAEL	Needs	0	0	0	0	0	0					
		Municipal Conservation	44	75	80	85	91	96	CT	$0.00	$8,000	$102	$0.31
ANGELINA	LUFKIN	Needs	0	0	0	0	0	0					
		Municipal Conservation	151	239	273	0	0	0	CT	$0.00	$60,000	$271	$0.83
	MANUFACTURING	Needs	(1,449)	(1,625)	(1,625)	(1,625)	(1,625)	(1,625)					
		Purchase from Lufkin (Sam Rayburn)	1,625	1,625	1,625	1,625	1,625	1,625	WWP	$0.00	$530,000	$326	$1.00
	MINING	Needs	(473)	(572)	(397)	(299)	(224)	(167)					
		Purchase from ANRA (Mud Creek)	0	572	397	299	224	167	WWP	$7,927,000	$1,245,000	$2,177	$6.68
CHEROKEE	ALTO	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	6	7	7	9	10	CT	$0	$3,000	$326	$1.00
	ALTO RURAL WSC	Needs	0	0	0	(65)	(137)	(215)					
		Municipal Conservation	9	16	18	21	25	28	CT	$0	$8,000	$316	$0.97
		New Wells (Carrizo-Wilcox)	0	0	0	191	191	191	CT	$2,426,000	$202,000	$1,058	$3.25
	BLACKJACK WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	3	4	5	5	6	CT	$0	$2,000	$360	$1.10
	JACKSONVILLE	Needs	0	0	0	0	0	0					
		Municipal Conservation	50	85	110	129	152	178	CT	$0	$42,000	$291	$0.89
	MINING	Needs	(238)	(247)	(210)	(147)	(84)	(40)					
		Purchase from ANRA (Mud Creek)	0	247	210	147	84	40	WUG & WWP	$7,013,000	$853,000	$3,453	$10.60
	RUSK	Needs	0	0	0	0	0	(122)					
		New Wells (Carrizo-Wilcox)	0	0	0	0	0	122	CT	$2,361,000	$192,000	$1,574	$4.83
		Municipal Conservation	15	26	30	34	40	46	CT	$0	$14,000	$361	$1.11
	WELLS	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	0	0	0	0	0	CT	$0	$1,000	$500	$1.53
	WRIGHT CITY WSC	Needs	0	0	0	(24)	(71)	(99)					
		New Wells (Carrizo-Wilcox)	0	0	0	25	71	121	CT	$2,361,000	$192,000	$1,574	$4.83
HARDIN	WILDWOOD POA	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	6	7	7	8	8	CT	$0.00	$2,000	$300	$0.92

Table 5B.1 2021 Needs, Recommended, and Alternative Water Management Strategies for Water User Groups (cont.)

NEEDS RECOMMENDED STRATEGY *ALTERNATIVE STRATEGY* BALANCE (Does not include Alternative totals)

County	WUG	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Strategy Source	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
HENDERSON	ATHENS	Needs	(7)	(13)	(16)	(20)	(30)	(40)					
		Municipal Conservation	7	13	16	20	23	27	CT	$786,000	$25,000	$1,156	$3.55
		Fish Hatchery Reuse	0	0	0	0	6	14	Region C	Strategy discussed in Table 5B.2			
		New Wells (Carrizo-Wilcox)	0	0	0	0	4	10	Region C	Strategy discussed in Table 5B.2			
	BROWNSBORO	Needs	0	0	0	0	0	0					
		Municipal Conservation	3	0	0	0	0	0	CT	$0	$2,000	$667	$2.05
	EDOM WSC	Needs	(2)	(3)	(4)	(5)	(7)	(9)	CT				
		New Wells (Carrizo-Wilcox)	2	3	4	5	7	9	CT	$1,088,000	$136,000	$2,125	$6.52
	CHANDLER	Needs	0	0	0	0	0	(118)					
		Municipal Conservation	9	17	21	26	32	36	CT	$0	$11,000	$362	$1.11
		New Wells (Carrizo-Wilcox)	0	0	0	0	0	101	CT	$1,397,000	$113,000	$1,119	$3.43
	IRRIGATION	Needs	0	0	0	0	(30)	(50)					
		Fish Hatchery Reuse	0	0	0	0	10	16	Region C	Strategy discussed in Table 5B.2			
		New Wells (Carrizo-Wilcox)	0	0	0	0	20	34	Region C	Strategy discussed in Table 5B.2			
	MINING	Needs	(10)	(21)	(10)	0	0	0					
		New Wells (Carrizo-Wilcox)	0	19	10	0	0	0	CT	$201,000	$15,000	$789	$2.42
	MOORE STATION WSC	Needs	0	0	0	0	(38)	(111)					
		New Wells (Carrizo-Wilcox)	0	0	0	0	38	111	CT	$1,417,000	$116,000	$1,045	$3.21
	R P M WSC	Needs	0	(7)	(16)	(27)	(38)	(48)					
		New Wells (Carrizo-Wilcox)	0	7	16	27	38	48	Region D	$3,469,000	$428,000	$1,972	$6.08
HOUSTON	COUNTY-OTHER	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	3	3	4	4	4	CT	$0.00	$1,000	$300	$0.92
	CROCKETT	Needs	0	0	0	0	0	0					
		Municipal Conservation	19	29	30	32	34	36	CT	$0.00	$11,000	$367	$1.13
	LIVESTOCK	Needs	0	0	0	0	0	(201)					
		New Wells (Yegua-Jackson)	0	0	0	0	0	201	CT	$399,000	$39,000	$194	$0.60
	LOVELADY	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	3	3	3	4	4	CT	$0.00	$1,000	$316	$0.97
	TDCJ EASTHAM UNIT	Needs	0	0	0	0	0	0					
		Municipal Conservation	15	25	27	29	30	32	CT	$0.00	$4,000	$152	$0.47
JASPER	JASPER	Needs	0	0	0	0	0	0					
		Municipal Conservation	75	124	141	158	178	196	CT	$15,444,000	$532,000	$3,008	$9.23
	KIRBYVILLE	Needs	0	0	0	0	0	0					
		Municipal Conservation	6	9	10	11	11	12	CT	$0	$3,000	$305	$0.94
	LIVESTOCK	Needs	(8,932)	(8,932)	(8,932)	(8,932)	(8,932)	(8,932)					
		Purchase from LNVA (Sam Rayburn)	8,932	8,932	8,932	8,932	8,932	8,932	CT	$0	$2,911,000	$326	$1.00

Table 5B.1 2021 Needs, Recommended, and Alternative Water Management Strategies for Water User Groups (cont.)

NEEDS RECOMMENDED STRATEGY *ALTERNATIVE STRATEGY* BALANCE (Does not include Alternative totals)

County	WUG	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Strategy Source	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
JEFFERSON	BEAUMONT	Needs	0	0	(1,248)	(3,843)	(6,357)	(9,218)					
		Municipal Conservation	2,027	3,425	4,202	5,112	6,171	7,382	CT	$60,175,000	$2,076,000	$371	$1.14
		Amendment to Supplemental Contract with LNVA	0	0	0	0	228	2,249	WWP	Strategy discussed in Table 5B.2			
	PORT ARTHUR	Needs	0	0	0	0	0	0					
		Municipal Conservation	2,708	4,449	5,222	6,029	6,844	7,664	CT	$51,618,000	$1,981,000	$295	$0.91
	COUNTY-OTHER	Needs	0	0	0	0	(855)	(1,950)					
		Municipal Conservation	34	0	0	0	0	0	CT	$0	$20,000	$588	$1.80
		Purchase from LNVA (Sam Rayburn)	0	0	0	0	855	1,950	WWP	$21,665,000	$2,402,000	$1,232	$3.78
	MANUFACTURING	Needs	(101,138)	(143,513)	(143,497)	(143,479)	(143,462)	(143,446)					
		Purchase from LNVA (Sam Rayburn)	0	143,513	143,497	143,479	143,462	143,446	WWP	$279,210,000	$69,673,000	$485	$1.49
	STEAM ELECTRIC POWER	Needs	(2,391)	(2,391)	(2,391)	(2,391)	(2,391)	(2,391)					
		Purchase from LNVA (Sam Rayburn)	0	2,391	2,391	2,391	2,391	2,391	WWP	$32,302,000	$3,464,000	$1,449	$4.45
NACOG-DOCHES	APPLEBY WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	9	17	20	23	27	32	CT	$0.00	$9,000	$336	$1.03
	COUNTY-OTHER	Needs	0	0	0	0	0	0					
		Lake Naconiche Regional Water System	0	1,700	1,700	1,700	1,700	1,700	CT	$42,117,000	$5,363,000	$3,155	$9.68
	CUSHING	Needs	0	0	0	0	(8)	(30)					
		Municipal Conservation	10	19	24	30	37	45	CT	$1,030,000	$42,000	$1,083	$3.32
	D & M WSC	Needs	0	0	(32)	(135)	(251)	(374)					
		New Wells (Carrizo-Wilcox)	0	0	32	135	251	374	CT	$4,567,000	$373,000	$997	$3.06
	GARRISON	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	6	8	9	10	12	CT	$0.00	$3,000	$286	$0.88
	NACOGDOCHES	Needs	0	0	0	0	0	0					
		Municipal Conservation	247	426	532	656	802	966	CT	$27,720,000	$986,000	$1,349	$4.14
	LIVESTOCK	Needs	(5,970)	(6,399)	(6,896)	(7,472)	(8,131)	(9,113)					
		New Wells (Carrizo-Wilcox)	0	6,399	6,896	7,472	8,131	9,113	CT	$26,677,000	$2,695,000	$296	$0.91
	MINING	Needs	(5,475)	(2,975)	(118)	0	0	0					
		Purchase from ANRA (Mud Creek)	0	2,975	118	0	0	0	WUG & WWP	$14,557,000	$4,159,000	$1,398	$4.29
NEWTON	NEWTON	Needs	0	0	0	0	0	0					
		Municipal Conservation	6	10	10	11	12	12	CT	$0	$4,000	$393	$1.21
	MINING	Needs	(115)	(59)	0	0	0	0					
		Purchase from SRA (Toledo Bend)	115	59	0	0	0	0	WWP	$0	$111,000	$965	$2.96
ORANGE	IRRIGATION	Needs	(526)	(526)	(526)	(526)	(526)	(526)					
		Purchase from SRA (Sabine Run of River)	0	526	526	526	526	526	WWP	$14,624,000	$1,355,000	$2,576	$7.91

Table 5B.1 2021 Needs, Recommended, and Alternative Water Management Strategies for Water User Groups (cont.)													
NEEDS	RECOMMENDED STRATEGY	*ALTERNATIVE STRATEGY*	BALANCE (Does not include Alternative totals)										
County	WUG	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Strategy Source	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
PANOLA	CARTHAGE	Needs	0	0	0	0	0	0					
		Municipal Conservation	23	39	41	44	47	50	CT	$0.00	$11,000	$266	$0.82
	PANOLA-BETHANY WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	0	0	0	0	1	2	CT	$0.00	$0	$0	$0.00
	LIVESTOCK	Needs	(982)	(982)	(982)	(982)	(982)	(982)					
		New Wells (Carrizo-Wilcox)	0	982	982	982	982	982	CT	$1,172,000	$122,000	$124	$0.38
POLK		No Needs or Strategies Identified											
RUSK	JACOBS WSC	Needs	0	0	0	0	0	(22)					
		New Wells (Carrizo-Wilcox)	0	0	0	0	0	22	CT	$1,795,000	$140,000	$6,364	$19.53
	HENDERSON	Needs	0	0	0	0	0	0					
		Municipal Conservation	83	148	179	235	283	334	CT	$9,900,000	$370,000	$1,431	$4.39
	KILGORE	Needs	0	0	0	0	0	0					
		Municipal Conservation	10	19	21	25	28	32	CT	$0.00	$8,000	$289	$0.89
	MT ENTERPRISE WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	8	0	0	0	0	CT	$0.00	$3,000	$500	$1.53
	NEW LONDON	Needs	0	0	0	0	0	0					
		Municipal Conservation	13	22	26	30	36	40	CT	$0.00	$6,000	$174	$0.53
	OVERTON	Needs	(66)	(122)	(177)	(241)	(310)	(384)					
		New Wells (Carrizo-Wilcox)	0	122	177	241	310	384	CT	$8,914,000	$846,000	$2,034	$6.24
		Municipal Conservation	8	15	18	21	24	28	CT	$0	$7,000	$289	$0.89
	TATUM	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	8	9	10	12	14	CT	$0.00	$4,000	$316	$0.97
	WRIGHT CITY WSC	Needs	0	0	0	0	0	21					
		New Wells (Carrizo-Wilcox)	0	0	0	0	0	22	CT	$2,361,000	$192,000	$1,574	$4.83
	LIVESTOCK	Needs	0	0	(20)	(51)	(83)	(83)					
		New Wells (Carrizo-Wilcox)	0	0	20	51	83	83	CT	$283,000	$24,000	$289	$0.89
	MINING	Needs	0	(305)	(168)	(22)	0	0					
		Purchase from ANRA (Mud Creek)	0	305	168	22	0	0	WUG & WWP	$14,808,000	$1,291,000	$4,233	$12.99
	STEAM ELECTRIC POWER	Needs	(1,103)	(1,103)	(1,103)	(1,103)	(1,103)	(1,103)					
		Purchase from SRA (Toledo Bend)	0	1,103	1,103	1,103	1,103	1,103	WWP	$30,008,000	$2,795,000	$2,534	$7.78
SABINE	HEMPHILL	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	8	7	7	8	8	CT	$0.00	$2,000	$286	$0.88
SAN AUGUSTINE	SAN AUGUSTINE	Needs	(120)	(105)	(92)	(89)	(89)	(89)					
		Municipal Conservation	10	17	18	20	22	23	CT	$2,297,000	$79,000	$3,661	$11.23
		New Wells (Carrizo-Wilcox)	0	105	92	89	89	89	CT	$1,045,000	$88,000	$838	$2.57
	LIVESTOCK	Needs	(1,333)	(1,539)	(1,774)	(2,048)	(2,349)	(2,349)					
		Purchase from SRA (Toledo Bend)	0	1,539	1,774	2,048	2,349	2,349	WWP	$41,302,000	$4,121,000	$1,754	$5.38
	MINING	Needs	(2,102)	(1,102)	0	0	0	0					
		Purchase from ANRA (Mud Creek)	0	1,102	0	0	0	0	WUG & WWP	$35,769,000	$3,911,000	$3,549	$10.89

Table 5B.1 2021 Needs, Recommended, and Alternative Water Management Strategies for Water User Groups (cont.)

NEEDS RECOMMENDED STRATEGY *ALTERNATIVE STRATEGY* BALANCE (Does not include Alternative totals)

County	WUG	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Strategy Source	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
SHELBY	CENTER	Needs	0	0	0	0	0	0					
		Municipal Conservation	26	45	52	57	64	70	CT	$0.00	$11,000	$187.90	$0.58
	SAND HILLS WSC	Needs	(65)	(76)	(85)	95	(107)	(117)					
		Purchase from Center	61	68	77	87	97	105	CT	$0	$102,000	$971	$2.98
		Municipal Conservation	4	8	8	9	10	12	CT	$0	$3,000	$353	$1.08
	TENAHA	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	6	6	7	8	8	CT	$0.00	$2,000	$308	$0.94
	LIVESTOCK	Needs	(6,491)	(8,761)	(11,524)	(14,896)	(19,006)	(19,006)					
		Purchase from SRA (Toledo Bend)	6,491	8,761	11,524	14,896	19,006	19,006	WWP	$0	$18,582,000	$978	$3.00
SMITH	ARP	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	0	0	0	0	0	CT	$0.00	$2,000	$1,000	$3.07
	BULLARD	Needs	(141)	(332)	(526)	(739)	(956)	(1,182)					
		Municipal Conservation	11	22	28	36	44	54	CT	$0	$14,000	$297	$0.91
		Purchase from Tyler	0	322	511	718	928	1,145	CT	$14,264,000	$1,615,000	$1,410	$4.33
	CRYSTAL SYSTEMS TEXAS	Needs	0	0	0	(52)	(164)	(291)					
		Municipal Conservation	18	38	52	71	92	118	CT	$954,000	$39,000	$471	$1.45
		New Wells (Carrizo Wilcox)	0	0	78	192	310	538	Region D	$2,531,000	$231,000	$429	$1.42
	DEAN WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	11	18	0	0	0	0	CT	$0.00	$7,000	$483	$1.48
	LINDALE	Needs	(25)	(136)	(259)	(384)	(535)	(696)					
		New Wells (Carrizo Wilcox)	25	136	259	384	535	696	Region D	$7,592,000	$714,000	$370	$1.13
		Municipal Conservation	7	14	18	23	29	36	CT	$0.00	$8,000	$260	$0.80
	OVERTON	Needs	(4)	(7)	(12)	(18)	(25)	(32)					
		New Wells (Carrizo Wilcox)	0	7	12	18	25	32	CT	$8,914,000	$846,000	$2,034	$6.24
	R P M WSC	Needs	0	(2)	(5)	(11)	(13)	(17)					
		New Wells (Carrizo-Wilcox)	0	2	5	11	13	17	Region D	$3,469,000	$428,000	$1,972	$6.05
	SOUTHERN UTILITIES	Needs	(71)	(74)	(79)	(84)	(90)	(98)					
		Municipal Conservation	514	866	1,058	1,279	1,527	1,803	CT	$33,264,000	$1,249,000	$808	$2.48
	TROUP	Needs	0	0	0	0	0	0					
		Municipal Conservation	6	11	12	14	17	18	CT	$0.00	$5,000	$321	$0.98
	TYLER	Needs	0	0	0	0	0	0					
		Municipal Conservation	657	1,101	1,338	1,613	1,924	2,268	CT	$58,766,000	$2,026,000	$1,123	$3.45
	WHITEHOUSE	Needs	0	0	0	0	(39)	(257)					
		Purchase from Tyler (Lake Palestine/ Lake Tyler/ Carrizo-Wilcox)	0	0	0	0	39	257	WWP	$7,666,000	$737,000	$2,868	$8.80
	MANUFACTURING	Needs	0	(84)	(84)	(84)	(84)	(84)					
		Purchase from Tyler (Lake Palestine/ Lake Tyler/ Carrizo-Wilcox)	0	84	84	84	84	84	Region D	$6,198,000	$545,000	$6,488	$19.91
TRINITY		No Needs or Strategies Identified											

Table 5B.1 2021 Needs, Recommended, and Alternative Water Management Strategies for Water User Groups (cont.)													
NEEDS	RECOMMENDED STRATEGY	*ALTERNATIVE STRATEGY*	BALANCE (Does not include Alternative totals)										
County	WUG	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Strategy Source	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
TYLER	CHESTER WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	5	5	5	6	6	CT	$0.00	$2,000	$414	$1.27
	COLMESNEIL	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	6	6	7	7	8	CT	$0.00	$2,000	$316	$0.97
	CYPRESS CREEK WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	3	3	3	3	4	CT	$0.00	$1,000	$333	$1.02
	WOODVILLE	Needs	0	0	0	0	0	0					
		Municipal Conservation	17	28	30	32	34	36	CT	$0.00	$9,000	$305	$0.94

(1) Entities split into more than one county within the East Texas Regional Water Planning Area reflect the cumulative need in the region.
(2) The annual and unit costs shown are for the decade with the highest annual and unit cost.
(3) CT denotes Consultant Team.
(4) Strategies with a sponsor in other regions do not appear in Appendix 5B-A.
(5) For Water User Groups (WUG) that are also Wholesale Water Providers (WWP), see Table 5B.2 for full list of strategies.
(6) Entities split into more than one region reflect only the need in the East Texas Regional Water Planning Area.

Table 5B.2 2021 Needs and Water Management Strategies for Wholesale Water Providers (ac-ft per year)

NEEDS RECOMMENDED STRATEGY *ALTERNATIVE STRATEGY* BALANCE (Does not include Alternative totals)

WWP	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
ANRA	Needs	(21,888)	(62,569)	(71,812)	(71,457)	(71,297)	(101,207)	----			
	Lake Columbia	0	75,720	75,640	75,560	75,480	75,400	$402,862,000	$23,509,000	$311	$0.95
	ANRA Treatment and Distribution System	0	0	0	0	0	0	$228,001,000	$49,839,000	$2,242	$6.88
	Run-of-River Supplies, Neches (New Application)	20,000	20,000	20,000	20,000	20,000	20,000	$0	$0	$0	$0.00
	Run-of-River Supplies, Neches (Submitted Application)	10,000	10,000	10,000	10,000	10,000	10,000	$0	$0	$0	$0.00
	New Wells (Carrizo-Wilcox Aquifer)	0	5,600	5,600	5,000	4,800	4,500	$29,775,000	$3,185,000	$569	$1.75
	RECOMMENDED WMS TOTAL	30,000	111,320	111,240	110,560	110,280	109,900				
AN WCID#1	Needs	0	0	0	0	0	0	----			
	Lake Striker Hydraulic Dredging (Volumetric Survey and Normal Pool Elevation Adjustment)	0	0	5,600	5,600	5,600	5,600	$23,716,000	-	$476	$1.46
	RECOMMENDED WMS TOTAL	0	0	5,600	5,600	5,600	5,600				
ATHENS MWA	Needs	0	0	0	0	(2,386)	(5,566)	----			
	Indirect Reuse of Flows from Fish Hatcheries	2,872	2,872	2,872	2,872	2,872	2,872	$0	$0	$0	$0.00
	Expanded Groundwater Supply	200	200	200	200	200	200	$2,573,000	$218,000	$1,090	$3.35
	New Wells in Carrizo-Wilcox Aquifer (Region C)	0	0	0	0	2,000	2,000	$15,151,000	$1,885,000	$943	$2.89
	New Wells in Carrizo-Wilcox Aquifer (Region C)	*1,262*	*1,262*	*1,262*	*1,262*	*1,262*	*1,262*	*$9,207,000*	*$1,171,000*	*$413*	*$1.27*
	WTP Booster PS Improvement	*450*	*450*	*450*	*450*	*450*	*450*	*$65,000*	*$57,000*	*$127*	*$0.39*
	RECOMMENDED WMS TOTAL	3,072	3,072	3,072	3,072	5,072	5,072				
BEAUMONT	Needs	0	0	(1,248)	(3,843)	(6,357)	(9,218)	----			
	Amendment to Supplemental Contract with LNVA	0	0	0	0	228	2,249	-	$2,199,000	$977	$3.00
	RECOMMENDED WMS TOTAL	0	0	0	0	228	2,249				
CARTHAGE	No Needs or Strategies Identified	-	-	-	-	-	-	----			
CENTER	Needs	0	0	0	0	0	0	----			
	Reuse Pipeline from WWTP to Lake Center	0	1,121	1,121	1,121	1,121	1,121	$2,456,000	$262,000	$234	$0.72
	Pipeline from Toledo Bend to Lake Center	0	0	2,242	2,242	2,242	2,242	$27,775,000	$3,462,000	$1,544	$4.74
	RECOMMENDED WMS TOTAL	0	1,121	3,363	3,363	3,363	3,363				
HOUSTON CO WCID #1	Needs	0	0	0	0	0	0	----			
	Permit Amendment for Houston County Lake	3,500	3,500	3,500	3,500	3,500	3,500	$0	$0	$0	$0.00
	New Wells in Carrizo-Wilcox Aquifer	*3,500*	*3,500*	*3,500*	*3,500*	*3,500*	*3,500*	*$22,793,000*	*$1,827,000*	*$522*	*$1.60*
	RECOMMENDED WMS TOTAL	3,500	3,500	3,500	3,500	3,500	3,500				

Table 5B.2 2021 Needs and Water Management Strategies for Wholesale Water Providers (ac-ft per year) (cont.)

NEEDS RECOMMENDED STRATEGY *ALTERNATIVE STRATEGY* BALANCE (Does not include Alternative totals)

WWP	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
JACKSONVILLE	Needs	0	0	0	0	0	0	----			
	Supply from Lake Columbia	0	0	1,700	1,700	1,700	1,700	$29,390,000	$3,150,000	$1,853	$5.69
	RECOMMENDED WMS TOTAL	0	0	1,700	1,700	1,700	1,700				
LNVA	Needs	0	0	0	0	0	0	----			
	Purchase from SRA (Toledo Bend)	0	0	200,000	200,000	200,000	200,000	$529,606,000	$110,157,000	$551	$1.69
	Beaumont West Regional Reservoir	0	7,700	7,700	7,700	7,700	7,700	$37,538,000	$1,970,000	$256	$0.79
	Neches-Trinity Basin Interconnect	0	67,000	67,000	67,000	67,000	67,000	$102,375,000	$8,907,000	$133	$0.41
	RECOMMENDED WMS TOTAL	0	74,700	274,700	274,700	274,700	274,700				
LUFKIN	Needs	0	0	0	0	0	0	----			
	Conveyance from Rayburn to Kurth Lake – Phase 1 (2030)	0	11,210	11,210	11,210	11,210	11,210	$78,220,000	$14,413,000	$1,286	$3.95
	Conveyance from Rayburn to Kurth Lake – Phase 2 (2040)	0	0	11,210	11,210	11,210	11,210	$78,199,000	$27,911,000	$1,255	$3.85
	Conveyance from Rayburn to Kurth Lake – Phase 3 (2050)	0	0	0	5,580	5,580	5,580	$8,834,000	$25,722,000	$919	$2.82
	RECOMMENDED WMS TOTAL	0	11,210	22,420	28,000	28,000	28,000				
NACOGDOCHES	Needs	0	0	0	0	0	0	----			
	Lake Columbia to Nacogdoches Raw Water Transmission System	0	8,551	8,551	8,551	8,551	8,551	$50,754,000	$6,739,000	$788	$2.42
	RECOMMENDED WMS TOTAL	0	8,551	8,551	8,551	8,551	8,551				
PANOLA COUNTY FWSD	No Needs or Strategies Identified							----			
PORT ARTHUR	See Table 5B.1 for Conservation Strategy Details; No Needs or Additional Strategies Identified							----			
SRA	No Needs or Strategies Identified							----			
TYLER	Needs	0	0	0	0	0	0	----			
	Lake Palestine Expansion	0	16,815	16,815	16,815	16,815	16,815	$111,190,000	$15,385,000	$915	$2.81
	RECOMMENDED WMS TOTAL	0	16,815	16,815	16,815	16,815	16,815				
UNRMWA	Needs	(12,537)	(14,114)	(15,592)	(17,174)	(66,109)	(68,409)	----			
	Neches Run-of-River with Lake Palestine	68,625	68,625	68,625	68,625	68,625	68,625	$518,977,000	$47,246,000	$688	$2.11
	Neches Run-of-River with Tributary Storage	*75,000*	*75,000*	*75,000*	*75,000*	*75,000*	*75,000*	*$404,497,000*	*$26,598,000*	*$355*	*$1.09*
	Neches Run-of-River with Groundwater	*84,875*	*84,875*	*84,875*	*84,875*	*84,875*	*84,875*	*$326,646,000*	*$38,237,000*	*$451*	*$1.38*
	RECOMMENDED WMS TOTAL	68,625	68,625	68,625	68,625	68,625	68,625				

(1) Needs incorporate existing supplies, existing contract demands, and future contract demands.
(2) The annual and unit costs shown are for the decade with the highest annual and unit costs.
(3) Strategies with a sponsor in other regions do not appear in Appendix 5B-A; see applicable regional water plan for strategy details.
(4) Recommended WMS Total does not include demand reduction from a Wholesale Water Provider's (WWP) customers' recommended Municipal Conservation strategy, if applicable.
(5) See Table 5B.1 for applicable demand reductions from Water User Group (WUG) Municipal Conservation strategies.

Chapter 5C

Water Conservation Recommendations

Water conservation is defined by Texas Water Code §11.002(8) as "the development of water resources; and those practices, techniques and technologies that will 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 water supply is made available for future or alternative uses." Water conservation measures are long-term, permanent strategies to reduce water use.

Title 31 Texas Administrative Code (31 TAC) §357.34(h) requires the 2021 Regional Water Plan to consolidate and present recommendations that may include Best Management Practices (BMPs) appropriate for the region. Further, for water user groups (WUGs) with identified water needs, conservation water management strategies (WMSs) must be included as part of the WUG list of strategies to meet shortages or a summary of reasons must be provided in the plan for not including conservation WMSs.

Following Section 5C.1 is a discussion of water conservation practices and trends in the East Texas Regional Water Planning Area (ETRWPA). This will be followed by a summary and discussion in Section 5C.2 of water conservation plans in use by WUGs in the region and BMPs in use currently or which could be implemented by WUGs in the future.

Conservation WMSs identified for WUGs with needs are addressed in Chapter 5B within the discussions of WMSs for these WUGs. For WUGs with identified needs where conservation WMSs were not recommended, Section 5C.3 of this chapter includes a discussion of reasons for not making such recommendations.

5C.1 Water Conservation Practices and Trends in the East Texas Regional Water Planning Area

The ETRWPA water demand projections incorporate an expected level of conservation to be implemented over the planning period. For municipal use, the assumed reductions in per capita water use are the result of the implementation of three regulatory initiatives:

- The Water Saving Performance Standards Act, implemented by Texas in 1992. This act prohibits the sale, distribution, or importation of plumbing fixtures that do not meet certain low flow performance standards. House Bill 2667, implemented September 1, 2009, updated the water savings performance standards. For new fixtures, the average toilet flush volume is limited to 1.28 gallons, and the maximum showerhead flow is limited to 2.5 gallons per minute.

- A federal requirement that residential clothes washers manufactured on or after January 1, 2007, must achieve a water factor[1] of 9.5 gallons per cubic foot of capacity. For front-loading machines, the maximum integrated water factor[2] decreases to 4.5 gallons per cubic foot on March 7, 2015.

[1] Total weighted per-cycle water consumption for the cold wash/cold rinse cycle divided by the clothes container capacity.
[2] Total weighted per-cycle water consumption for all wash cycles divided by the clothes container capacity.

For top-loading machines, the maximum integrated water factor decreases to 8.4 gallons per cubic foot on March 7, 2015, and 6.5 gallons per cubic foot on January 1, 2018.

- A federal requirement that residential dishwashers manufactured on or after May 30, 2013, must achieve water consumption of 5.0 gallons per cycle or less.

The "low flow plumbing fixture rules" measure assumes that all new construction will be built with water saving plumbing fixtures and that existing plumbing fixtures will be replaced over time with low flow fixtures. The "efficient new residential clothes washer standards" and "efficient new residential dishwasher standards" measures assume that all new construction will be built with efficient clothes washers and dishwashers and that existing clothes washers and dishwashers will be replaced over time with efficient appliances. On a regional basis, these regulatory initiatives are projected to reduce municipal water use by 11.1 percent (over 30,000 acre-feet (ac-ft) per year) by 2070. See Appendix 5C-A for volumetric water savings by county.

The ETRWPA is a water-rich region, and water conservation in the region is generally driven by economics rather than by lack of water supply. The East Texas Regional Water Planning Group (ETRWPG) believes that water users in the ETRWPA will implement advanced water conservation measures (i.e., savings associated with active conservation measures) as economic conditions dictate to each individual user. Given the general abundance of accessible water supply to the water users in the ETRWPA, the ETRWPG believes the water conservation strategies included in this planning period represent an economically achievable level of conservation.

5C.1.1 Water Use in the East Texas Regional Water Planning Area

The State of Texas Water Conservation Implementation Task Force has set a statewide goal of an average per capita consumption of 140 gallons per capita per day (gpcd). The Water Conservation Implementation Task Force also set a recommended goal for municipal water suppliers to have a minimum annual reduction of one percent in total gpcd until the entity achieves a total gpcd of 140 or less. Currently, over 39 percent of the municipal water users in the ETRWPA are projected to use less than 100 gallons per capita per day (gpcd) in 2020 and 71 percent are projected to use less than the Water Conservation Implementation Task Force recommended 140 gpcd; therefore, the potential savings from advanced municipal conservation could be considered relatively small.

It must be recognized that long-term changes to water supplies can be brought on by impacts on water quality or quantity, or by changing economic conditions. Such changes could require additional emphasis on water conservation in the future. The need for additional water conservation will continue to be evaluated in future plans.

The base per-capita values used to calculate demand projections in Chapter 2 are presented in Table 5C.1 for every WUG in the ETRWPA. The base gpcd for each WUG was calculated by the Texas Water Development Board (TWDB) using 2011 water-use surveys, setting a minimum gpcd value of 60.

House Bill 807 was passed by the Texas State Legislature on June 10th, 2019. This bill requires planning groups to set specific gpcd goals in each decade of the planning period for municipal water user groups in Region I. These goals are provided in Appendix 5C-B.

Table 5C.1 Texas Water Development Board Base per Capita Water Use in the East Texas Regional Water Planning Area by Water User Group

Water User Group	Base GPCD	Water User Group	Base GPCD
AFTON GROVE WSC	146	JACOBS WSC	117
ALGONQUIN WATER RESOURCES OF TEXAS	69	JASPER	203
ALTO	175	JASPER COUNTY WCID 1	77
ALTO RURAL WSC	185	JEFFERSON COUNTY WCID 10	87
ANDERSON COUNTY CEDAR CREEK WSC	98	JOAQUIN	147
ANGELINA WSC	85	KELLY G BREWER	147
APPLEBY WSC	170	KILGORE	202
ARP	153	KIRBYVILLE	171
ATHENS	192	KOUNTZE	116
B B S WSC	96	LAKE LIVINGSTON WSC	70
B C Y WSC	113	LEAGUEVILLE WSC	104
BEAUMONT	221	LILLY GROVE SUD	133
BECKVILLE	132	LINDALE	211
BEN WHEELER WSC	85	LINDALE RURAL WSC	78
BERRYVILLE	106	LOVELADY	181
BETHEL ASH WSC	100	LUFKIN	158
BEVIL OAKS	99	LUMBERTON MUD	90
BLACKJACK WSC	168	M & M WSC	86
BRIDGE CITY	89	MAURICEVILLE SUD	70
BROOKELAND FWSD	113	MCCLELLAND WSC	149
BROWNSBORO	151	MEEKER MWD	124
BRUSHY CREEK WSC	86	MELROSE WSC	139
BULLARD	185	MINDEN BRACHFIELD WSC	63
CARO WSC	97	MOORE STATION WSC	123
CARROLL WSC	113	MOSCOW WSC	141
CARTHAGE	222	MT ENTERPRISE WSC	156
CENTER	304	MURCHISON	148
CENTERVILLE WSC	120	NACOGDOCHES	173
CENTRAL WCID OF ANGELINA COUNTY	72	NECHES WSC	126
CHALK HILL SUD	87	NEDERLAND	125
CHANDLER	161	NEW LONDON	322
CHESTER WSC	164	NEW PROSPECT WSC	80
CHINA	113	NEW SUMMERFIELD	122
CHOICE WSC	109	NEWTON	168
COLMESNEIL	225	NORTH CHEROKEE WSC	118
CORRIGAN	121	NORTH HARDIN WSC	71

Table 5C.1 Texas Water Development Board Base per Capita Water Use in the East Texas Regional Water Planning Area by Water User Group (Cont.)

Water User Group	Base GPCD	Water User Group	Base GPCD
COUNTY-OTHER, ANDERSON	135	NORWOOD WSC	150
COUNTY-OTHER, ANGELINA	111	ORANGE	129
COUNTY-OTHER, CHEROKEE	113	ORANGE COUNTY WCID 1	119
COUNTY-OTHER, HARDIN	116	ORANGE COUNTY WCID 2	130
COUNTY-OTHER, HENDERSON	91	ORANGEFIELD WSC	89
COUNTY-OTHER, HOUSTON	166	OVERTON	199
COUNTY-OTHER, JASPER	103	PALESTINE	240
COUNTY-OTHER, JEFFERSON	151	PANOLA-BETHANY WSC	187
COUNTY-OTHER, NACOGDOCHES	103	PENNINGTON WSC	94
COUNTY-OTHER, NEWTON	106	PINEHURST	124
COUNTY-OTHER, ORANGE	114	PINELAND	93
COUNTY-OTHER, PANOLA	99	PLEASANT SPRINGS WSC	164
COUNTY-OTHER, POLK	102	POLLOK-REDTOWN WSC	97
COUNTY-OTHER, RUSK	107	PORT ARTHUR	320
COUNTY-OTHER, SABINE	87	PORT NECHES	102
COUNTY-OTHER, SAN AUGUSTINE	95	R P M WSC	107
COUNTY-OTHER, SHELBY	107	RAYBURN COUNTRY MUD	103
COUNTY-OTHER, SMITH	114	REDLAND WSC	80
COUNTY-OTHER, TRINITY	74	RURAL WSC	102
COUNTY-OTHER, TYLER	122	RUSK	159
CRAFT TURNEY WSC	93	RUSK RURAL WSC	100
CROCKETT	171	SAN AUGUSTINE	228
CROSS ROADS SUD	83	SAN AUGUSTINE RURAL WSC	94
CRYSTAL FARMS WSC	99	SAND HILLS WSC	163
CRYSTAL SYSTEMS TEXAS	291	SILSBEE	127
CUSHING	171	SLOCUM WSC	115
CYPRESS CREEK WSC	186	SODA WSC	84
D & M WSC	137	SOUR LAKE	139
DAMASCUS-STRYKER WSC	121	SOUTH JASPER COUNTY WSC	76
DEAN WSC	153	SOUTH NEWTON WSC	60
DIBOLL	127	SOUTH RUSK COUNTY WSC	98
EAST LAMAR WSC	124	SOUTHERN UTILITIES	162
EBENEZER WSC	149	SWIFT WSC	147
EDOM WSC	107	TATUM	182
ELDERVILLE WSC	60	TDCJ BETO GURNEY & POWLEDGE UNITS	289
ELKHART	164	TDCJ COFFIELD MICHAEL	551
EMERALD BAY MUD	147	TDCJ EASTHAM UNIT	407

Table 5C.1 Texas Water Development Board Base per Capita Water Use in the East Texas Regional Water Planning Area by Water User Group (Cont.)

Water User Group	Base GPCD	Water User Group	Base GPCD
ETOILE WSC	111	TENAHA	171
FIVE WAY WSC	106	THE CONSOLIDATED WSC	110
FLAT FORK WSC	109	TIMPSON	137
FOUR PINES WSC	91	TROUP	187
FOUR WAY SUD	84	TUCKER WSC	107
FRANKSTON	178	TYLER	180
FRANKSTON RURAL WSC	127	TYLER COUNTY WSC	113
G M WSC	60	UPPER JASPER COUNTY WATER AUTHORITY	116
GARRISON	210	VIRGINIA HILL WSC	96
GASTON WSC	113	WALNUT GROVE WSC	120
GILL WSC	113	WALSTON SPRINGS WSC	100
GOODSPRINGS WSC	91	WARREN WSC	130
GRAPELAND	133	WELLS	153
GROVES	133	WEST GREGG SUD	86
GROVETON	105	WEST HARDIN WSC	68
GUM CREEK WSC	97	WEST JACKSONVILLE WSC	141
HARDIN COUNTY WCID 1	91	WEST JEFFERSON COUNTY MWD	86
HEMPHILL	220	WHITEHOUSE	122
HENDERSON	233	WILDWOOD POA	182
HUDSON WSC	68	WODEN WSC	119
HUNTINGTON	100	WOODLAWN WSC	89
HUXLEY	125	WOODVILLE	200
JACKSON WSC	91	WRIGHT CITY WSC	111
JACKSONVILLE	160	ZAVALLA	101

SOURCE: TEXAS WATER DEVELOPMENT BOARD

5C.1.2 Water Loss in the East Texas Regional Water Planning Area

Since 2003, retail public water utilities have been required to complete and submit a water loss audit form to the TWDB once every five years. Since 2013, retail public utilities that supply potable water to more than 3,300 connections or receive financial assistance from the TWDB must file an annual water audit with the TWDB. The most recent available data were reported in 2018 for water loss during calendar year 2017. The TWDB compiled the data from these reports. The water audit reporting requirements follow the International Water Association and American Water Works Association Water Loss Control Committee methodology.

The primary purposes of a water loss audit are to account for all of the water being used and to identify potential areas where water can be saved. Water audits track multiple sources of water loss that are commonly described as apparent loss and real loss. Apparent loss is water that was used but for which the utility did not receive compensation. Apparent losses are associated with customer meters under-registering, billing adjustment and waivers, and unauthorized consumption. Real loss is water that was physically lost from the system before it could be used, including main breaks and leaks, customer service line breaks and leaks, and storage overflows. The sum of the apparent loss and the real loss make up the total water loss for a utility.

In the ETRWPA, 36 public water suppliers submitted a water loss audit to TWDB for calendar year 2017. These water suppliers represent a retail service population of approximately 665,000 people, or about 58 percent of the regional population. Table 5C.2 shows a summary of reported 2017 water loss accounting for the ETRWPA.

Table 5C.2 Reported 2017 Water Loss Accounting in the East Texas Regional Water Planning Area

<table>
<tr><td rowspan="9">System Input Volume
39,766,361,869
100.0%</td><td rowspan="4">Authorized Consumption
30,853,952,487
77.6%</td><td rowspan="2">Billed Consumption
28,767,060,097
72.3%</td><td>Billed Metered
28,737,914,742
72.3%</td><td rowspan="2">Revenue Water
28,767,060,097
72.3%</td></tr>
<tr><td>Billed Unmetered
29,145,355
0.1%</td></tr>
<tr><td rowspan="2">Unbilled Consumption
2,086,892,390
5.2%</td><td>Unbilled Metered
1,445,944,231
3.6%</td><td rowspan="7">Non-Revenue Water
10,999,301,772
27.7%</td></tr>
<tr><td>Unbilled Unmetered
640,948,159
1.6%</td></tr>
<tr><td rowspan="5">Water Loss
8,912,409,382
22.4%</td><td rowspan="3">Apparent Loss
1,358,574,661
3.4%</td><td>Unauthorized Consumption
100,382,539
0.3%</td></tr>
<tr><td>Customer Meter Accuracy Loss
1,057,698,802
2.7%</td></tr>
<tr><td>Systematic Data Handling Discrepancy
200,493,320
0.5%</td></tr>
<tr><td rowspan="2">Real Loss
7,553,834,721
19.0%</td><td>Reported Breaks and Leaks
1,329,073,651
3.3%</td></tr>
<tr><td>Unreported Loss
6,224,761,070
15.7%</td></tr>
</table>

SOURCE: TEXAS WATER DEVELOPMENT BOARD

One problem with the reported water loss accounting data is negative real water losses. Three utilities reported negative real losses. The physical meaning of a negative water loss is that water is infiltrating into the distribution system, which is not realistic.

On a regional basis, the reported percentage of total water loss for the ETRWPA was 22.4 percent. Based on this figure, it appears that enhanced water loss control programs may be a potentially feasible water conservation strategy for some WUGs in the East Texas Region.

5C.2 Water Conservation Plans

The Texas Commission on Environmental Quality (TCEQ) requires water conservation plans for all municipal, industrial, and other non-irrigation water users with surface water rights of 1,000 ac-ft per year or more, all irrigation water users with surface water rights of 10,000 ac-ft per year or more, and all retail public water suppliers providing water service to 3,300 connections or more.[1] Water conservation plans are also required for all water users applying for a new or amended State water right and for entities seeking more than $500,000 in State funding for water supply projects.

All conservation plans must specify quantifiable 5-year and 10-year conservation goals and targets. While these goals are not enforceable, they must be identified. Updated water conservation plans for WUGs in the region were to be submitted to the Executive Director of the TCEQ and to the ETRWPG by May 1, 2019. Failure to submit a water conservation plan is a violation of the Texas Water Code, Section 11.1272 and the Texas Administrative Code, Section 288.30, and is subject to enforcement by the TCEQ.

In the ETRWPA, 30 entities hold municipal, industrial, or other non-irrigation surface water rights in excess of 1,000 ac-ft per year, four entities have irrigation water rights greater than 10,000 ac-ft per year, and 24 entities serve 3,300 connections or more. A list of the users in the ETRWPG required to submit water conservation plans is shown in Table 5C.3.

Other entities have contracts with regional and wholesale water providers (WWPs) for greater than 1,000 ac-ft per year. Presently, these water users are not required to develop water conservation plans unless the user is seeking State funding; however, a WWP may request that its customers prepare a conservation plan to assist in meeting the goals and targets of the WWP's plan.

To assist entities in the ETRWPA with developing water conservation plans, model plans for municipal water users (major or retail public water suppliers), industrial users, mining, and irrigation districts are available on the TCEQ's website (https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/conserve.html). Each of these model plans addresses the latest TCEQ requirements and is intended to be modified by each user to best reflect the activities appropriate to the entity.

Table 5C.3 Water Users and Types of Use that are Required to Develop, Implement, and Submit Water Conservation Plans

Entity	WUG	3,300 Connections or More	Non-Irrigation Water Right of 1,000 ac-ft/yr or More				Irrigation Water Right of 10,000 ac-ft/yr or More	Financial Assistance of $500,000 or More from TWDB
			Municipal / Domestic	Industrial	Mining	Other		
Athens	Yes	•						
Beaumont	Yes	•	•					
Bridge City	Yes	•						
Carthage	Yes	•						
Center	Yes		•					
G-M WSC	Yes							•
Groves	Yes	•						
Henderson	Yes	•	•					
Jacksonville	Yes	•	•					
Jasper	Yes	•						
Kilgore	Yes	•	•					
Lake Livingston WSC	Yes							•
Lindale Rural WSC	Yes	•						
Lufkin	Yes	•	•	•	•			
Lumberton MUD	Yes	•						
Mauriceville MUD	Yes	•						
Nacogdoches	Yes	•	•					
Nederland	Yes	•						
Orange	Yes	•						
Orange County WCID 1	Yes	•						•
Palestine	Yes	•						
Port Arthur	Yes	•						
Port Neches	Yes	•						
San Augustine	Yes		•					
Silsbee	Yes	•						
Southern Utilities	Yes	•						
The Consolidated WSC	Yes	•						
Tyler	Yes	•	•	•				
Angelina & Neches River Authority	No		•	•				
Angelina-Nacogdoches WCID 1	No		•	•				
Athens Municipal Water Authority	No		•	•				
E I Dupont De Nemours & Co	No			•				
Entergy Texas Inc.	No			•				
Exxon Mobil Oil Co	No			•				
Houston Co WCID 1	No		•					

Table 5C.3 Water Users and Types of Use That are Required to Develop, Implement, and Submit Water Conservation Plans (Cont.)

Entity	WUG	3,300 Connections or More	Non-Irrigation Water Right of 1,000 ac-ft/yr or More				Irrigation Water Right of 10,000 ac-ft/yr or More	TWDB Loans $500,000 or More
			Municipal / Domestic	Industrial	Mining	Other		
Jefferson County Drainage District No 6	No					•		
Joe Broussard II et al	No						•	
Lower Neches Valley Authority	No		•	•	•	•	•	
Luminant Generation Co LLC	No			•	•		•	
Luminant Mining Co LLC	No				•			
M Half Circle Ranch Company	No						•	
Motiva Enterprises LLC	No			•				
Panola Co FWSD 1	No		•	•				
Premcor Refining Group Inc.	No			•				
Rowan Companies Inc.	No			•				
Sabine River Authority	No		•	•	•	•	•	
Texas Parks & Wildlife Dept.	No			•				
Union Oil Company of California	No			•				
United States Department of Energy	No				•			
Upper Neches River MWD	No		•					

NOTE: List may not include applicants for new water rights or TWDB funding.
Water user group (WUG), water supply corporation (WSC), municipal utility district (MUD), Water Control & Improvement District (WCID), municipal water district (MWD)

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

Implemented water conservation strategies vary by water user and are shown in Table 5C.4. This table lists water conservation strategies for individuals who have submitted water conservation plans to the TWDB, TCEQ, or City of Nacogdoches as of October 31, 2019, or who have published water conservation plans on their web sites. The focus of the conservation activities for municipal water users in the ETRWPA are:

- Education and public awareness programs.
- Reduction of unaccounted for water through universal metering, water audits, maintenance and repair of water systems, and meter testing and repair.
- Water rate structures that discourage water waste.
- Table 5C.5 summarizes water conservation measures implemented by the utilities for which water conservation plans were available.

Table 5C.4 Primary Water Conservation Strategies Documented in Water Conservation Plans

Entity	Plan Date	Primary Water Conservation Strategies						
		Enhanced Water Loss Control Programs	Public Education / Awareness Programs	Assigned Water Conservation Coordinator	Water Waste Prohibition	Rate Structure Not Promoting Excessive Use	Fixture Retrofit Program	Other
		Active Conservation Strategies						
Angelina & Neches River Authority	2019	•	•			•		
Angelina-Nacogdoches WCID No.1	2019	•	•					
City of Athens	2019	•	•	•				
City of Beaumont	2019	•	•	•				•
City of Bridge City	2019	•	•			•	•	•
City of Carthage	2019	•	•				•	•
City of Center	2019	•	•				•	•
City of Groves	2019		•					
City of Jasper	2019	•	•					
City of Kilgore	2019	•	•			•		
City of Lufkin	2019	•	•			•		
City of Nacogdoches	2018	•	•			•		•
City of Orange	2019	•	•					
City of Palestine	2019	•	•		•	•		
City of Port Arthur	2019	•	•	•	•	•		•
City of Port Neches	2009	•	•					
City of San Augustine	2015	•	•					
City of Silsbee	2019	•	•					
City of Tyler	2019	•	•	•	•	•	•	•
G-M WSC	2019	•	•			•		
Houston County WCID 1	2019	•	•			•		•
Lake Livingston WSC	2019		•	•		•		
Lindale Rural WSC	2019	•	•					
Lower Neches Valley Authority	2019	•	•			•		
Lumberton MUD	2019	•	•			•		
Mauriceville MUD	2019	•	•			•		
Orange County WCID 1	2019	•	•	•				•
Sabine River Authority	2019	•	•					•
Southern Utilities	2019	•	•	•	•	•		
Upper Neches River MWA	2019	•	•					

Water control & improvement district (WCID), water supply corporation (WSC), municipal utility district (MUD), municipal water authority (MWA)

SOURCE: TEXAS WATER DEVELOPMENT BOARD

Table 5C.5 Summary of Measures in Water Conservation Plans

Number of Plans That Include Measure	Measure
30	Public education (distribute materials, web site, school programs, news articles, conservation tips, etc.)
28	Enhanced water loss control measures (comprehensive water loss audits, active leak detection and repair, replacement/repair of mains and lines that are a significant source of water loss, etc.)
15	Increasing block rate structure to promote conservation
7	Designated water conservation coordinator
6	Water reuse/recycling
4	Water waste prohibition
4	Retrofit program for inefficient plumbing fixtures
3	Landscape irrigation conservation and/or incentives
2	Park and athletic field conservation
1	Residential water audits and irrigation checkups
1	Efficient municipal landscaping practices
1	Wholesale agency assistance to customers
1	Water-wise landscape design program
1	Pressure reduction

SOURCE: TEXAS WATER DEVELOPMENT BOARD

5C.3 Recommended Water Conservation Strategies in the East Texas Regional Water Planning Area

Water conservation actions implemented as strategies would result in savings above that assumed for the TWDB water demand projections. The Texas Water Development Board, in conjunction with the Texas Commission on Environmental Quality and the Water Conservation Advisory Council has developed guidelines for conservation BMPs. These BMP guidelines are available online at https://www.twdb.texas.gov/conservation/BMPs/. Recommended water conservation strategies are presented by WUG type in the following sections.

5C.3.1 Municipal Water Conservation Strategies

Water conservation BMPs were evaluated for municipal WUGs that have a projected per capita water use greater than 140 gpcd, regardless of whether they have a demonstrated need. Evaluated water conservation practices included enhanced public and school education, water conservation pricing, and an enhanced water loss control program.

Enhanced Public and School Education. Enhanced public and school education would involve providing formal and indirect means of information on how to conserve water beyond current efforts. Education costs were applied to all of the entities meeting the above criteria. Assumptions made in evaluating the efficiency of this measure included restrictions that the annual budget spent on education would be limited to approximately $1.50 per capita. The total budget available will be an indication as to the effectiveness of the program. Table 5C.6 indicated efficiencies assigned to various ranges of available budget.

Table 5C.6 Water Conservation Efficiencies for Enhanced Public and School Education

Budget		Efficiency of Conservation
Low	High	
$1,500 (minimum)	$14,999	1.5%
$15,000	$29,999	2.0%
$30,000	$44,999	2.5%
$45,000	$60,000 (maximum)	3.0%

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

Water Conservation Pricing. Water conservation pricing requires an increasing rate structure with increasing use. The minimum price increase between rate blocks should be 25 percent. For maximum effectiveness, the price increase between rate blocks should be at least 50 percent.[2] The effectiveness of this measure is, in part, determined by whether water conservation pricing is currently implemented. Water conservation pricing is assumed to achieve a 1.5 percent reduction in demand.

Enhanced Water Loss Control Program. An enhanced water loss control program involves committing more resources towards identifying and repairing leaks, replacing inaccurate water meters, minimizing billing errors, and replacing mains with chronic leakage. Utilities would strive to achieve target water loss percentages that depend on water system characteristics. For more rural utilities with fewer than 32 connections per mile of main, the target water loss is 18 percent of water entering the system (Table 5C.7). For more urban or suburban utilities with 32 or more connections per mile of main, the target water loss is 12 percent of water entering the system. For WUGs with severe water loss, achieving the water loss target may involve replacing a substantial portion of the potable water transmission and distribution system. Only utilities that have submitted a water loss audit to the TCEQ within the last five years were considered for an enhanced water loss control program.

Table 5C.7 Enhanced Water Loss Control Program Targets

Service Connections per Mile of Main	Water Loss Target (% of System Input)
Less than 32	18% or less
32 or more	12% or less

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

The projected total water savings is provided in Table 5C.8 for WUGs that have a projected per capita water use greater than 140 gpcd, regardless of having a demonstrated need, or are the project sponsor for a recommended water management strategy that involves an interbasin transfer.

Table 5C.8 Water Conservation Savings for Selected Water User Groups

Entity (County)	Amount Conserved (ac-ft per year)					
	2020	2030	2040	2050	2060	2070
Alto (Cherokee)	4	6	7	7	9	10
Alto Rural WSC (Cherokee)	9	16	18	21	25	28
Appleby WSC (Nacogdoches)	9	17	20	23	27	32
ARP (Smith)	2	0	0	0	0	0
Athens (Henderson)	7	13	16	20	23	27
Beaumont (Jefferson)	2,027	3,425	4,202	5,112	6,171	7,382
Blackjack WSC (Cherokee)	2	3	4	5	5	6
Brownsboro (Henderson)	3	0	0	0	0	0
Bullard (Smith)	11	22	28	36	44	54
Carthage (Panola)	23	39	41	44	47	50
Center (Shelby)	26	45	52	57	64	70
Chandler (Henderson)	9	17	21	26	32	36
Chester WSC (Tyler)	2	5	5	5	6	6
Colmesneil (Tyler)	4	6	6	7	7	8
County-Other, Houston (Houston)	2	3	3	4	4	4
County-Other, Jefferson (Jefferson)	34	0	0	0	0	0
Crockett (Houston)	19	29	30	32	34	36
Crystal Systems Texas (Smith)	18	38	52	71	92	118
Cushing (Nacogdoches)	10	19	24	30	37	45
Cypress Creek WSC (Tyler)	2	3	3	3	3	4
Dean WSC (Smith)	11	18	0	0	0	0
Elkhart (Anderson)	4	6	6	7	7	8
Frankston (Anderson)	4	6	7	7	7	8
Garrison (Nacogdoches)	4	6	8	9	10	12
Hemphill (Sabine)	4	8	7	7	8	8
Henderson (Rusk)	83	148	179	235	283	334
Jacksonville (Cherokee)	50	85	110	129	152	178
Jasper (Jasper)	75	124	141	158	178	196
Kilgore (Rusk)	10	19	21	25	28	32
Kirbyville (Jasper)	6	9	10	11	11	12
Lindale (Smith)	7	14	18	23	29	36
Lovelady (Houston)	2	3	3	3	4	4
Lufkin (Angelina)	151	239	273	0	0	0
MT Enterprise WSC (Rusk)	4	8	0	0	0	0
Nacogdoches (Nacogdoches)	247	426	532	656	802	966
New London (Rusk)	13	22	26	30	36	40
Newton (Newton)	6	10	10	11	12	12
Norwood WSC (Anderson)	2	0	0	0	0	0
Overton (Smith)	8	15	18	21	24	28
Palestine (Anderson)	81	129	140	150	161	172
Panola-Bethany WSC (Panola)	0	0	0	0	1	2
Pleasant Springs WSC (Anderson)	2	4	5	5	5	6
Port Arthur (Jefferson)	2,708	4,449	5,222	6,029	6,844	7,664
Rusk (Cherokee)	15	26	30	34	40	46
San Augustine (San Augustine)	10	17	18	20	22	23

Table 5C.8 Water Conservation Savings for Selected Water User Groups

Entity (County)	Amount Conserved (ac-ft per year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Sand Hills WSC (Shelby)	4	8	8	9	10	12
Southern Utilities (Smith)	514	866	1,058	1,279	1,527	1,803
Tatum (Rusk)	4	8	9	10	12	14
TDCJ Beto Gurney & Powledge Units (Anderson)	16	27	29	30	32	34
TDCJ Coffield Michael (Anderson)	44	75	80	85	91	96
TDCJ Eastham Unit (Houston)	15	25	27	29	30	32
Tenaha (Shelby)	4	6	6	7	8	8
Troup (Smith)	6	11	12	14	17	18
Tyler (Smith)	657	1,101	1,338	1,613	1,924	2,268
Wells (Cherokee)	2	0	0	0	0	0
Wildwood POA (Hardin)	4	6	7	7	8	8
Woodville (Tyler)	17	28	30	32	34	36
Total	**7,017**	**11,658**	**13,920**	**16,188**	**18,987**	**22,032**

SOURCE: EAST TEXAS REGIONAL WATER PLANNING GROUP

The following WUGs have water needs but use less than 140 gpcd:

- Joaquin (Shelby)
- D & M WSC (Nacogdoches)
- Moore Station WSC (Henderson)
- Whitehouse (Smith)
- Jacobs WSC (Rusk)
- Wright City WSC (Cherokee)
- R P M WSC (Smith)

In addition, seven WUGs are customers of the Lower Neches Valley Authority (LNVA), a WWP with a recommended WMS involving an interbasin transfer. These WUGs are also projected to use less than 140 gpcd:

- County-Other (Jefferson)
- Groves (Jefferson)
- Jefferson County Water Control & Improvement District #10 (Jefferson)
- Nederland (Jefferson)
- Port Neches (Jefferson)
- West Jefferson County Municipal Water District (Jefferson)

The WUGs listed above already use water in an efficient manner. It should be noted that, the water demand projections for these entities already include projected water savings from natural replacement of inefficient fixtures and appliances with high-efficiency toilets and showerheads, residential clothes washers, and residential dishwashers. For these WUGs, the "built-in" water savings from these measures is 7.7 percent of pre-savings water demand in 2020, increasing to 14.3 percent in 2070. For these reasons, no additional water conservation strategies are recommended for WUGs that use less than 140 gpcd.

5C.3.2 Non-Municipal Water User Groups

Water conservation measures for non-municipal water user groups are described in the following sections.

Manufacturing. Industrial water users include large petrochemical industries as well as smaller local manufacturers. The current state of water conservation at existing manufacturing facilities is unknown. Conservation measures associated with industries are highly industry- and site-specific. For example, some industries can utilize brackish water supplies or wastewater effluent while others require only potable water. In addition, the water demand types of future industries are unknown.

It is important in evaluating conservation strategies for industries to balance the water savings from conservation to economic benefits to the industry and the region. In the ETRWPA, where water is readily available, requiring costly changes to processes and equipment may not be practical economically. Finally, although it is expected that manufacturers will implement water conservation measures during the planning period, the ETRWPG does not have the industry- and site-specific information necessary to identify the current status of manufacturing water conservation or to say what measures should be implemented. In light of these considerations, the ETRWPG has not recommended water conservation strategies for manufacturing WUGs.

Irrigation. Most irrigation occurs in the lower parts of the Neches and Sabine Basins. Much of the irrigation water is delivered by canals and is used for rice farming along the coast. The LNVA is the largest provider of agricultural irrigation water in the ETRWPA. LNVA has implemented significant irrigation water conservation measures, including:

- Information and education program.
- Meter repair and replacement program.
- Water billing based on water usage: In 2005, LNVA began billing rice farmers based on metered water use rather than farmed acreage. After implementation of this measure, average water consumption was reduced from 3.79 ac-ft per acre farmed in 2004 to 2.84 ac-ft per acre farmed in 2005, a reduction of about 25 percent.
- Canal water loss reduction: From 2009 to 2013, LNVA reduced its canal water loss from 25 percent to 14 percent through aggressive leak detection and repair along with vegetation control. This represents a reduction in canal water loss of more than 23,000 ac-ft per year.
- Neches River saltwater barrier: This measure is estimated to conserve an average of 200,000 ac-ft per year of stored, fresh water that does not have to be released to prevent saltwater intrusion into the river.

Individual farmers also apply measures such as minimization of water loss from on-farm water distribution, irrigation scheduling, land leveling, and tailwater recovery. As described above, significant increases in efficiency have already been achieved. In addition, the appropriate water conservation strategies for individual farms are site-specific. Although the ETRWPG encourages implementation of irrigation water conservation measures, it does not have the farm-specific information necessary to identify the current status of on-farm water conservation or to recommend what measures should be implemented. In light of these considerations, the ETRWPG has not recommended further water conservation strategies for irrigation WUGs.

Other. Steam-electric power, livestock, and mining WUGs together account for between 17 and 19 percent of the total water demand in the ETRWPA during the planning period. The demand for steam-electric use is projected remain at approximately 8 percent of the total demand during the 50-year period. The projections for steam-electric use were provided by the TWDB. Livestock and mining together comprise 9 to 10 percent of the total demand. The cost of water in these industries comprises a small percentage of the overall business cost, and it is not expected that these industries will see an economic benefit to water conservation. Based on these considerations, water conservation strategies have not been recommended for steam-electric, livestock and mining WUGs.

Chapter 6

Impacts of the Regional Water Plan and Consistency with Protection of Resources

The development of viable strategies to meet the demand for water is the primary focus of regional water planning. However, another important goal of water planning is the long-term protection of resources that contribute to water availability, and to the quality of life in the State. The purpose of this chapter is to describe how the 2021 Regional Water Plan (2021 Plan) is consistent with the long-term protection of the State's water resources, agricultural resources, and natural resources. The requirement to evaluate the impact of the regional water plan and its consistency with protection of resources is found in 31 Texas Administrative Code Chapter 357.40 & 41, which require the following:

- A description of potential impacts of the regional water plan regarding agricultural resources; other water resources; threats to agricultural and natural resources; third-party social and economic impacts resulting from voluntary redistributions of water; major impacts of recommended water management strategies (WMS) on key water quality parameters; and, effects on navigation. (§357.40(b))

- A description of how the 2021 Plan is consistent with the long-term protection of the state's water resources, agricultural resources, and natural resources. (§357.41)

- A summary of identified water needs that remain unmet by the plan. (§357.40(c))

- A description of the socioeconomic impacts of not meeting identified water needs in the region. (§357.40(a))

These requirements are addressed by providing general descriptions of how the plan is consistent with protection of water resources, agricultural resources, and natural resources.

Additionally, the chapter will specifically address consistency of the 2021 Plan with the State's water planning requirements.

6.1 Impacts of Water Management Strategies

The Impacts of Water Management Strategies (WMSs) on Key Water Quality Parameters and the threat to Agricultural Resources/Rural Areas due to moving water were evaluated for each WMS included in the 2021 Regional Water Plan (2021 Plan). The result of this evaluation for each WMS is included in Appendix 5B-A, in the Project Evaluation section of each Technical Memorandum. Each WMS Technical Memorandum presents a rating for the strategy on a scale of 1-5 and a brief explanation for the rating. Appendix 5B-B provides a summary of the methodology behind the quantification of the rating system for each category. In addition, each technical memorandum describes impacts to other water sources, threats to natural resources, third-party social and economic impacts resulting from voluntary redistribution of water, and effects on navigation, if applicable.

6.1.1 Key Water Quality Parameters in the State

All WMSs in the 2021 Plan received a rating of a 4 in the category for "Major Impacts on Key Water Quality Parameters" with an Explanation of "Minimal or No Negative Impacts/Some Positive Impacts" with three exceptions:

The City of Center Raw Water Pipeline from Toledo Bend to Lake Center and Reuse Pipeline from their wastewater treatment plant to Lake Center WMSs both received a rating of 3 due to the WMSs' potential impacts of the addition of raw water and return flows, respectively, on the quality of the receiving bodies. The third exception was the Lower Neches Valley Authority Neches Trinity Basin Interconnect which also received a rating of 3 for the projects potential "Low Negative Impacts."

6.1.2 Moving Water from Agricultural and Rural Areas

All WMSs in the 2021 Plan were reviewed for their potential "Threat to Agricultural Resources/Rural Areas" and assigned a rating from 1-5 with an explanation listed rating.

Of the 64 WMSs presented in Appendix 5B-A, 1 received a rating of 3 indicating "Low Negative Impacts," 56 received a rating of 4 indicating "Minimal or No Negative Impacts", and 7 received a rating of 5 indicating High Positive Impacts. According to this evaluation, the WMS with the greatest impact to Agricultural/Rural areas is Lake Columbia due to the large project area compared to the remaining Region I WMSs. The strategies with the lowest impacts include permit amendments, contract amendments where the infrastructure to access water is already in place, volumetric surveys, and reuse strategies.

6.2 Consistency with the Long-term Protection of the State

To be considered consistent with long-term protection of the State's water, agricultural, and natural resources, the ETRWPA Water Plan must be in compliance with provisions of 31 Texas Administrative Code Chapter 357. The information, data, evaluation, and recommendations included in Chapters 1 through 5C and 7 through 11 of the 2021 Plan collectively demonstrate compliance with these regulations. To demonstrate compliance, the ETRWPA has developed a matrix addressing the specific recommendations contained in the applicable regulations from 31 Texas Administrative Code Chapters 357 and 358. Appendix 6-A contains a completed matrix or checklist highlighting each pertinent paragraph of the regulations. The content of the 2021 Plan has been evaluated against this matrix.

6.2.1 Protection of Water Resources

The water resources in the ETRWPA include portions of three river basins providing surface water, and portions of four aquifers providing groundwater. The three major river basins within the ETRWPA boundaries are the Sabine River Basin (Basin 5), the Neches River Basin (Basin 6), and the Trinity River Basin (Basin 8). The respective boundaries of these basins are depicted in Figure 1.10, in Chapter 1.

The region's groundwater resources include, primarily, the Gulf Coast and Carrizo-Wilcox aquifers. Lesser amounts of water are also drawn from the Sparta aquifer, Queen City aquifer, and localized aquifers, such as the Yegua-Jackson. The extents of these aquifers within the region are depicted on Figures 1.7 and 1.8, in Chapter 1.

Surface water accounts for approximately 75 percent of the total water use in the region. Sources within the region include 11 reservoirs in the Neches River Basin, three in the Sabine River Basin, and one in the Trinity River Basin. If constructed, Lake Columbia would be located in the Neches River Basin. Currently, the majority of the available surface water supply used in the ETRWPA comes from the Neches River Basin.

The Carrizo-Wilcox aquifer and Gulf Coast aquifers are, by far, the most important groundwater resources in the ETRWPA, accounting for approximately 75 percent of the available groundwater. Significant water level declines have been observed in the Carrizo-Wilcox aquifer around the cities of Tyler, Lufkin, and Nacogdoches over the past two decades. Lufkin and Nacogdoches are both considering development of new surface water sources to meet projected shortages. The City of Tyler already relies largely on surface water supplies.

Protection of surface water resources and groundwater resources necessarily involves understanding potential impacts to the interrelationship between groundwater and surface water. This is particularly important in aquifer recharge (i.e., outcrop) areas and contributing zones to recharge areas. The Carrizo-Wilcox Aquifer outcrops in the northeastern area of the region, predominantly in Panola, Shelby, and Rusk counties. In addition, the Queen City Aquifer outcrop is found in the northwestern area of the region, mostly in Henderson, Smith, Cherokee, and Anderson counties. All of these counties support surface water supplies that are likely located on a portion of an aquifer outcrop.

Hence, water management impacts on surface water sources could affect supplies in these important groundwater supplies. Strategies to manage impacts in the ETRWPA need to consider protection of the groundwater-surface water interfaces, where it is may be possible to do so.

To be consistent with the long-term protection of water resources, the 2021 Plan must recommend strategies that minimize threats to the region's sources of water over the planning period. The WMSs identified in Chapter 5B were evaluated for threats to water resources. The recommended strategies represent a comprehensive plan for meeting the needs of the region while effectively minimizing threats to water resources. Threats to water resources are minimized in the 2021 Plan in the following ways:

- **Water conservation**. Strategies for water conservation have been recommended that will help reduce the demand for water, thereby reducing the impact on the region's groundwater and surface water sources. Water conservation practices are expected to save over 20,000 ac–ft of water annually by 2070, reducing impacts on both groundwater and surface water resources. The plan also assumes significant savings in municipal demands due to the implementation of plumbing codes. Water conservation benefits the State's water resources by reducing the volumes of water withdrawals necessary to support human activity. This can benefit surface water, groundwater, and groundwater-surface water relationships.

- **Development of Lake Columbia**. This strategy will increase surface water supplies available for cities, industry, and agriculture in the ETRWPA.

- **Optimized use of existing surface water resources**. WMSs that involve existing surface water resources work to optimize the utilization of these resources. The Water Availability Model, a part of the regional planning process, assesses how the increased use of surface water resources will impact the Region's water resources. The Water Availability Models developed for the ETRWPA indicate adequate availability of surface water in the region. As with conservation, optimized use of existing surface water resources can help protect groundwater-surface water relationships where surface waters extend across an aquifer outcrop.

- **Optimized use of groundwater**. This strategy has generally been recommended for entities with sufficient groundwater supply available to meet needs, but currently without adequate infrastructure (i.e., well capacity). Groundwater availability reported in the plan is based on the long-term sustainability of the aquifer. No strategies are recommended to use water above currently identified sustainable levels.

6.2.2 Consistency with Protection of Agricultural Resources

Agriculture is an important economic cornerstone of the ETRWPA. Even with adequate rainfall, irrigation is a critical aspect of some agriculture in the region. Rice irrigation in the coastal counties is supplied by Lower Neches Valley Authority, primarily, with water from the Rayburn/Steinhagen system. The Water Availability Models indicate adequate availability of surface water to meet the projected irrigation demands for the planning period.

6.2.3 Consistency with Protection of Natural Resources

The ETRWPA contains many natural resources including threatened or endangered species; local, state, and federal parks and public land; and energy/mineral reserves. Following is a brief discussion of how the 2021 Plan is consistent with the long-term protection of these resources.

Threatened/Endangered Species. A list of species of special concern, including threatened or endangered species, located within the ETRWPA is contained in Appendix 1-A. Included are 22 species of birds, eight insects, six mammals, 11 reptiles, one amphibian, nine fish, six mollusks, 27 plants, and two crustaceans. In general, most WMSs planned for the ETRWPA will not affect threatened or endangered species. Development of new reservoirs in the region could affect threatened or endangered species and their habitats. However, the development of any reservoir requires extensive environmental impact studies that address potential effects on threatened or endangered species. Any such impacts indicated by these studies would need to be mitigated in accordance with federal and state environmental regulations in order for the reservoir project to be allowed.

Parks and Public Lands. The ETRWPA contains national forests, wildlife refuges, and a preserve; as well as state parks, forests, and wildlife management areas. In addition, there are numerous local (e.g., city or county parks), recreational facilities, and other local public lands located throughout the region. None of the WMSs currently proposed for the ETRWPA is expected to adversely impact state or local parks or public land.

In general, federal lands (i.e., national forests, wildlife refuges, or preserves) cannot be subjugated by state or local projects. Therefore, a proposed WMS for the ETRWPA would not be permitted to adversely impact such properties unless adequate mitigation measures were planned, and the plans approved by the appropriate federal agencies.

Timber Resources. Timber is an important economic resource for the ETRWPA. Although the development of Lake Columbia would inundate some forested areas, this loss in timber resources would be partially offset by gains in wetland areas, aquatic habitat and water recreation areas. A full environmental assessment is part of the planning process for development of reservoirs. The results of such environmental assessments identify any significant effects on timber resources and propose mitigation, as necessary.

Energy Reserves. Numerous oil and gas wells are located within the ETRWPA, including the East Texas Oil Field, and four of the top 10 producing gas fields in the state. Producing oil wells and top producing oil fields are depicted in Chapter 1 Figures 1.16 and 1.17, respectively. In addition, significant lignite coal resources can be found in the ETRWPA under portions of 12 counties. Lignite coal resources are depicted in Figure 1.19. These resources represent an important economic base for the region. None of the WMSs is expected to significantly impact oil, gas, or coal production in the region.

6.3 Unmet Water Need

Unmet water need refers to the portion of a water need identified in Chapter 4 that is not met by a recommended WMS in Chapter 5B.

The development of demand and supply projections for the 2021 Plan created 'artificial' needs in the region. Each planning decade represents a snapshot of conditions. Both the demand and supply listed for a decade represent conditions for that year and the subsequent years prior to the next decade; for example, 2020-decade demands shall be assumed to carry through the year 2029 while a 2020-decade supply must come online prior to the year 2020. The TWDB has allowed a slight variance in this requirement allowing for a WMS to include an online decade of 2020 if the project provides a water supply by January 5, 2023. Twenty-two projects are expected to go online between 2023 and 2029 and therefore have a supply decade of 2030 in order to meet demands that will develop between 2023 and 2029 and therefore have a demand decade of 2020. This gap in planning decade between demand and supply creates an 'artificial' need in 2020 for the 15 entities identified in Table 6.1 below, two of which are municipal: the City of Overton and the City of San Augustine.

Table 6.1 Unmet Needs Projected in 2020

County	Water User Group	2020 Unmet Need (ac-ft/yr)	Conservation Recommended
Angelina	Mining	473	No
Cherokee	Mining	238	No
Henderson	Mining	10	No
Jefferson	Manufacturing	101,138	No
Jefferson	Steam Electric Power	2,391	No
Nacogdoches	Livestock	5,970	No
Nacogdoches	Mining	5,475	No
Orange	Irrigation	526	No
Panola	Livestock	982	No
Rusk	Overton	62	Yes
Rusk	Steam Electric Power	1,103	No
San Augustine	San Augustine	110	Yes
San Augustine	Livestock	1,333	No
San Augustine	Mining	2,102	No
Smith	Bullard	130	Yes

TWDB guidance requires for any unmet municipal needs included in the 2021 Plan to include:

1. documentation that all potentially feasible WMS were considered to meet the need, including drought management WMS;

2. explanations as to why additional conservation and/or drought management WMS were not recommended to address the need;

3. descriptions of how, in the event of a repeat of the drought of record, the WUG associated with the unmet need shall ensure the public health, safety, and welfare in each planning decade with an unmet need; and,

4. explanation as to whether there may be occasion, prior to the development of the next Initially Prepared Plan (IPP), to amend the Regional Water Plan (RWP) to address all or a portion of the unmet municipal need.

For the cities of Overton, San Augustine, and Bullard, all potentially feasible WMSs types were considered to meet their 2020 Needs. Water conservation WMSs were included in the 2021 Plan for these cities as discussed in Chapter 5B, while drought management WMSs were considered but ultimately not recommended as discussed in Chapter 7. The municipal unmet needs presented in the table above are due to future demands that will develop late in the 2020 decade, after January 5, 2023, the TWDB deadline for a project to come online to be considered a supply for an entity in the 2020 planning decade. Therefore, these unmet needs are considered to be 'artificial' rather than 'true' needs. The cities opted not to include an additional WMS for a project they did not intend to implement prior to the 2023 supply deadline, and instead, confirmed their corresponding WMSs with an online decade of 2030 will meet the late 2020 demand increases that exceed their present-day existing supplies. Each WMS project sponsor has developed the timeline of their WMSs with an online year prior to the anticipated development of projected demands, and therefore, in the event of a repeat drought of record, the public health, safety, and welfare of each city is ensured through the 2020 decade. It is not feasible to amend the 2021 Plan prior to development of the 2026 IPP to meet all or a portion of the unmet municipal needs because the project sponsors do not foresee any water supply infrastructure projects to yield a supply prior to January 5, 2023.

Despite the 'artificial' needs identified; the ETRWPA is a water-rich region with no 'true' unmet needs, municipal or non-municipal, across the planning horizon.

6.4 Socioeconomic Impacts of Not Meeting Identified Needs

Administrative rules in 31 TAC §357.10 require regional water planning groups to evaluable socioeconomic impacts of not meeting water needs as a part of the regional water planning process. The TWDB conducted a comprehensive socioeconomic analysis to assess the impacts of failing to meet projected water needs within the region. This analysis calculated the impacts of a severe drought occurring in a single year at each decadal period within Region I. It was assumed that all of the projected impacts were attributed to drought conditions. Under these assumptions, notable findings from TWDB socioeconomic impact analysis are summarized as follows:

With the projected shortages, the region's projected 2020 population would be reduced by 12,571 people, which equates to approximately 1.1 percent of the total projected population.

Without any additional supplies, the projected water needs would reduce the region's projected 2020 employment by approximately 68,468 jobs (11.5 percent reduction). Employment is projected to continue to decline to 51,585 lost jobs by 2070. The mining sector accounts for nearly 56 percent of these jobs losses in 2020 but only accounts for 5 percent by 2070. Conversely, the livestock sector accounts for approximately 38 percent of job losses in 2020 and increases to account for nearly 83 percent of job losses by 2070. Municipal and manufacturing sectors are the next biggest contributors, particularly in later decades.

Without any additional supplies, the projected water needs would reduce the region's projected annual income by $9.3 billion in 2020, approximately 77 percent of which is within the mining industry. This represents nearly 16 percent of the region's current income. The loss in income reduces to approximately $3.9 billion in 2070, after mining is projected to decline.

The full socioeconomic impact analysis performed by the TWDB is attached in Appendix 6-B.

Chapter 7

Drought Response Information, Activities, and Recommendations

Drought response and management have long been important aspects of regional water planning. The extensive drought experienced in Texas during the 2010-2012 timeframe, however, served to re-focus attention on the need for comprehensive consideration of drought management measures. Requirements for improved drought planning in the State through the regional water planning process are found in Title 31 of the Texas Administrative Code, Part 10, Chapter 357, Subchapter D. Specifically, §357.42 of Subchapter D includes requirements related to drought response information, activities, and recommendations. This chapter addresses the requirements found in §357.42.

While the East Texas Regional Water Planning Area (ETRWPA) is generally less prone to extreme drought, there have been significant historical droughts identified throughout the region. These have tended to be sub-regional in nature, meaning a significant or extreme drought is more likely to be localized than in other, drier regions of the State. This limited geographic extent affects how the region prepares for and responds to drought when it does occur.

7.1 Droughts of Record

A central principal of regional water planning is that the availability of water sources is determined for drought-of-record conditions. State-wide, the drought of the 1950's is often considered the drought of record, but on regional or sub-regional bases, droughts during other periods of time may actually be demonstrated to have been more severe. Chapter 7 includes a detailed examination of preparations for and responses to drought conditions in the region, as required by §357.42. Such examination begins with identification of significant recent droughts within the region.

7.1.1 Historical Droughts of Record

As described in Chapter 3, the surface water supplies for the regional water plans were determined using the Texas Commission on Environmental Quality (TCEQ)-approved Water Availability Models (WAMs).[1] The WAMs can be used to simulate the response of existing and proposed water supply reservoirs to historical hydrologic conditions. The firm yield of a reservoir is the greatest amount of water the reservoir can supply on an annual basis without shortage during a repeat of historical drought of record conditions. The WAMs incorporate historical hydrologic conditions that occurred between 1940 and 1996. The historical droughts of record that were used to evaluate currently available water supplies occurred during this time period. Table 7.1 shows the historical drought of record for each major reservoir in the ETRWPA.

Table 7.1 Historical Droughts of Record for Major Water Supply Reservoirs

Reservoir Name	Counties	Drought of Record[a] Start Date	Drought of Record[a] End Date
Trinity River Basin			
Houston County	Houston	Jul 1950	Apr 1957
Neches River Basin			
Lake Athens	Henderson	Jun 1947	Mar 1957
Lake Jacksonville	Cherokee	Jul 1950	Mar 1957
Lake Palestine	Anderson, Cherokee, Henderson, Smith	Jul 1950	Feb 1957
Sam Rayburn	Angelina, Jasper, Nacogdoches, Sabine, San Augustine	Jun 1954	Feb 1957
B. A. Steinhagen	Jasper, Tyler		
Lake Columbia[b]	Cherokee, Smith	Jul 1962	Mar 1966
Lake Naconiche	Nacogdoches	Jan 1962	Oct 1973
Striker Creek Reservoir	Cherokee, Rusk	May 1963	Mar 1965
Lake Nacogdoches	Nacogdoches	Jun 1969	Oct 1972
Lake Pinkston	Shelby	Jun 1969	Oct 1972
Lake Tyler/Tyler East	Smith	Jun 1980	Oct 1985
Sabine River Basin			
Lake Cherokee	Gregg, Rusk	Jun 1962	Dec 1964
Lake Murvaul	Panola	Jun 1962	Jan 1965
Toledo Bend Reservoir	Newton, Panola, Sabine, Shelby	Jun 1962	Jan 1968

[a] For each location, the drought of record refers to a set of hydrologic conditions that is used to evaluate the firm yield of an existing or proposed reservoir.
[b] Lake Columbia is permitted but not yet constructed and is in the process of U.S. Army Corps of Engineers permitting.

The drought of record can be different for different geographic locations. There have been four primary droughts of record in the East Texas Region:

- The drought of the 1950s in the western and central portions of the region.
- With exceptions described below, the drought beginning in about 1962 and spanning the mid-1960s for the north central and eastern portions of the region.
- The June 1969-October 1972 drought in the north central portion of the region.
- The June 1980-October 1985 drought for the northern portion of the region.

7.1.2 Recent Droughts in the Region

There are a number of ways to measure drought, including the U.S. Drought Monitor index, the Palmer Hydrological Drought Index (PHDI), and reservoir water levels. These indicators were used in an attempt to identify significant new droughts in the ETRWPA since the mid-1990's.

The Drought Monitor is a composite index that is calculated weekly based on measurements of climatic, hydrologic, and soil conditions, as well as reported impacts and observations from more than 350 contributors around the country.[2] The Drought Monitor was initiated in 2000, and data can be obtained for each county in the United States. Figure 7.1 shows a composite Drought Monitor index calculated for the 20 counties in the ETRWPA over the period of record. This composite index shows the percentage of the land area in the affected counties that experienced different levels of drought. Approximately 15 to 30 percent of the region experienced extreme drought in 2006, 2007, and for a brief period in 2013. The Drought Monitor index indicates that the region experienced extreme/exceptional drought conditions from late 2010 through early 2012. In October 2011, the entire region experienced exceptional drought conditions. Since 2011 no major periods of drought have been recorded.

Compared to climatic effects of drought, the hydrological effects, such as lower reservoir and groundwater levels, may take longer to develop and take longer to recover from. The PHDI was developed as an indicator of the long-term cumulative moisture supply. The PHDI is available on a monthly basis for each year since 1900 for ten climatic zones in each state.[3] The East Texas climatic zone includes most of the ETRWPA, as well as parts of Regions C, G, and H and the North East Texas Regional Water Planning Area. Figure 7.2 shows the PHDI for the East Texas climatic zone. The PHDI reflects extreme droughts in this area during the 1950s, as well as in 1981, 1998, 2005-06, and 2010-12. According to the PHDI, the 2010-2012 drought was more severe than any of the individual droughts in the 1950s.

Since construction of the Sam Rayburn and Toledo Bend Reservoirs in the late 1960s, reservoirs in the ETRWPA reached minimum conservation storage during the droughts of 1995-1996 and 2010-2012, with several smaller droughts occurring during the period (Figure 7.3).[4]

Each of the three drought indicators suggests that the 2010-2012 period was one of significant drought for the ETRWPA. However, each of these indicators applies to the ETRWPA as a whole, and more localized hydrologic information is necessary to evaluate whether accounting for recent droughts would change the estimates of available surface water supplies. For a full evaluation of the impact of a potential new drought of record on surface water supply availability, the WAMs should be updated to incorporate the hydrologic conditions that have occurred since 1996.

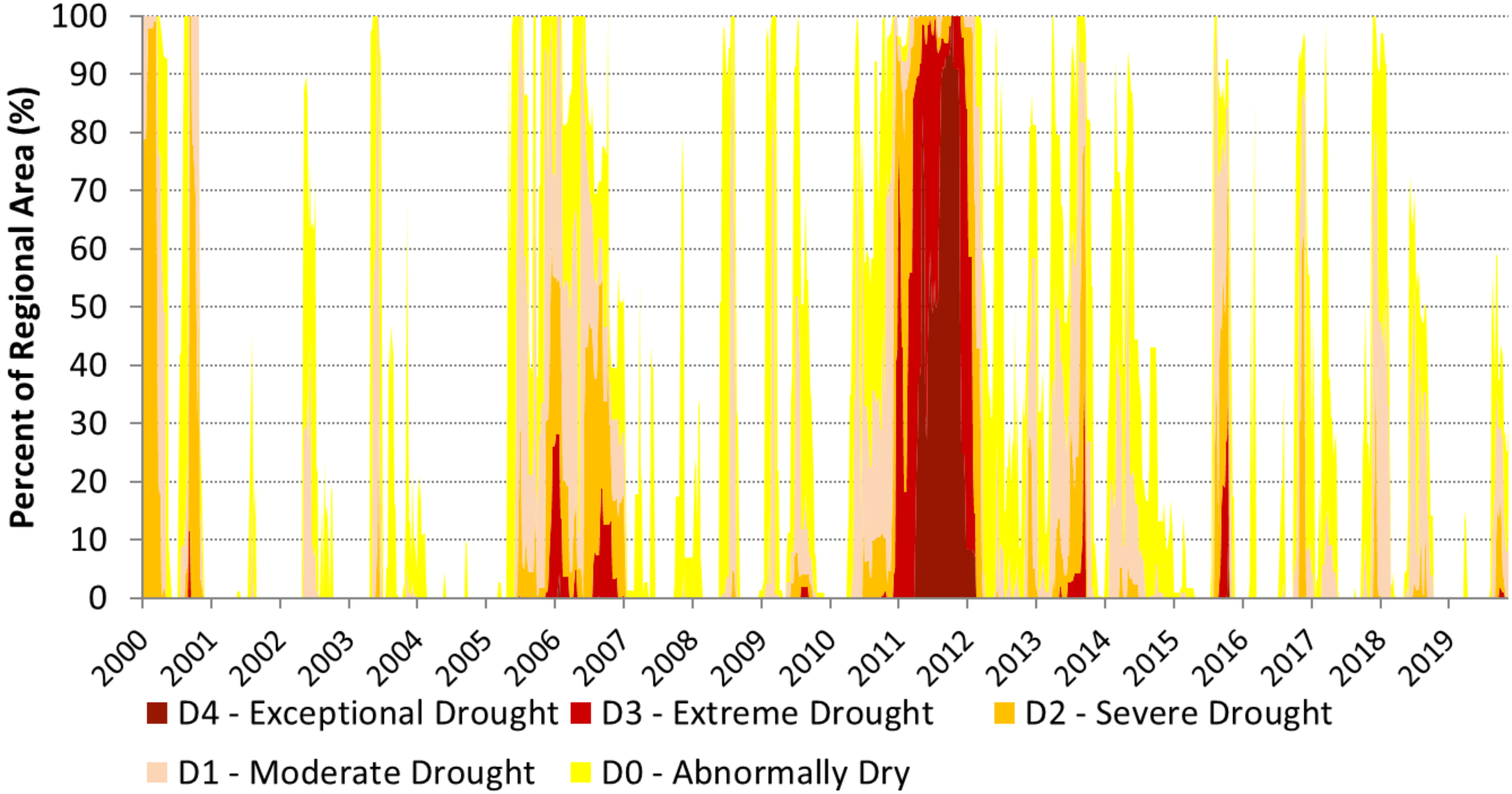


Figure 7.1 Composite Drought Monitor Index for Counties in the East Texas Regional Water Planning Area

SOURCE: DATA PROVIDED BY THE NATIONAL DROUGHT MITIGATION CENTER, NOVEMBER 2019.

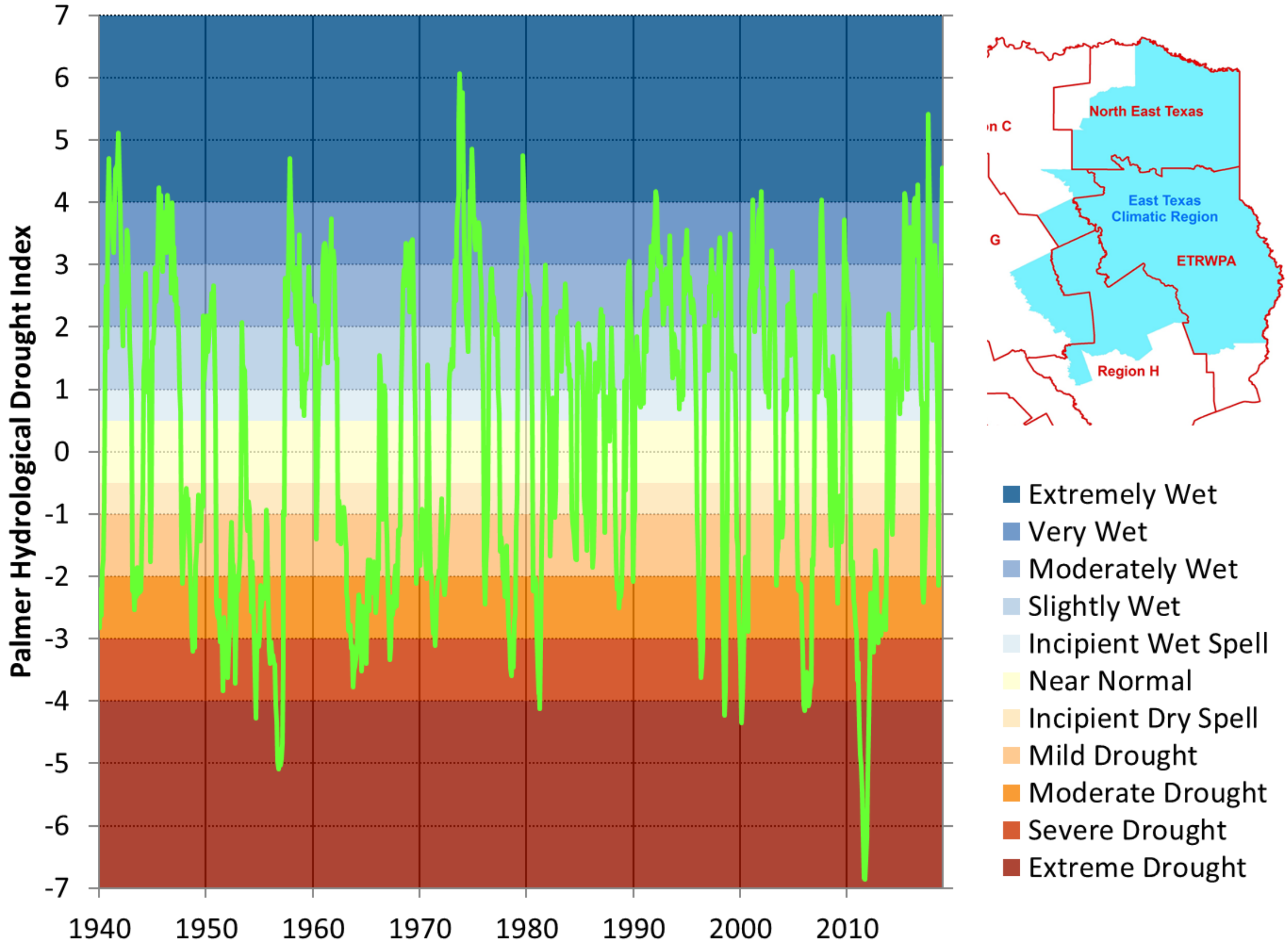


Figure 7.2 Palmer Hydrological Drought Index for the East Texas Climatic Zone

SOURCE: NATIONAL CLIMATIC DATA CENTER: PHDI DIVISIONAL DATA,
URL: HTTPS://WWW.NCDC.NOAA.GOV/TEMP-AND-PRECIP/DROUGHT/HISTORICAL-PALMERS/PHD/190011-201910

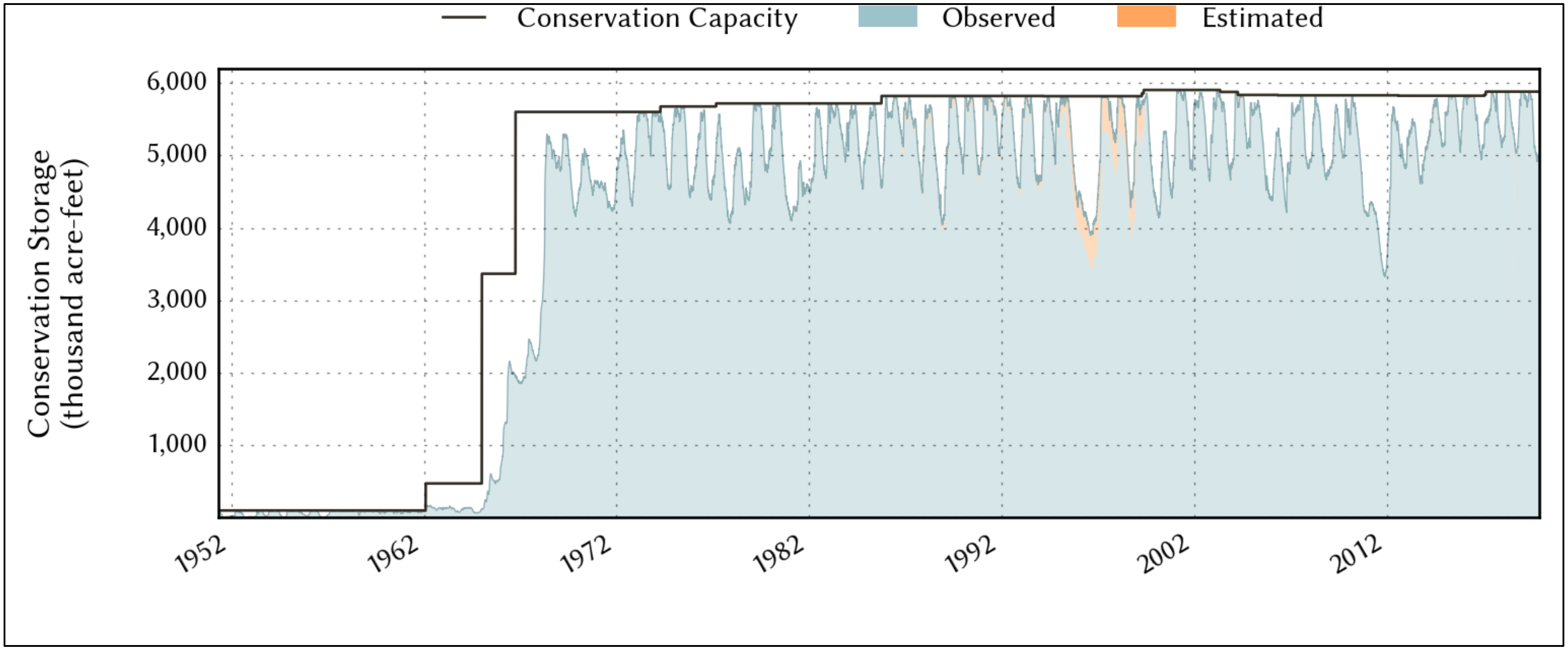


Figure 7.3 Composite Reservoir Storage in the East Texas Regional Water Planning Area

SOURCE: TEXAS WATER DEVELOPMENT BOARD: EAST TEXAS PLANNING REGION RESERVOIRS, URL: HTTP://WATERDATAFORTEXAS.ORG/RESERVOIRS/REGION/EAST-TEXAS, ACCESSED NOVEMBER 2019.

7.2 Current Drought Preparations and Responses in Drought Contingency Plans

The TCEQ requires the following types of water providers to submit drought contingency plans to the agency:

- Retail public water suppliers serving 3,300 connections or more
- Wholesale public water suppliers
- Irrigation districts
- Applicants for new or amended water rights
- Investor-owned or privately-owned water utilities

In addition, the TCEQ requires retail public water suppliers serving fewer than 3,300 connections to prepare and adopt a drought contingency plan and make the plan available upon request. A list of water users that are required by Texas Water Code Section 11.1272 to submit a drought contingency plan is included in Table 7.2. For retail public water suppliers, the current number of connections was obtained from the TCEQ Water Utility Database. Drought contingency plans were to be updated and submitted to the TCEQ and East Texas Regional Water Planning Group (ETRWPG) by May 1, 2019. Failure to submit a drought contingency plan is a violation of the Texas Water Code, Section 11.1272 and the Texas Administrative Code, Section 288.30, and is subject to enforcement by the TCEQ.

7.2.1 Summary of Current Drought Triggers, Goals, and Response Measures

The majority of the drought contingency plans (DCPs) in the ETRWPA use trigger conditions based on a combination of water supply and demands placed on the water distribution system.

Utilities use water supply-based triggers to identify the onset of drought and to reduce water usage accordingly. Typical supply-based triggers depend on water levels in wells, water levels in reservoirs, and/or water system storage capacity.

Demand-based triggers are based on limitations in a utility's ability to treat and/or convey water to its customers. Demand-based triggers are typically expressed as a percentage of water production capacity.

Drought contingency plans typically identify different stages of drought and specific triggers and responses for each stage. In addition, the plan must specify quantifiable targets for water use reductions for each stage, and a means and method for enforcement. Table 7.3 summarizes 46 DCPs for entities who submitted their plans to the ETRWPG by May 20, 2019 or who have published drought contingency plans on their web sites. The plans include 3 to 6 stages, typically with voluntary measures beginning in Stage 1 and mandatory measures beginning in Stage 2. Some DCPs include an emergency stage not directly related to drought but based on system rupture or failure. Other DCPs have a water rationing section, apparently for situations that are more severe than the final drought contingency stage. In these instances, water rationing is listed in Table 7.3 as the final stage.

Many plans that list water savings goals in terms of percentages of total water use. For these plans, Figure 7.4 shows the following by drought response stage:

- Range of water savings goals and
- Number of plans that include percentage water savings goals.

Table 7.2 East Texas Regional Water Planning Area Water Suppliers Required to Submit Drought Contingency Plans

Angelina & Neches River Authority	City of Pineland
Angelina Nacogdoches WCID	City of Port Arthur
Athens Municipal Water Authority	City of Port Neches
City of Athens	City of Rusk[a]
City of Beaumont	City of San Augustine[a]
City of Bridge City	City of Silsbee
City of Carthage	City of Tyler
City of Center	Craft Turney WSC
City of Crockett[a]	Four Pines WSC[a]
City of Grapeland	G-M WSC
City of Groves	Houston County WCID No. 1
City of Hemphill	Lake Livingston WSC
City of Henderson[a]	Lindale Rural WSC
City of Huntington	Lower Neches Valley Authority
City of Jacksonville[a]	Lumberton MUD
City of Jasper	Mauriceville MUD
City of Kilgore	North Cherokee WSC[b]
City of Kountze	Orange County WCID 1
City of Lindale	Sabine River Authority
City of Lufkin	Slocum WSC
City of Nacogdoches	South Sabine WSC
City of Orange	Southern Utilities
City of Palestine	Upper Neches River Municipal Water Authority

[a] Data is from 2014 drought contingency plan.
[b] Data is from 2000 drought contingency plan.

Table 7.3 Drought Trigger Conditions and Strategies Documented in Drought Contingency Plans

Entity	Plan Date	Trigger Based On: Supply	Trigger Based On: Demand	No. of Stages	First Stage with Mandatory Measures	Retail Water Sales	Wholesale Water Sales	Water Use Reduction Goals by Stage: (Percent Reduction in Total Use Unless Otherwise Specified)[a] 1	2	3	4	5
Angelina and Neches River Authority	2019	•	•	5	2	•	•	5%	10%	10%	10%	10%
Angelina Nacogdoches WCID 1	2019	•		4	2		•	0%	10%	25%	50%	
Athens Municipal Water Authority	2019	•	•	6	2		•	10%	4 MGD[b]	4 MGD[b]	4 MGD[b]	4 MGD[b]
City of Athens	2019	•	•	6	2	•		10%	4 MGD[b]	4 MGD[b]	4 MGD[b]	4 MGD[b]
City of Beaumont	2019	•	•	5	2	•	•	8%	10%	12.5%	15%	30%
City of Bridge City	2015	•	•	6	2	•		5%	10%	15%	25%	40%
City of Carthage	2019	•	•	5	2	•	•	5%	10%	15%	20%	25%
City of Center	2019	•	•	4	2	•	•	5%	10%	15%	n/a	
City of Crockett	2014	•	•	4	2	•	•	10%	20%	30%	n/a	
City of Grapeland	2019	•	•	4	2	•	•	10%	20%	30%	n/a	
City of Groves	2019	•	•	6	2	•		5%	10%	12.5%	15%	15%
City of Hemphill	2019	•	•	4	2	•	•	10%	15%	20%	25%	
City of Henderson	2014	•	•	3	2	•		10%	10%	10%[c]		
City of Huntington	2017	•	•	4	3	•		n/a	n/a	n/a	n/a	
City of Jacksonville	2014	•	•	3	2	•	•	5%	10%	12.5%	12.5%	
City of Jasper	2019	•	•	2	2	•		10%	n/a			
City of Kilgore	2019	•	•	6	2	•	•	5%	80%[d]	85%[d]	90%[d]	95%[d]
City of Kountze	2017	•	•	5	2	•		5%	10%	15%	20%	25%
City of Lindale	2019	•	•	5	2	•		5%	7%	10%	15%	20%

Table 7.3 Drought Trigger Conditions and Strategies Documented in Drought Contingency Plans (Cont.)

Entity	Plan Date	Trigger Based On:		No. of Stages	First Stage with Mandatory Measures	Retail Water Sales	Wholesale Water Sales	Water Use Reduction Goals by Stage: (Percent Reduction in Total Use Unless Otherwise Specified) [a]				
		Supply	Demand					1	2	3	4	5
City of Lufkin	2019	•	•	6	2	•	•	5%	10%	10%	10%	10%
City of Nacogdoches	2019	•	•	5	2	•		5%	7%	9%	n/a	n/a
City of Orange	2019	•	•	4	2	•		10%	15%	25%	n/a	
City of Palestine	2019	•	•	4	2	•		n/a	n/a	n/a	n/a	
City of Pineland	2019	•	•	5	2	•	•	5%	7%	10%	15%	20%
City of Port Arthur	2019	•	•	3	2	•		n/a	n/a	n/a		
City of Port Neche	2019	•	•	5	2	•		n/a	n/a	n/a	n/a	n/a
City of Rusk	2014	•	•	4	2	•	•	10%	15%	20%	n/a	
City of San Augustine	2014	•		5	2	•	•	5%	10%	15%	25%	n/a
City of Silsbee	2019	•	•	4	2	•		10%	15%	25%	n/a	
City of Tyler	2019	•	•	5	2	•	•	5%	10%	25%	n/a	n/a
Craft Turney WSC	2019	•	•	5	2	•		5%	10%	15%	20%	75%
Four Pines WSC	2014	•	•	3	2	•	•	20%	30%	40%		
G M WSC	2019	•	•	6	2	•		5%	10%	20%	30%	40%
Houston County WCID No. 1	2019	•	•	4	2	•	•	10%	20%	30%	n/a	
Lake Livingston WSC	2019	•	•	4	2	•		10%	25%	40%	n/a	
Lindale Rural WSC	2019	•	•	4	2	•		10%	15%	20%	25%	
Lower Neches Valley Authority	2019	•	•	4	2		•	10%	20%	30%	Max	
Lumberton MUD	2019	•	•	6	2	•		25%	30%	50%	60%	70%
Mauriceville MUD	2019	•	•	6	2	•		20%	30%	40%	50%	60%
North Cherokee WSC	2000	•		6	2	•		n/a	n/a	n/a	n/a	n/a
Orange County WCID 1	2019	•	•	6	2	•		10%	15%	20%	25%	30%
Sabine River Authority	2019	•		4	2		•	n/a	10%	20%	n/a	

Table 7.3 Drought Trigger Conditions and Strategies Documented in Drought Contingency Plans (Cont.)

Entity	Plan Date	Trigger Based On:		No. of Stages	First Stage with Mandatory Measures	Retail Water Sales	Wholesale Water Sales	Water Use Reduction Goals by Stage: (Percent Reduction in Total Use Unless Otherwise Specified) [a]				
		Supply	Demand					1	2	3	4	5
Slocum WSC	2019	•	•	3	1	•	•	n/a	n/a	n/a		
South Sabine WSC	2019	•	•	6	2	•	•	10%	15%	20%	30%	35%
Southern Utilities	2019	•	•	5	2	•		5%	5%[e]	7%	10%	15%
Upper Neches River Municipal Water Authority	2019	•	•	4	2		•	5%	10%	15%	n/a	

[a] Blank cell indicates entity does not have reduction goal.
[b] Maximum use goal.
[c] Cushion between demand and capacity.
[d] Reduce daily production to below the available production capacity.
[e] 5% reduction in average daily demand.

Figure 7.4 Range of Percentage Water Savings Goals East Texas Regional Water Planning Area Drought Contingency Plans

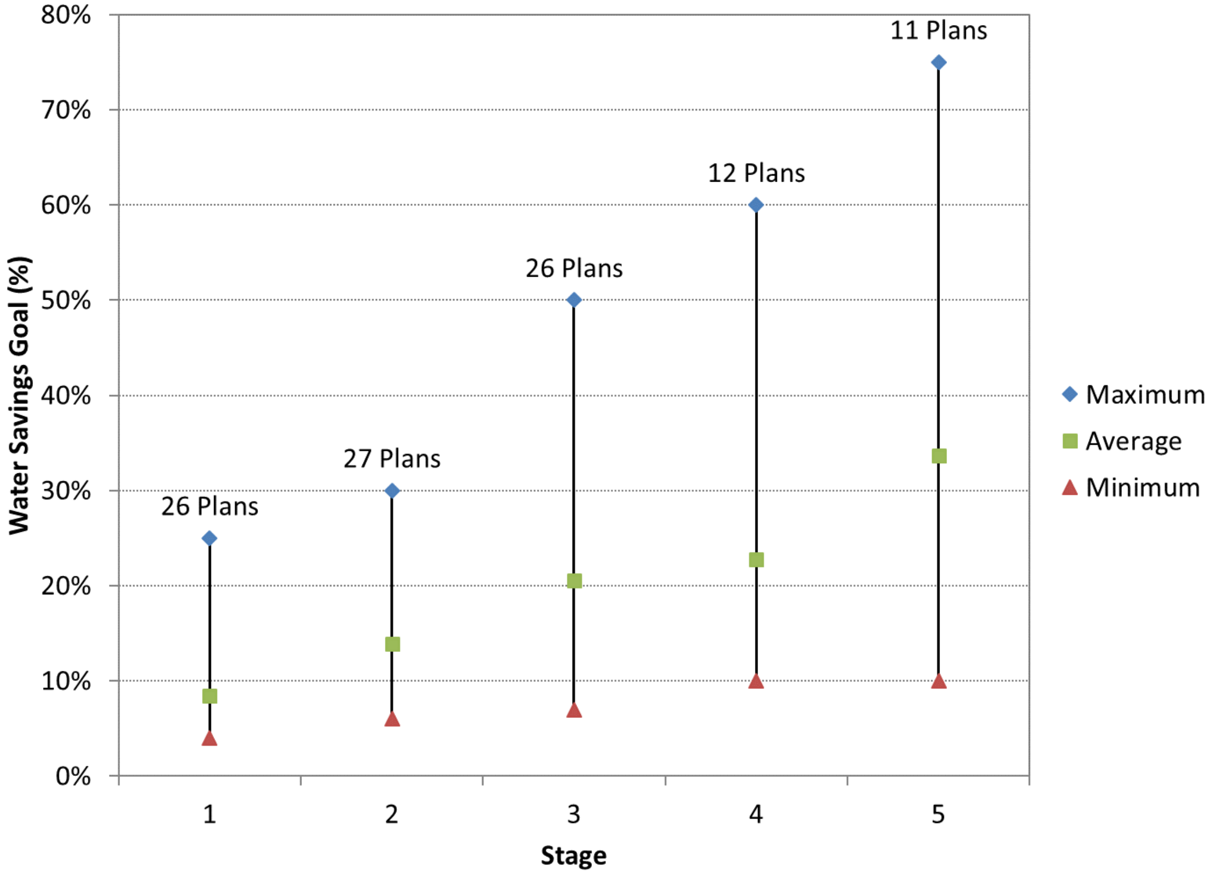


Table 7.4 summarizes drought response measures in the DCPs. In general, retail water suppliers have a wider range of drought response measures available to them compared to wholesale water suppliers.

Table 7.4 Summary of Drought Response Measures

Strategy Type 1	Strategy Type 2	Percentage of Plans Specifying Strategy	Stage Index[a] (0-1)	Strategy
General		98%	0.24	Voluntary usage reductions
Waste	Ban	79%	0.50	Prohibit non-essential water uses (washdown, dust control, uncontrolled leaks)
Irrigation	Ban	66%	0.89	No irrigation
Rationing		66%	0.89	Water rationing
Education		81%	0.25	Public awareness/ customer awareness measures
Irrigation	Ban	66%	0.41	No irrigation during certain hours
Irrigation	Timing	53%	0.20	Voluntary irrigation hours
Waste	Ban	55%	0.73	No adding water to pools, spas
Waste	Ban	60%	0.45	No operation of ornamental fountains, ponds
Irrigation	Timing	53%	0.40	Mandatory twice-weekly irrigation limits
Irrigation	Ban	53%	0.62	No irrigation with hose-end sprinklers
Waste	Reduce	62%	0.38	Add water to pools, spas only during certain days/hours
Comm/Ind		49%	0.38	Restaurants serve water only on request
Vehicle		64%	0.40	Residential vehicle watering, window washing, pavement washing limited to hose with positive shutoff and/or bucket
Irrigation	Timing	47%	0.20	Voluntary twice-weekly irrigation limits
Comm/Ind		28%	0.72	Mandatory (or additional mandatory) reductions by wholesale, industrial, and commercial customers
Vehicle		60%	0.39	Vehicle washing only during certain days/hours (outside of commercial facilities)
Vehicle		43%	0.70	No vehicle washing outside commercial facilities
Vehicle		43%	0.70	Commercial vehicle washing only during certain hours
Irrigation	Ban	47%	0.59	No irrigation of golf course tees
Irrigation	Ban	43%	0.72	No irrigation with automatic sprinkler systems
Utility	Hydrant	53%	0.38	Limit use of water from hydrants to firefighting, activities necessary to maintain public health, safety, and welfare, and specially permitted uses.
Vehicle		57%	0.89	No vehicle washing
Rationing		30%	0.69	Initiate pro rata curtailment for wholesale customers (focus on temporary & short-term contracts first)
Utility	Similar	34%	0.28	Discuss conservation/ rationing with wholesale customers; request voluntary measures
Utility	Rates	47%	0.91	Implement rate surcharges
Utility	Admin	23%	0.94	If appropriate, notify city, county, and/or state emergency response officials for assistance
Utility	Hydrant	38%	0.26	Reduce flushing of water mains
Utility	Similar	21%	0.49	Request wholesale customers implement mandatory conservation/ rationing measures
Utility	Hydrant	45%	0.61	No construction water use from hydrants

Table 7.4 Summary of Drought Response Measures (Cont.)

Strategy Type 1	Strategy Type 2	Percentage of Plans Specifying Strategy	Stage Index[a] (0-1)	Strategy
Utility	Admin	21%	0.90	Inform the utility director or other responsible official of each wholesale water customer by telephone or in person and suggest actions, as appropriate, to alleviate problems
Utility	Admin	23%	0.86	Undertake necessary actions, including repairs and/or clean-up as needed
Utility	Admin	21%	0.98	Assess the severity of the problem and identify the actions needed and time required to solve the problem
Utility	System	38%	0.71	No new or increased connections
Alternative		26%	0.70	Use alternative supply sources, including interconnects
Utility	Admin	17%	0.98	Prepare a post-event assessment report on the incident and critique of emergency response procedures and actions
Utility	Similar	43%	0.25	Utility water use follows Stage 2
Irrigation	Timing	6%	0.36	Mandatory odd-even irrigation limits
Waste	Ban	19%	0.76	No outdoor water use
Waste	Ban	13%	0.96	All water usage except to protect public health, safety, and welfare is prohibited
Utility	System	15%	0.25	Inspect infrastructure, equipment; system oversight
Rationing		26%	0.44	Prepare monthly water usage allocations for wholesale customers in advance of pro rata curtailment
Utility	Hydrant	26%	0.52	No hydrant flushing/ no flushing of water mains
Irrigation		21%	0.52	Reduce or discontinue irrigation of public areas
Waste	Enforce	17%	0.65	Increased enforcement; add personnel
Alternative		17%	0.56	Investigate alternative water sources, including interconnects
Waste	Ban	6%	0.56	Discontinue non-essential water use by utility personnel
Irrigation	Timing	6%	0.22	Voluntary odd-even irrigation limits
Comm/Ind		17%	0.40	Discuss conservation with industrial and commercial customers
Utility	System	6%	0.41	Take steps toward increasing system capacity (e.g., repair wells, etc.)
Irrigation	Ban	23%	0.50	Discontinue irrigation of public areas
Irrigation	Ban	11%	0.62	No irrigation of golf course fairways
Rationing		4%	0.54	Eliminate reservoir releases to supply interruptible supplies
Utility	Leaks	15%	0.32	Aggressively locate and repair major water main leaks and breaks; move personnel to leak repair
Waste	Reduce	6%	0.39	Request customers insulate pipes to prevent freezing
Irrigation	Timing	13%	0.64	Mandatory irrigation schedule (unspecified)
Irrigation	Timing	2%	0.40	Mandatory every fourth day irrigation limits
Irrigation	Ban	11%	0.67	No irrigation of athletic fields
Rationing		36%	0.93	Establish water allocations for residential customers

[a] Stage index is the average over all plans of the stage in which a strategy is specified divided by the number of stages. It indicates of how far into the drought response stages a strategy is specified: The higher the value, the later the stage.

One of the primary drought response measures for retail water suppliers is restricting irrigation. Many plans include the following progression of irrigation limits:

- Stage 1: Voluntary limits on irrigation days (maximum of twice per week, odd/even schedule, etc.) and hours (no irrigation in the middle of the day).
- Stage 2: Mandatory limits on irrigation days and hours.
- Stage 3: No use of hose-end sprinklers.
- Stage 4: No use of automatic irrigation systems.
- Stage 5: No irrigation.

A number of utilities have recently implemented drought contingency measures. The TCEQ maintains a list of entities that are currently restricting supplies to avoid water shortages. The locations of Public Water Systems (PWS) within Region I are shown in Figure 7.5. Table 7.5 lists the Region I PWS that have notified the TCEQ of limiting water use through voluntary or required restrictions, the county where the entity is located, and the most recent date the TCEQ was notified of limiting water use. The table also provides the TCEQ drought response stage and the related response stage in the entity's Drought Contingency Plan if the plan was available.

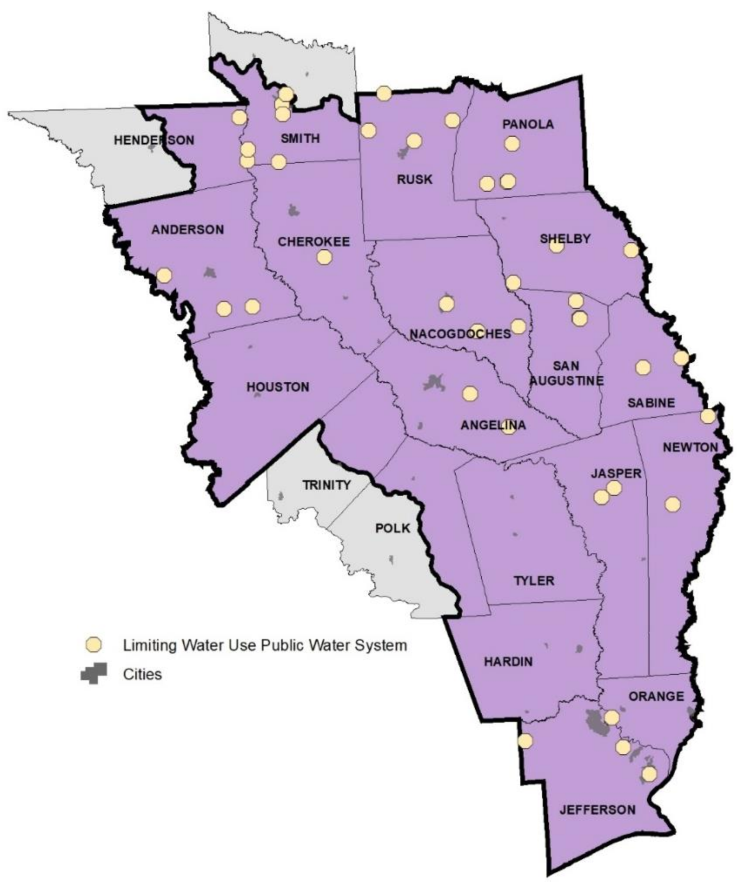


Figure 7.5 Map of Public Water Providers Limiting Water Use

SOURCE: TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 7.5 Public Water Providers Limiting Water Use

PWS ID	PWS Name	County	TCEQ Stage[a]	Date Implemented	TWDB Database WUG Name	DCP Stage
10026	Pleasant Springs WSC	Anderson	V	7/5/2013	Pleasant Springs WSC	---
10028	Slocum WSC	Anderson	1	8/17/2015	Slocum WSC	Stage I
10044	TDCJ Beto Unit	Anderson	3	2/1/2017	TDCJ Beto Gurney & Powledge Units	---
30007	Pleasure Point	Angelina	1	1/1/2011	Angelina, County-Other	---
30002	City of Huntington	Angelina	V	8/16/2011	Huntington	Stage II
370031	Rusk Rural WSC Crockett St Plant	Cherokee	V	7/18/2011	Rusk Rural WSC	---
370053	Rusk Rural WSC US 69 Plant	Cherokee	V	7/18/2011	Rusk Rural WSC	---
370054	Rusk Rural WSC Loop 343 Plant	Cherokee	V	7/18/2011	Rusk Rural WSC	---
1070211	Phoenix Water Works	Henderson	V	6/24/2011	Henderson, County-Other	---
1210020	Holmwood Angelina & Neches River Authority	Jasper	1	8/22/2011	Angelina & Neches River Authority[b]	Stage II
1210014	Rayburn Country MUD	Jasper	1	8/4/2017	Rayburn Country MUD	---
1230039	City of Nome	Jefferson	V	4/11/2011	Jefferson, County-Other	---
1230003	Jefferson County WCID 10	Jefferson	V	7/13/2011	Jefferson County WCID 10	---
1230009	City of Port Arthur	Jefferson	V	6/19/2014	Port Arthur	Stage I
1740006	Melrose WSC	Nacogdoches	1	7/14/2011	Melrose WSC	---
1740003	City of Nacogdoches	Nacogdoches	V	5/6/2013	Nacogdoches	Stage I
1740020	Woden WSC	Nacogdoches	V	6/26/2013	Woden WSC	---
1760001	City of Newton	Newton	1	11/19/2012	Newton	---
1760015	Tall Timbers WSC	Newton	V	5/21/2013	Newton, County-Other	---
1810139	City of Rose City	Orange	V	7/14/2011	Orange, County-Other	---
1830010	Murvaul WSC	Panola	1	6/24/2011	Panola, County-Other	---
1830017	A & P WSC Pump 1	Panola	1	9/22/2011	Panola, County-Other	---
1830027	South Murvaul WSC	Panola	V	1/13/2012	Panola, County-Other	---
1830008	Gary WSC	Panola	2	4/25/2013	Panola, County-Other	---
2010024	City of New London	Rusk	V	8/15/2011	New London	---
2010013	Dirgin WSC	Rusk	V	10/2/2011	Rusk, County-Other	---

Table 7.5 Public Water Providers Limiting Water Use (Cont.)

PWS ID	PWS Name	County	TCEQ Stage[a]	Date Implemented	TWDB Database WUG Name	DCP Stage
2010058	Cross Roads SUD Greenwood Ranch	Rusk	V	4/24/2013	Cross Roads SUD	---
2010018	Southern Utilities Laird Hill	Rusk	V	5/9/2013	Southern Utilities	Stage I
2010025	New Prospect WSC Plant 1	Rusk	V	9/20/2013	New Prospect WSC	---
2010067	New Prospect WSC Plant 2 & 3	Rusk	V	9/20/2013	New Prospect WSC	---
2010011	Cross Roads SUD	Rusk	2	8/18/2015	Cross Roads SUD	---
2020013	El Camino Bay Water System	Sabine	V	6/24/2011	Sabine, County-Other	---
2020001	City of Hemphill	Sabine	V	7/13/2011	Hemphill	Stage I
2030001	City of San Augustine	San Augustine	1	1/13/2012	San Augustine	Stage II
2030007	San Augustine Rural WSC	San Augustine	1	8/29/2013	San Augustine Rural WSC	---
2030034	New WSC	San Augustine	1	9/11/2013	San Augustine, County-Other	---
2030004	Denning WSC	San Augustine	V	9/30/2013	San Augustine, County-Other	---
2030002	Bland Lake Rural WSC	San Augustine	V	9/30/2013	San Augustine, County-Other	---
2100001	City of Center	Shelby	1	11/21/2011	Center	Stage I
2100019	City of Huxley	Shelby	V	7/15/2013	Huxley	---
2100013	Sand Hills WSC	Shelby	V	8/27/2015	Sand Hills WSC	---
2120064	Lakeway Harbor Subdivision	Smith	V	6/24/2011	Smith, County-Other	---
2120004	City of Tyler	Smith	V	3/27/2012	Tyler	Stage I
2120063	Southern Utilities	Smith	V	5/9/2013	Southern Utilities	Stage I
2120008	Community Water Co Montgomery Gardens	Smith	V	6/13/2013	Smith, County-Other	---
2120006	City of Bullard	Smith	V	8/20/2013	Bullard	---
2120035	Pine Trail Shores	Smith	V	11/19/2019	Smith, County-Other	---

Data source: https://www.tceq.texas.gov/drinkingwater/trot/droughtdic.html

[a] V – customers requested to voluntarily limit water use; 1 – use of water for non-essential uses is restricted; 2 – all outdoor water usage is prohibited except by hand-held hoses with manual on/off nozzles, water usage for livestock is exempt from this restriction; and 3 – all outdoor water usage is prohibited, livestock watering may be exempted by the utility, all consumption may also be limited to each customer in specific ways.

[b] Angelina & Neches River Authority is a wholesale water provider which acquired the Holmwood infrastructure.

7.2.2 Drought Contingency Plan Recommendations

During the review of submitted DCPs, eight common water sources were identified. In the following sections, DCPs are compared for entities that sell or receive water from these common water sources. The comparison focuses on the number of response stages, the triggers that initiate the stages, the water savings goals, and the response measures.

Lake Athens

The Athens Municipal Water Authority supplies treated water from Lake Athens to the City of Athens. The DCPs for Athens Municipal Water Authority and Athens are identical.

Houston County Lake

The Houston County Water Control and Improvement District No. 1 (HCWCID 1) supplies treated water from Houston County Lake to the Cities of Crockett and Grapeland. In the DCPs for HCWCID 1 and Crockett, the triggers, stages, and goals are aligned, and the response measures are complementary. In the DCPs for HCWCID 1 and Grapeland, the triggers, stages, and goals are aligned, and the response measures are the same. However, response measures for the HCWCID 1 are general in nature and not necessarily appropriate for a retail water provider. Grapeland should consider adding detail about the specific response measures that will be used to achieve its goals for each response stage.

Lake Jacksonville

The City of Jacksonville supplies treated water from Lake Jacksonville to the North Cherokee water supply corporation (WSC). Jacksonville’s DCP has three stages, while the North Cherokee WSC DCP has six stages. Neither plan specifies water savings goals for any of the stages. Response measures are not well-aligned, probably due to the different numbers of stages. For example, the third stage in each plan is labeled "Severe Conditions," but Jacksonville's plan bans all outdoor water use, while North Cherokee WSC's plan appears to allow twice-weekly irrigation by hand or drip irrigation system.

Both Jacksonville and North Cherokee WSC should specify water savings goals by response stage. In addition, North Cherokee WSC and Jacksonville should consider revising their plans to have the same number of response stages and commensurate response measures.

Sam Rayburn Reservoir-Steinhagen Lake System

The Lower Neches Valley Authority (LNVA) supplies raw water from the Sam Rayburn Reservoir-Steinhagen Lake System to Beaumont, Bolivar Peninsula special utility district (SUD), Groves, Jefferson County Water Control and Improvement District (WCID) 10, Nederland, Nome, Port Arthur, Port Neches, West Jefferson County MWD, and Woodville. The triggers in the LNVA and Groves DCPs are aligned, but the Groves water savings goals for Stages 3 through 5 are significantly lower than LNVA's goals (12.5 percent vs. 20 percent for Stage 3, 15 percent vs. 30 percent for Stage 4, and 15 percent vs. "maximum" for Stage 5). Groves should consider revising response measures for Stages 3 through 5 to achieve water savings goals similar to LNVA's goals.

The Port Arthur DCP has three stages, while the LNVA DCP has five stages. Some of the Port Arthur triggers depend on LNVA declarations of "mild", "moderate", or "severe" conditions, but LNVA's stages are labeled "moderate", "severe", "extreme", "exceptional", and "emergency". Port Arthur does not specify water savings goals for any of the response stages. Due to the different stage names, different numbers of stages, and uncertain savings goals, it is not clear whether response measures are well-aligned between the two plans. Port Arthur and LNVA should consider revising plans to have the same number of response stages and commensurate response measures, and Port Arthur should specify water savings goals by response stage.

Lake Fork Reservoir

The Sabine River Authority (SRA) Iron Bridge/Lake Fork Division supplies raw water from Lake Fork Reservoir to the Cities of Henderson and Kilgore. The Henderson DCP has three stages, while the SRA Iron Bridge/Lake Fork DCP has five stages (not counting the emergency stage). Henderson's water savings goals appear to be commensurate with or more stringent than SRA's, so the response measures appear to be complementary. Henderson's triggers are based on its treatment/distribution capacity and not on raw water supply conditions. Henderson and SRA should consider revising the plans to have the same number of response stages, and Henderson should consider adding triggers based on raw water supply conditions.

The Kilgore DCP has six stages, while the SRA Iron Bridge/Lake Fork DCP has five stages (not counting the emergency stage). Kilgore's triggers consider the SRA response stages. However, there is no mention of SRA Stage 5 or SRA "Emergency Water Shortage Conditions", partly due to different numbers of stages between the plans. Kilgore's water savings goals appear to be commensurate with or more stringent than SRA's, so the response measures appear to be complementary. Kilgore and SRA should consider revising the plans to have the same number of response stages, and Kilgore should consider amending triggers to acknowledge SRA Stage 5 and SRA "Emergency Water Shortage Conditions".

Toledo Bend Reservoir

The Sabine River Authority (SRA) Toledo Bend/Gulf Coast Division supplies raw water from Toledo Bend Reservoir to the City of Hemphill, which in turn provides treated water to the G M WSC. No drought contingency plan was available for the City of Hemphill.

The G M WSC DCP has five stages, while the SRA Toledo Bend/Gulf Coast DCP has three stages (not counting the emergency stage). G M WSC's water savings goals are commensurate with or more stringent than SRA's, so the response measures appear to be complementary. For each response stage, the SRA DCP contains triggers that are based on the water surface elevation in Toledo Bend Reservoir (165.1 feet in Stage 1, 162.2 feet in Stage 2, and 156 feet in Stage 3). The G M WSC DCP only contains trigger based on the Toledo Bend Reservoir elevation in Stage 1 (168 feet). The other stages are triggered based only on demands.

In coordination with the City of Hemphill, G M WSC and SRA should consider revising the plans to have the same number of response stages. In addition, G M WSC should consider adding Stage 2 and Stage 3 triggers based on raw water supply conditions (similar or complementary to SRA's and/or Hemphill's triggers).

Lake Palestine

The Upper Neches River Municipal Water Authority (UNRMWA) supplies raw water from Lake Palestine to the City of Tyler, which in turn provides treated water to the Southern Utilities. Tyler's triggers are based on its treatment/distribution/storage capacity and other factors but not on raw water supply conditions. Tyler's water savings goals are commensurate with or more stringent than UNRMWA's, so the response measures appear to be complementary. Tyler should consider adding triggers based on raw water supply conditions (similar or complementary to UNRMWA's triggers).

The Tyler and Southern Utilities DCPs have the same number of response stages, with the complementary triggers, identical water savings goals, and substantially similar response measures. Like Tyler, Southern Utilities should consider adding triggers based on raw water supply conditions (similar or complementary to UNRMWA's and/or Tyler’s triggers).

The UNRMWA also supplies raw water from Lake Palestine to the City of Palestine via the Neches River. The UNRMWA and Palestine DCPs have the same number of response stages. Palestine's triggers are based on demand volume, water levels in storage tanks, and UNRMWA drought stage. Although Palestine has not listed water savings goals for its drought stages, the response measures for each stage appear to be commensurate with UNRMWA's goals. Therefore, the triggers, stages, and goals in the UNRMWA and Palestine DCPs are aligned.

Yegua-Jackson Aquifer

The City of Pineland supplies treated water from the Yegua-Jackson Aquifer to the G M WSC. The G M WSC triggers are based on its Toledo Bend Reservoir and Carrizo-Wilcox Aquifer supplies but not on Pineland water supply conditions. The G M WSC DCP has five stages, while the Pineland DCP has four stages. G M WSC's water savings goals in the latter stages (30-40 percent) are also greater than Pineland's (unspecified). In addition, the response measures are not particularly well-aligned. Examples include:

- In Stage 2, Pineland allows even/odd irrigation days, while G M WSC allows twice-weekly watering.
- In Stage 3, Pineland prohibits outdoor water use, while G M WSC bans hose-end sprinklers but allow twice-weekly irrigation by other methods.

However, the water purchased from Pineland comprises only a small amount of the G M WSC water supply (5.5 percent in 2012). For this reason, major changes to the GM-WSC plan do not appear to be necessary.

7.3 Existing and Potential Emergency Interconnects

Regional water planning requirements include collection of information on existing major water infrastructure facilities that could be used for interconnections with water user groups (WUG) in the event of an emergency shortage of water (§357.42(d)). However, Texas Water Code §16.053(c) requires such information to be confidential and may not be released to the public. Texas Water Development Board guidance on the subject states that the regional water planning group will collect such information confidentially and separately from the 2021 Plan. However, a general description in the plan that does not divulge details such as interconnect locations is acceptable. This section of Chapter 7 provides the required general information regarding the use of interconnections in the region and how they are or may be used as potential drought management measures, the methodology used to collect emergency interconnect information, the methodology for determining potential future emergency interconnects, and a summary of the evaluations performed

In a region where drought may be more geographically limited, emergency interconnects become an effective tool to mitigate its effects. As emergency interconnects become more common in the region, it may be necessary to encourage the connected communities to coordinate closely on their individual drought planning processes to that when emergency interconnections are utilized, all affected communities are aware of the need and can help facilitate water transfers with a minimum of adverse impact on all parties.

Interconnecting with another water system is a potential drought response measure. The drought contingency plans reviewed in Section 7.2 establish the following interconnection drought response measures.

- Evaluate the potential for interconnecting with other neighboring systems (Stage 1, one utility)
- Implement protocols to establish interconnections with other neighboring systems, if appropriate (Stage 2, one utility)

- Interconnect with other neighboring systems/implement agreements with adjacent water providers (Stage 3, three utilities)

Section 7.4.4 of this chapter discusses the methodology for identifying potential future emergency interconnects and Table 7.8 reports on the 274 potential interconnects identified by this evaluation.

Existing emergency interconnect information was obtained from the Texas Commission on Environmental Quality, Texas Drinking Water Watch available at https://dww2.tceq.texas.gov/DWW/ and by soliciting such information from wholesale water providers regarding their own water distribution systems as well as those of their customers. The ETRWPG found that 31 WUGs have an existing emergency interconnect with another utility as shown in the following list with the Receiver WUG listed first and the Provider WUG listed second:.

- ANGELINA WSC ← LUFKIN
- APPLEBY WSC ← NACOGDOCHES
- CENTRAL WCID OF ANGELINA COUNTY ← LUFKIN
- CONSOLIDATED WSC ← CROCKETT
- CROSS ROADS SUD ← KILGORE
- D & M WSC ← NACOGDOCHES
- ELKHART ← SLOCUM WSC
- FOUR PINES WSC ← PALESTINE
- FOUR WAY SUD ← HUNTINGTON
- GILL WSC ← MARSHALL
- G-M WSC ← HEMPHILL
- GROVES ← PORT NECHES
- HUNTINGTON ← LUFKIN
- LILLY GROVE SUD ← NACOGDOCHES
- LINDALE RURAL WSC ← LINDALE
- LUFKIN ← CENTRAL WCID OF ANGELINA COUNTY
- M & M WSC ← LUFKIN
- MEEKER MWD ← BEAUMONT
- MELROSE WSC ← NACOGDOCHES
- NECHES WSC ← PALESTINE
- ORANGE COUNTY WCID 2 ← ORANGE
- PLEASANT SPRINGS WSC ← PALESTINE
- PORT NECHES ← NEDERLAND
- PORT NECHES ← GROVES
- SAND HILLS WSC ← CENTER
- SOUTHERN UTILITIES ← TYLER
- WALNUT GROVE WSC ← NORTH CHEROKEE WSC

- WALNUT GROVE WSC ← SOUTHERN UTILITIES
- WALSTON SPRINGS WSC ← SLOCUM WSC
- WEST GREGG SUD ← KILGORE
- WODEN WSC ← NACOGDOCHES

7.4 Emergency Responses to Local Drought Conditions or Loss of Municipal Supply

For all County-Other WUGs and for municipal WUGs with 2010 population less than 7,500 that rely on a sole water source, regional water planning rules require an evaluation of potential emergency response to local drought conditions or temporary loss of existing water supplies.

Of the 142 municipal WUGs, 82 had a 2010 Census population of less than 7,500 people and rely on a single water source. Of these municipal WUGs:

- Most (66) rely on their own groundwater wells;
- Eight also rely on groundwater but the water users are retail customers of other entities;
- Seven purchase surface water from other entities; and
- One relies on its own surface water source.

Figure 7.6 shows the relative distribution of sole water supplies for these municipal WUGs.

The ETRWPG conducted a limited, screening-level review of emergency response options available to the WUGs described in the previous section. The results are to serve as a general indicator of the potential options that might be considered in the event of a local emergency and should be investigated in greater detail by the subject WUG(s) before implementation. For the purposes of this analysis, it is assumed that the emergency response option must provide additional water within 180 days.

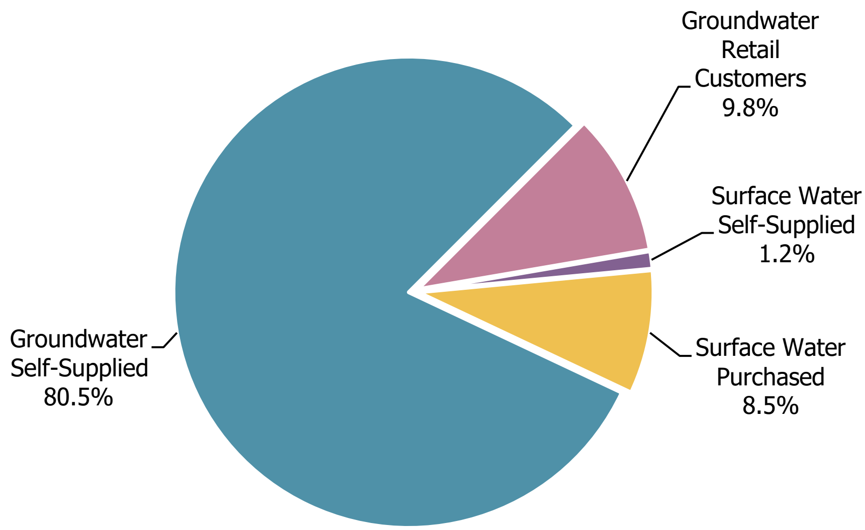


Figure 7.6 Summary of Sole-Source Water Supplies for Municipal Water User Groups with Population Less Than 7,500

Emergency response options considered include:

- Additional local groundwater well(s),
- Use of brackish groundwater,
- Voluntary Redistribution,
- Emergency interconnect(s), and
- Trucked-in water.

7.4.1 Additional Local Groundwater Wells

Depending on the emergency, drilling one or more wells may be a potential option for obtaining an emergency water supply. Since virtually the entire region is underlain by water supply aquifers, this is a potential option that each of the subject WUGs should evaluate in more detail.

Required infrastructure would include a new well and additional conveyance facilities. If the subject WUG is located within a Groundwater Conservation District, additional rules may apply.

7.4.2 Brackish Groundwater

Brackish water has total dissolved solids (TDS) concentrations between 1,000 and 10,000 milligrams per liter (mg/L). Brackish groundwater can be obtained from two locations in the ETRWPA: (1) relatively narrow bands of the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers that cross the middle of the ETRWPA in an east-west orientation and (2) a narrow band of the Gulf Coast aquifer that crosses Jefferson and Orange Counties near the coast in an east-west orientation.[5] Subject WUGs that are located in these bands should evaluate the emergency use of brackish groundwater in more detail (Table 7.6).

Required infrastructure would include a new well into the brackish part of the formation and additional conveyance facilities. Treatment to remove dissolved salts might also be included. However, such treatment is very expensive and disposal of treatment residuals is often difficult. Therefore, treatment is considered to be a viable component of using brackish groundwater only in extraordinary circumstances.

For brackish groundwater that is at the lower end of elevated TDS concentrations, the brackish water could be blended with existing non-brackish supplies to create an emergency potable supply. As the TDS of a brackish source increases or as fresh water supplies diminish, blending may become less practical. For reasons noted above, brackish groundwater at the higher end of TDS concentrations would likely not be a viable alternative, even for emergency situations.

Table 7.6 Potential Brackish Groundwater Sources for Subject Water User Groups

Subject WUG	Aquifer			
	Carrizo-Wilcox	Gulf Coast	Queen City/ Sparta	Yegua-Jackson
Angelina Water Supply Corporation (WSC)	x		x	
Colmesneil				x
Diboll	x		x	
Four Way Special Utility District	x		x	
Groveton	x			
Hemphill	x		x	
Hudson WSC	x		x	
Lufkin	x		x	
Pineland	x		x	
Tyler County WSC				x
Woodville				x
Angelina County-Other	x		x	
Houston County-Other	x		x	
Jasper County-Other				x
Jefferson County-Other		x		
Nacogdoches County-Other	x		x	
Newton County-Other				x
Orange County-Other		x		
Polk County-Other				x
Sabine County-Other	x		x	
San Augustine County-Other	x		x	
Trinity County-Other	x		x	x
Tyler County-Other				x

Brackish groundwater availability, productivity, and production costs are summarized for each aquifer in Table 7.7. In the counties where brackish groundwater is located, availability is moderate to high. The major aquifers (Carrizo-Wilcox and Gulf Coast) have greater productivity than the minor aquifers. The production cost for the Carrizo-Wilcox aquifer is moderate to high, since the depth to the brackish groundwater may be 3,000 to 6,000 feet.

Table 7.7 Summary of East Texas Regional Water Planning Area Potential Emergency

Aquifer	Availability	Productivity	Source Water Production Cost	Primary Counties
Carrizo-Wilcox	High	Moderate	Moderate to High	Houston, Trinity, Angelina, Nacogdoches, San Augustine, Sabine
Queen City/ Sparta	High	Low	Moderate	
Gulf Coast	High	High	Low to Moderate	Jefferson, Orange
Yegua-Jackson	Moderate	Low	Moderate	Trinity, Polk, Tyler, Jasper, Newton

SOURCE: LBG-GUYTON ASSOCIATES IN ASSOCIATION WITH NRS CONSULTING ENGINEERS: BRACKISH GROUNDWATER MANUAL FOR TEXAS REGIONAL WATER PLANNING GROUPS, PREPARED FOR TEXAS WATER DEVELOPMENT BOARD, AUSTIN, FEBRUARY 2003.

7.4.3 Voluntary Redistribution

Another emergency response option for WUGs that already treat surface water is a voluntary redistribution of water from upstream water right holders. This option requires a contract with an upstream entity for water to release from an upstream reservoir for diversion by the subject WUG downstream. For purposes of this evaluation, if a watercourse downstream of a major reservoir flows through or within close proximity to the Certificate of Convenience and Necessity of a subject WUG that treats surface water and has an existing surface water intake, then a release from an upstream reservoir is considered a potential emergency response alternative (Table 7.8). The TCEQ's Water Utilities Map Viewer was used to identify subject WUGs and potential emergency releases from upstream reservoirs.[6]

Required infrastructure may include upgrades to existing intake and conveyance facilities. It has been assumed that WUGs that would use this emergency response option already treat surface water, but improvements to treatment processes may also be necessary. This option would require an agreement with one or more water right holders or their contracts in the upstream reservoir and would require approval of the treatment facilities by the TCEQ. This option would also require a new or amended water right permit from the TCEQ that authorizes the use of stream bed and banks for conveyance of the water and a new diversion point.

Table 7.8 Potential Supplies from Releases from an Upstream Reservoir for Subject Water User Groups

Subject WUG	Upstream Reservoir	Water Right Holders
Jefferson County WCID 10	Sam Rayburn Reservoir; B.A. Steinhagen Reservoir	LNVA, Lufkin; LNVA
Jefferson County-Other (Nome)	Sam Rayburn Reservoir; B.A. Steinhagen Reservoir	LNVA, Lufkin; LNVA
Cherokee County-Other	Lake Palestine; Lake Jacksonville; Striker Lake; Lake Tyler; Lake Tyler East	Upper Neches River Municipal Water Authority; Jacksonville; Angelina Nacogdoches WCID 1; Tyler; Tyler
Houston County-Other	Lake Palestine; Lake Jacksonville; Various Region C Reservoirs	Upper Neches River Municipal Water Authority; Jacksonville; Various
Nacogdoches County-Other	Striker Lake; Lake Tyler; Lake Tyler East; Lake Naconiche	Angelina Nacogdoches WCID 1; Tyler; Tyler; County of Nacogdoches
Panola County-Other	Lake Cherokee; Martin Lake; Lake Tawakoni/Lake Fork	Cherokee Water Company; Luminant Generation Company LLC; SRA, North Texas Municipal Water District
San Augustine County-Other	Lake Pinkston; Lake Naconiche; San Augustine City Lake	Center; County of Nacogdoches; San Augustine
Shelby County-Other	Lake Murvaul; Lake Cherokee; Martin Lake; Lake Tawakoni/Lake Fork	Panola County FWSD 1; Cherokee Water Company; Luminant Generation Company LLC; SRA, North Texas Municipal Water District
Trinity County-Other	Lake Palestine; Lake Jacksonville	Upper Neches River Municipal Water Authority; Jacksonville

WCID – water control & improvement district
LNVA – Lower Neches Valley Authority
SRA – Sabine River Authority of Texas

7.4.4 Emergency Interconnect

An emergency interconnect is an alternative for subject WUGs that are located in close proximity to another water provider. For purposes of this evaluation, it is assumed that an emergency interconnect is a potential emergency response option if there is another Certificate of Convenience and Necessity located contiguous to or within close proximity to the subject WUG's Certificate of Convenience and Necessity. Potential emergency interconnects are summarized in Table 7.9. Some of these potential emergency interconnects may already be in place. Subject WUGs should investigate further the potential for obtaining potable water through emergency interconnects with neighboring water systems.

Table 7.9 Potential Emergency Interconnect Sources for Subject Water User Groups

Subject WUG	Potential Emergency Interconnects
Alto	Alto Rural WSC
Alto Rural WSC	Alto, Rusk Rural WSC, Rusk, Iron Hill WSC, Lilbert-Looneyville WSC, D & M WSC, Forest WSC
Angelina WSC	Lufkin, Beulah WSC, M & M WSC, Four Way SUD
Appleby WSC	Nacogdoches, Caro WSC, Swift WSC, Libby WSC, Garrison
Arp	Jackson WSC, Wright City WSC,
Beckville	Fairplay WSC, Rock Hill WSC, Hollands Quarter, Riderville WSC
Berryville	Frankston Rural WSC, Monarch Utilities I LP
Bethel Ash WSC	Eustace, Quality Water of East Texas, Monarch Utilities I LP, Leagueville WSC, Virginia Hill WSC, Athens, Payne Springs WSC
Bevil Oaks	Water Necessities Inc., Hardin County WCID 1, Lumberton MUD, Meeker MWD
Brownsboro	Leagueville WSC, Edom WSC, Union Hill WSC, Moore Station WSC
Brushy Creek WSC	BBS WSC, Virginia Hill WSC, Poynor Community WSC, Dogwood Springs WSC, Frankston Rural WSC, Norwood WSC, Montalba WSC
Bullard	Southern Utilities, Walnut Grove WSC, North Cherokee WSC
Central WCID Of Angelina County	Woodlawn WSC, Hudson WSC, Pollok Redtown WSC, D & M WSC, Redland WSC, Angelina County FWSD 1, Lufkin
Chalk Hill SUD	New Prospect WSC, Crims Chapel WSC, Elderville WSC, Crystal Farms WSC, Tatum
Chandler	R P M WSC, Chandler Water Company, Three Community WSC, Dean WSC
China	Meeker MWD
Colmesneil	Tyler County WSC, Lakeside Water Supply
Corrigan	Damascus Stryker Water Supply, Moscow WSC
Cross Roads SUD	Kilgore, Elderville WSC, Kennedy Road WSC, Leveretts Chapel WSC, Jacobs WSC
Crystal Systems Texas	Texas Water Systems Inc., Carroll WSC, Lindale Rural WSC, Lindale, Tyler, Southern Utilities
Cushing	Lilbert-Looneyville WSC, Sacul WSC, Caro WSC, South Rusk County WSC
Dean WSC	Southern Utilities, Tyler, R P M WSC, Chandler Water Company, Chandler
Diboll	Prairie Grove WSC, Lufkin
Elderville WSC	Chalk Hill SUD
Elkhart	Slocum WSC, Walston Springs WSC

Table 7.9 Potential Emergency Interconnect Sources for Subject WUGs (Cont.)

Subject WUG	Potential Emergency Interconnects
Four Pines WSC	Palestine, BCY WSC, Tucker WSC, Pleasant Springs WSC, Lone Pine WSC
Four Way SUD	Zavalla, Angelina WSC, Huntington, M & M WSC
Frankston	Frankston Rural WSC,
Garrison	Appleby WSC, Timpson Rural WSC, Arlam Concord WSC
Gill WSC	Marshall, Deadwood WSC, Dewberry WSC, Elysian Fields WSC, Blocker-Crossroads WSC
Groveton	Pennington WSC, Centerville WSC, Woodlake-Josserand WSC, Trinity Rural WSC, Glendale WSC
Hemphill	G M WSC
Hudson WSC	Lufkin, Woodlawn WSC, Central WCID of Angelina County
Jackson WSC	Wright City WSC, Lakeshore Utility Co. Inc., Southern Utilities, Tyler, Star Mountain WSC, Starrville WSC, West Gregg WSC
Jasper County WCID 1	South Jasper County WSC, Cougar Country Water System
Jefferson County WCID 10	Beaumont, Nederland
Joaquin	Deadwood WSC, Paxton WSC,
Kirbyville	Upper Jasper County Water Authority, South Kirbyville Rural WSC
Kountze	West Hardin WSC, Johnson Water Service, Ranchland POA Inc.
Lilly Grove SUD	Nacogdoches, D & M WSC, Lilbert-Looneyville WSC, Caro WSC
Lindale	Tyler, Lindale Rural WSC, Crystal Systems Texas
Lufkin	Hudson WSC, Diboll, Woodlawn WSC, Central WCID of Angelina County
Meeker MWD	Beaumont, West Jefferson County MWD, China, Bevil Oaks, Lumberton MUD
Melrose WSC	Nacogdoches, Woden WSC, Swift WSC, New WSC, Denning WSC
Murchison	Bethel Ash WSC, Leagueville WSC
New London	Overton, Wright City WSC, Gaston WSC, Pleasant Hill WSC, Jacobs WSC
New Summerfield	Blackjack WSC, Stryker Lake WSC, Afton Grove WSC
Newton	East Newton WSC, Bon Wier WSC, Holly Huff WSC, Jamestown WSC
North Hardin WSC	Water Necessities Inc., Tyler County WSC, Johnson Water Service, Silsbee
Orange County WCID 2	Orange
Orangefield WSC	Orange County WCID 1, Orange, Bridge City
Overton	New London, Wright City WSC, Jackson WSC, Southern Utilities, Jacobs WSC, Leveretts Chapel WSC
Pinehurst	Orange
Pineland	G M WSC
R P M WSC	Chandler, Edom WSC, Ben Wheeler WSC, Southern Utilities
Rusk	Rusk Rural WSC, Alto Rural WSC, Iron Hill WSC,
San Augustine	San Augustine Rural WSC, New WSC, Bland Lake Rural WSC, Denning WSC, G M WSC

Table 7.9 Potential Emergency Interconnect Sources for Subject WUGs (Cont.)

Subject WUG	Potential Emergency Interconnects
Silsbee	North Hardin WSC, Johnson Water Service, Lumberton MUD
Sour Lake	Hardin County WCID 1, Water Necessities Inc.
South Newton WSC	Orange, Mauriceville SUD
Southern Utilities	Algonquin Water Resources, Tyler, Dean WSC, Jackson WSC, Lakeshore Utility Co. Inc., Wright City WSC, Walnut Grove WSC
Swift WSC	Melrose WSC, Nacogdoches, Woden WSC, Appleby WSC, Libby WSC, Sand Hills WSC
Tatum	Crystal Farms WSC, Chalk Hill SUD, Rock Hill WSC
Tenaha	Tennessee WSC, Paxton WSC, Flat Fork WSC, Buena Vista WSC
Timpson	Timpson Rural WSC, Tennessee WSC, Buena Vista WSC,
Troup	Blackjack WSC, Wright City WSC,
Tyler County WSC	North Hardin WSC, Colmesneil, Warren WSC, Monarch Utilities I LP, Seneca WSC, Woodville, Chester WSC, Upper Jasper County Water Authority
Virginia Hill WSC	Aqua Texas Inc., Brushy Creek WSC, Athens, Double Diamond Utilities Co, Leagueville WSC, Bethel Ash WSC, Moore Station WSC, Poynor Community WSC
Walston Springs WSC	Slocum WSC, Anderson County Cedar Creek WSC, Pleasant Springs WSC, Neches WSC, Palestine
Wells	Pollok Redtown WSC, Forest WSC
West Gregg SUD	Kilgore, Jackson WSC, Starrville WSC, Liberty City WSC, Southern Utilities
West Hardin WSC	Hardin WSC, Lake Livingston Water Supply and Sewer Service Company, Johnson Water Service
Woden WSC	Nacogdoches, Melrose, WSC, Swift WSC, D & M WSC
Woodville	Cypress Creek WSC, Doucette Water System, Tyler County WSC,
Wright City WSC	Southern Utilities, Jackson WSC, Price WSC, New Concord WSC, Blackjack WSC, Troup
Zavalla	Four Way SUD, Raylake WSC

WSC - water supply corporation
WCID - water control & improvements district
MUD - municipal utility district
MWD - municipal water district

Potential emergency interconnects were not identified for County-Other WUGs. In a given county, the County-Other WUG may represent many small utilities, and an emergency interconnect that may be a feasible emergency source for one of these utilities may not be a feasible source for another. Therefore, an extensive list of potential emergency interconnects in each county will not be sufficiently "local" to assist an individual utility that is a component of the County-Other WUG. Utilities that are not named in Table 7.9, should consult local maps/data to identify nearby utilities that may be potential emergency interconnect supplies.

Required infrastructure would include piping and valving necessary to connect the systems. If the relative system pressures are not appropriate for the proposed connection, additional pressurization and/or conveyance facilities may be needed. This option would require an agreement with one or more neighboring utilities. Construction would require authorization from the TCEQ.

7.4.5 Trucked-In Water

Trucked-in water is considered to be an emergency response option for every subject WUG. Although this would likely require little infrastructure, it would require agreements with a treated water provider and a water transporter.

Findings for the subject WUGs and the County-Other WUGs are briefly summarized in Table 7.10.

Table 7.10 Summary of Potential Emergency Supplies for Subject Water User Groups

Entity		Potential Emergency Water Supply Source(s)					
Water User Group Name	**County**	**Local groundwater well**	**Brackish groundwater**	**Other named local supply**	**Release from upstream reservoir**	**Emergency interconnect**	**Trucked-in water**
Alto	Cherokee	x				x	x
Alto Rural WSC	Cherokee	x		x	x	x	x
Angelina WSC	Angelina	x	x	x		x	x
Appleby WSC	Nacogdoches	x		x		x	x
Arp	Smith	x		x		x	x
Beckville	Panola	x				x	x
Berryville	Henderson	x		x		x	x
Bethel Ash WSC	Henderson, Van Zandt	x		x		x	x
Bevil Oaks	Jefferson	x		x		x	x
Brownsboro	Henderson	x				x	x
Brushy Creek WSC	Anderson, Henderson	x		x		x	x
Bullard	Smith, Cherokee	x				x	x
Central WCID Of Angelina County	Angelina	x		x		x	x
Chalk Hill SUD	Rusk	x		x		x	x
Chandler	Henderson	x		x		x	x
China	Jefferson	x		x	x	x	x
Colmesneil	Tyler	x	x	x		x	x
Corrigan	Polk	x				x	x
Cross Roads SUD	Rusk, Gregg	x		x		x	x
Crystal Systems Texas	Smith	x		x		x	x
Cushing	Nacogdoches	x		x		x	x
Dean WSC	Smith	x		x		x	x
Diboll	Angelina	x	x	x	x	x	x
Elderville WSC	Gregg, Rusk	x		x	x	x	x
Elkhart	Anderson	x		x		x	x
Four Pines WSC	Anderson	x		x		x	x
Four Way SUD	Angelina	x	x	x		x	x
Frankston	Anderson, Henderson	x		x		x	x
Garrison	Nacogdoches	x		x		x	x

Table 7.10 Summary of Potential Emergency Supplies for Subject WUGs (Cont.)

Entity		Potential Emergency Water Supply Source(s)					
Water User Group Name	**County**	**Local groundwater well**	**Brackish groundwater**	**Other named local supply**	**Release from upstream reservoir**	**Emergency interconnect**	**Trucked-in water**
Gill WSC	Harrison, Panola	x		x	x	x	x
Groveton	Trinity	x	x	x		x	x
Hemphill	Sabine	x	x	x		x	x
Hudson WSC	Angelina	x	x	x	x	x	x
Jackson WSC	Smith	x		x		x	x
Jasper County WCID 1	Jasper	x				x	x
Jefferson County WCID 10	Jefferson	x		x	x	x	x
Joaquin	Shelby	x		x	x	x	x
Kirbyville	Jasper	x				x	x
Kountze	Hardin	x				x	x
Lilly Grove SUD	Nacogdoches	x				x	x
Lindale	Smith	x		x		x	x
Lufkin	Angelina	x	x	x	x	x	x
Meeker MWD	Jefferson	x		x	x	x	x
Melrose WSC	Nacogdoches	x		x	x	x	x
Murchison	Henderson	x		x		x	x
New London	Rusk	x		x		x	x
New Summerfield	Cherokee	x				x	x
Newton	Newton	x				x	x
North Hardin WSC	Hardin	x		x	x	x	x
Orange County WCID 2	Orange	x		x		x	x
Orangefield WSC	Orange	x				x	x
Overton	Rusk, Smith	x		x		x	x
Pinehurst	Orange	x		x		x	x
Pineland	Sabine	x	x	x		x	x
R P M WSC	Van Zandt, Henderson, Smith	x		x		x	x
Rusk	Cherokee	x		x		x	x
San Augustine	San Augustine	x				x	x
Silsbee	Hardin	x		x	x	x	x
Sour Lake	Hardin	x		x		x	x
South Newton WSC	Newton, Orange	x		x	x	x	x
Southern Utilities	Smith	x		x		x	x
Swift WSC	Nacogdoches	x		x	x	x	x
Tatum	Rusk, Panola	x		x	x	x	x
Tenaha	Shelby	x		x		x	x
Timpson	Shelby	x		x		x	x
Troup	Smith, Cherokee	x		x	x	x	x
Tyler County WSC	Tyler	x	x	x		x	x

Table 7.10 Summary of Potential Emergency Supplies for Subject WUGs (Cont.)

Entity		Potential Emergency Water Supply Source(s)					
Water User Group Name	**County**	**Local groundwater well**	**Brackish groundwater**	**Other named local supply**	**Release from upstream reservoir**	**Emergency interconnect**	**Trucked-in water**
Virginia Hill WSC	Henderson	x		x		x	x
Walston Springs WSC	Anderson	x		x	x	x	x
Wells	Cherokee	x				x	x
West Gregg SUD	Gregg, Smith, Rusk	x		x		x	x
West Hardin WSC	Hardin, Liberty	x		x		x	x
Woden WSC	Nacogdoches	x		x		x	x
Woodville	Tyler	x		x		x	x
Wright City WSC	Smith, Cherokee, Rusk	x		x		x	x
Zavalla	Angelina	x		x		x	x
Anderson County-Other	Anderson	x		n/a[a]	x	n/a	x
Angelina County-Other	Angelina	x	x	n/a	x	n/a	x
Cherokee County-Other	Cherokee	x		n/a	x	n/a	x
Hardin County-Other	Hardin	x		n/a		n/a	x
Henderson County-Other	Henderson	x		n/a	x	n/a	x
Houston County-Other	Houston	x	x	n/a	x	n/a	x
Jasper County-Other	Jasper	x	x	n/a	x	n/a	x
Jefferson County-Other	Jefferson	x	x	n/a		n/a	x
Nacogdoches County-Other	Nacogdoches	x	x	n/a	x	n/a	x
Newton County-Other	Newton	x	x	n/a	x	n/a	x
Orange County-Other	Orange	x	x	n/a	x	n/a	x
Panola County-Other	Panola	x		n/a	x	n/a	x
Polk County-Other	Polk	x	x	n/a		n/a	x
Rusk County-Other	Rusk	x		n/a	x	n/a	x
Sabine County-Other	Sabine	x	x	n/a		n/a	x
San Augustine County-Other	San Augustine	x	x	n/a	x	n/a	x
Shelby County-Other	Shelby	x		n/a	x	n/a	x
Smith County-Other	Smith	x		n/a		n/a	x
Trinity County-Other	Trinity	x	x	n/a	x	n/a	x
Tyler County-Other	Tyler	x	x	n/a	x	n/a	x

[a] "n/a" indicates that this potential emergency water supply was not evaluated for a given WUG. Additional discussion is provided in Section 7.4.

7.5 Region-Specific Recommendations Regarding Triggers and Actions to be Taken in Drought

Region-specific drought response recommendations regarding the management of existing surface water and groundwater sources are presented in the following sections. These recommendations include:

- Factors specific to each source of water supply to be considered in determining whether to initiate a drought response for each water source, including specific recommended drought response triggers;

- Actions to be taken as part of the drought response by the manager of each water source and the entities relying on each source, including the number of drought stages;

- Triggers and actions consider existing triggers and actions associated with existing drought contingency plans.

7.5.1 Drought Trigger Conditions for Reservoirs

The major recommended triggers and potential actions for reservoirs in the ETRWPA are presented in this section. Where possible, the ETRWPG has incorporated triggers and major actions from drought contingency plans that have been developed for these water sources. A summary of triggers and actions for the 12 reservoir systems in the ETRWPA is provided in Tables 7.11 through 7.22. An additional five reservoirs in the region have not submitted drought contingency plans. Therefore, Generic drought triggers and actions have been developed by the consulting team for the reservoirs in the region that have not submitted drought contingency plans in Table 7.23. These drought contingency plans may require more actions than shown in this section and may contain exceptions to these potential actions. These additional potential actions and exceptions are also endorsed by the ETRWPA.

The potential actions are generally cumulative between stages: actions implemented in Stage 1 remain in effect in Stage 2 and so on.

Lake Athens (Athens Municipal Water Authority)

The Athens Municipal Water Authority adopted its drought contingency plan in May 2019. The triggers and actions are related to water demand and the elevation of Lake Athens and are summarized below in Table 7.11.

Table 7.11 Lake Athens Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	• Total daily usage of potable water exceeds 4.5 million gallons per day (MGD).	Request voluntary conservation measures, including odd/even watering schedule and limited irrigation hours.
Moderate	• Total daily usage of potable water exceeds 4.5 MGD and the storage facilities do not refill to a level above 80% capacity overnight.	Implement mandatory conservation measures, including odd/even watering schedule and limited irrigation hours. Prohibit non-essential water use. Limit water use for vehicle washing and filling of pools. Limit water use from fire hydrants.
Severe	• Total daily usage of potable water exceeds 4.5 MGD and the storage facilities do not refill to a level above 65% capacity overnight.	Implement mandatory conservation measures, including continued odd/even watering schedule and limited irrigation hours. Prohibit oil/gas/construction water use from fire hydrants. Prohibit irrigation of golf course tees and greens. Restaurants serve water only on request.
Critical	• Total daily usage of potable water exceeds 4.5 MGD and the storage facilities do not refill to a level above 50% capacity overnight.	Implement mandatory conservation measures, including continued odd/even watering schedule and curtailed irrigation hours. Prohibit use of hose end sprinklers and permanently installed automatic sprinkler systems. No new connections. No adding water to pools and spas. No vehicle washing outside commercial facilities.
Emergency	• Major water line breaks or pump or system failures occur, which cause an unprecedented loss of capability to provide water service; or • Natural or man-made contamination of the water supply source(s) occurs; or	Prohibit irrigation of landscaped areas. Prohibit vehicle washing.

Lake Center and Lake Pinkston (Center)

Center adopted its current Drought Contingency Plan in 2019. The triggers are associated with water demands and total storage in the reservoirs. The triggers and actions related to Lake Center and Lake Pinkston are outlined below in Table 7.12.

Table 7.12 Lake Center and Lake Pinkston Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	Water demand reaches 90% of production capacity; or Distribution limitations	Implement mandatory maximum twice-weekly watering schedule. Request that customers discontinue non-essential water uses.
Moderate	Water demand reaches 95% of production capacity; Water storage falls to 50% of storage capacity; or Distribution limitations	Implement mandatory maximum once-weekly watering schedule. Require that customers discontinue non-essential water uses. Expand enforcement.
Severe	Water demand reaches 100% of production capacity; Water storage falls to 25% of storage capacity; or Major distribution limitations	Prohibit all landscape, non-essential, and discretionary water uses. Continue enforcement. Examine alternative sources.

Houston County Lake (Houston County WCID No. 1)

The Houston County WCID No. 1 adopted its current Drought Contingency Plan in January 2019. The triggers are associated with water demands, weather conditions, and the reservoir's elevation. The triggers and actions related to Houston County Lake are outlined below in Table 7.13.

The Consolidated WSC and the Cities of Crockett, Lovelady and Grapeland purchase water from the Houston County WCID No. 1. Recommendations for aligning their DCPs with the Houston County WCID No. 1 DCP are presented in Section 7.2.2.

Table 7.13 Houston County Lake Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	1. Water demand has reached 90% of the capacity of the system for three consecutive days with the plant operating at 100% of the rated production; or 2. Weather conditions that will result in reduced water supply available from the Houston County Lake for an extended period of time; or 3. Water level at the Lake drops below 258 feet above mean sea level, which is 2 feet below pool (260 feet mean sea level).	Request voluntary conservation measures.
Moderate	1. Water demand has reached 100% of the capacity of the system for three consecutive days with the plant operating at 100% of the rated production; or 2. Weather conditions that result in Lake levels falling to 256 mean sea level, which is 3 feet below pool; or 3. Water supply storage facilities are not maintaining a constant level with the plant operating at 100% of the rated production.	Implement mandatory conservation measures, limiting outdoor watering to hand-held hose use only. Require wholesale customers to initiate Stage 2 of their DCPs. Prepare for curtailment by preparing a monthly usage allocation for each wholesale customer.
Severe	1. The treatment plant is non-operational due to a malfunction at the site; or 2. Water levels drop at the reservoir to a point where pumping equipment will not function properly.	Implement additional mandatory conservation measures, including prohibition of outdoor watering except for livestock. Initiate pro-rata curtailment of water sales to each wholesale customer.
Emergency	1. A major water line breaks which causes considerable water loss; or 2. Pumps or system failures occur which causes the inability to obtain the water from the Lake, treat the water adequately, or supply the water to our customers; or 3. Natural or man-made contamination of the water supply source.	Assess the severity of the problem, and identify actions needed and time required to solve the problem. If necessary, notify city, county, and/or state emergency response officials for assistance. Undertake necessary actions as needed.

Lake Jacksonville (Jacksonville)

The City of Jacksonville adopted its current Drought Contingency Plan on September 10, 2019. The triggers are associated with water demands and the status of water supply facilities such as storage tanks and pumps. The triggers and actions related to Lake Jacksonville are outlined below in Table 7.14.

The North Cherokee, Afton Grove, Gum Creek, and Craft Turney Water Supply Corporations purchase water from the City of Jacksonville. Recommendations for aligning the DCPs for these entities are presented in Section 7.2.2.

Table 7.14 Lake Jacksonville Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	a. Water demand is approaching the safe capacity of the system on a sustained basis. Sustained water usage over 85% of safe capacity, or 7.04 million gallons per day (MGD) (five consecutive days) should be taken as a trigger condition for mild conditions. b. Mild contamination is noted in the water supply, but water can still be treated by existing facilities by means such as increasing chlorine dosage; or contamination is reported in updip portions of aquifer. c. Additional well drilling in the vicinity threatens interference with water wells. d. Water levels in tanks are consistently below 75% full (five days uninterrupted). e. Local power failures are imminent as a result of power station failures, storms, transmission problems, or excessive power demand in the area. f. Performance of well water pumps, high service pumps, or other equipment indicates imminent failure. g. Transmission line from surface water plant to Dorothy St. tank is in danger of failure.	Warn customers to reduce water use. Recommend a voluntary lawn watering schedule. Explore possibility of interconnection with other systems. Take steps toward increasing system capacity, including repair of wells not currently in use.
Moderate	a. Water demand occasionally reaches safe limit of system (two days within a 30-day period), and failure of any pump or chlorine feeder could reduce the level of service to the system. Safe limit is 8.38 MGD as discussed above. b. Contamination of supply water is approaching limit of treatability with existing facilities; or brackish water is very near the well. c. Additional wells in vicinity are drawing water at a rate which interferes with production rate of City's wells. d. Over 20% of storage tank capacity is out of service due to structural failure, leakage, maintenance, or contamination. e. Water level in tanks is consistently below half full (three days uninterrupted). f. Water emergencies in adjacent communities require diversion of so much water that the level of service to any part of the Jacksonville system is threatened. g. Severe freezing conditions have resulted in widespread damage to home plumbing or distribution lines.	Implement mandatory lawn watering schedule. Prohibit wasteful water uses. Seek reduced usage from commercial users and industries. Take steps toward interconnection with other systems. Impose system surcharge. Take steps toward increasing system capacity, including repair of wells not currently in use.

Table 7.14 Lake Jacksonville Triggers and Potential Actions (Cont.)

Drought Stage	Trigger	Potential Action
Severe	a. Water demand is exceeding safe capacity (8.38 MGD) on a regular basis (more than five consecutive days). b. Supply water is so contaminated that it cannot be treated with existing facilities or such contamination is imminent because of nearby aquifer pollution. c. Rupture of transmission lines from the raw water pumps or from the water treatment plant. d. An immediate health or safety hazard could result from actual or imminent failure of system components. e. Water levels in elevated tanks are too low to provide adequate fire protection (generally less than 1/4 full). f. Over half of storage tank capacity is out of service. h. All service pumps are out of service. i. Water emergencies in adjacent communities require so much water diversion that service to portions of the Jacksonville system is severely disrupted.	Prohibit all outdoor use and all wasteful use. Impose system surcharge. Impose rationing. Require commercial users and industries to stop using City water for processes, cooling, or recreation. Implement interconnection with other systems. Implement increased system capacity.

Lake Murvaul (Panola County Fresh Water Supply District No. 1)

The Panola County Fresh Water Supply District No. 1 did not submit a drought contingency plan. Therefore, recommendations are based on the drought contingency plan for the City of Carthage, which purchases water from the Panola County Fresh Water Supply District No. 1. Carthage adopted its most recent drought contingency plan in 2019. The triggers and actions are based on water demands, weather conditions, and reservoir storage. These are outlined in Table 7.15 below.

Table 7.15 Lake Murvaul Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	a. Average daily water consumption reaches 90% of the water treatment plant's production capacity for three consecutive days. b. Water level in Lake Murvaul is declining at a rate that could disrupt water supply in the future. c. Weather conditions are considered in drought classification determination. Predicted long, cold, or dry periods are to be considered in impact analysis.	Encourage voluntary reduction of water use. Discuss conservation with industrial and commercial customers. Implement system oversight. Discuss conservation/ rationing with wholesale customers and request voluntary measures.

Table 7.15 Lake Murvaul Triggers and Potential Actions (Cont.)

Drought Stage	Trigger	Potential Action
Moderate	a. Average daily water consumption reaches 100% of the water treatment plant's production capacity for three consecutive days. b. Water levels in Lake Murvaul continue to decline or are declining at a rate that makes supply problems imminent. c. Weather conditions indicate mild drought will exist for five or more consecutive days.	Implement mandatory conservation measures, including odd/even watering schedule and limited watering hours. Discontinue irrigation of parks and public areas. Limit water use for vehicle washing. Prohibit water use from fire hydrants except for firefighting. Request wholesale customers implement mandatory conservation/ rationing measures. Prepare monthly water usage allocations for wholesale customers in advance of pro rata curtailment.
Severe	a. Average daily water consumption reaches 110% of the water treatment plant's production capacity for three consecutive days. b. Water storage levels are drained daily and recover only during overnight periods of low demand. c. Lake Murvaul water levels have declined to the point where any additional loss of water will expose an intake point to the atmosphere. d. Lake Murvaul water levels have declined to the point where water withdrawal is impeded. e. A clear well at the water treatment plant is taken out of service during a mild or moderate water shortage period.	Prohibit use of hose-end sprinklers. Prohibit use of water for street washing, filling pools, water athletic fields and courses, and dust control. Initiate development of alternative supply sources. Initiate pro rata curtailment for wholesale customers.
Critical	a. Average daily water consumption reaches 115% of the water treatment plant's production capacity for any one day. b. Water storage levels do not fully recover even during overnight periods of low demand. c. Lake Murvaul water levels have declined to the point where water withdrawal is impeded due to exposed water inlets on the intake structure. d. System demand exceeds available high service pump capacity.	Prohibit vehicle washing.

Table 7.15 Lake Murvaul Triggers and Potential Actions (Cont.)

Drought Stage	Trigger	Potential Action
Emergency	a. Average daily water consumption reaches 120% of the water treatment plant's production capacity for any one day. b. Lake Murvaul water levels have declined to the point where water withdrawal is impeded or equipment could be damaged by normal operation of water supply system facilities and equipment due to water supply deficiency. c. Water system is contaminated, either accidentally or intentionally. Severe condition is reached immediately upon detection. d. Water system fails-- from acts of God (tornados, hurricanes) or man. Severe condition is reached immediately upon detection.	Prohibit all non-essential water uses, including landscape watering and vehicle washing. Implement alternative supply sources. Implement pro-rate water allocation.

Lake Nacogdoches (Nacogdoches)

Nacogdoches adopted its most recent drought contingency plan in 2019. The triggers and actions are based on water demands and production capacity. These are outlined in Table 7.16 below

Table 7.16 Lake Nacogdoches Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	When total daily water demand equals or exceeds 90% of the daily water production capacity for 4 consecutive days or 92% of water capacity production on a single day.	Reduce flushing of water mains. Discontinue water hydrant testing. Repair major water main leaks and breaks. Discuss conservation/ rationing with wholesale customers; request voluntary measures.
Moderate	When total daily water demand equals or exceeds 92% of the daily water production capacity for 4 consecutive days or 94% of the daily production capacity on a single day.	Implement mandatory conservation measures, including maximum twice-weekly watering schedule and limited watering hours. Prohibit non-essential water use. Limit water use for vehicle washing and filling of pools. Limit water use from fire hydrants. Limit irrigation of golf course greens, tees and fairways. Discontinue irrigation of public areas. Prepare monthly water usage allocations for wholesale customers in advance of pro rata curtailment. Prohibit non-essential water uses. Restaurants serve water only on request.

Table 7.16 Lake Nacogdoches Triggers and Potential Actions (Cont.)

Drought Stage	Trigger	Potential Action
Severe	When total daily water production capacity equals or exceeds 94% of the daily production capacity for 4 consecutive days or 96% of the daily water production capacity on a single day.	Initiate pro rata curtailment for wholesale customers.
Emergency	When the City Manager, or designee, determines a water supply emergency exists based on: a. Major water line breaks, or pump or system failures occur which cause unprecedented loss of capability to provide water service; or b. Natural or man-made contamination of water supply source(s).	Assess the severity of the problem and identify the actions needed and time required to solve the problem. Prepare a post-event assessment report on the incident and critique of emergency response procedures and actions. If appropriate, notify city, county, and/or state emergency response officials for assistance. Undertake necessary actions, including repairs and/or clean-up as needed. Inform the utility director or other responsible official of each wholesale water customer by telephone or in person and suggest actions, as appropriate, to alleviate problems

Lake Palestine (Upper Neches River Municipal Water Authority)

The UNRMWA adopted its most recent drought contingency plan in 2019. The triggers and actions are based on water elevations in the reservoir. These are outlined in Table 7.17 below.

In the ETRWPA, the Cities of Tyler and Palestine purchase water from the UNRMWA. In addition, Southern Utilities purchases water from Tyler. Recommendations for aligning these DCPs are presented in Section 7.2.2.

Table 7.17 Lake Palestine Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	When the stage elevation of Lake Palestine reaches or drops below 339.5 feet for three consecutive days.	Minimize unnecessary releases from Lake Palestine. Encourage wholesale customers to use alternative water sources. Request that wholesale customers implement voluntary conservation measures and Stage 1 of drought contingency plan (DCP).
Moderate	When the stage elevation of Lake Palestine reaches or drops below 336 feet for three consecutive days.	Request that wholesale customers implement mandatory conservation measures and Stage 2 of DCP. Prepare monthly water usage allocation in preparation for pro-rata curtailment.

Table 7.17 Lake Palestine Triggers and Potential Actions (Cont.)

Drought Stage	Trigger	Potential Action
Severe	When the stage elevation of Lake Palestine reaches or drops below 333 feet for three consecutive days.	Coordinate with authorities to reduce or eliminate releases downstream. Request that wholesale customers implement additional mandatory conservation measures and Stage 3 of DCP. Initiate pro-rata curtailment of water diversions/deliveries.
Emergency	When any of the following occur: a. A dam, spillway, or outlet works and associated appurtenances failure occurs, which cause unprecedented loss of capability to provide water service; or b. Natural or man-made contamination of the water supply source occurs.	Assess the severity of the problem, and identify actions needed and time required to solve the problem. If necessary, notify city, county, and/or state emergency response officials for assistance. Undertake necessary actions as needed. Prepare a post-event assessment report on the incident and critique of emergency response procedures and actions. Inform the utility director or other responsible official of each wholesale water customer by telephone or in person and suggest actions, as appropriate, to alleviate problems.

Rusk City Lake (Rusk)

Rusk adopted its most recent drought contingency plan in 2014. The triggers and actions are based on water demands. These are outlined in Table 7.18 below.

Table 7.18 Rusk City Lake Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	When total daily water demand equals or exceeds 800,000 gallons for five consecutive days or 1,600,000 gallons on a single day.	Request that wholesale customers implement voluntary conservation measures and Stage 1 of drought contingency plan (DCP).
Moderate	When total daily water demand equals or exceeds 1,600,000 gallons for five consecutive days or 1,900,000 gallons on a single day.	Request that wholesale customers implement mandatory conservation measures and Stage 2 of DCP. Prepare monthly water usage allocation in preparation for pro-rata curtailment.
Severe	When total daily water demand equals or exceeds 1,900,000 gallons for five consecutive days or 2,200,000 gallons on a single day.	Request that wholesale customers implement additional mandatory conservation measures and Stage 3 of DCP. Initiate pro-rata curtailment of water diversions/deliveries.

Table 7.18 Rusk City Lake Triggers and Potential Actions (Cont.)

Drought Stage	Trigger	Potential Action
Emergency	When there exist major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; or natural or man-made contamination of the water supply source(s).	Assess the severity of the problem, and identify actions needed and time required to solve the problem. If necessary, notify city, county, and/or state emergency response officials for assistance. Undertake necessary actions as needed.

Sam Rayburn/B.A. Steinhagen System (Lower Neches Valley Authority)

The LNVA adopted its most recent drought contingency plan in 2019. The triggers and actions are based on water elevations in the Sam Rayburn Reservoir. These are outlined in Table 7.19 below.

Bolivar Peninsula SUD and the Cities of Port Arthur and Groves purchase water from the LNVA. Recommendations for aligning these DCPs are presented in Section 7.2.2.

Table 7.19 Sam Rayburn/B. A. Steinhagen System Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	When the water surface elevation in Sam Rayburn Reservoir falls below 153.0 MSL for a continuous period of five (5) days.	Request municipal customers evaluate the need for mandatory water use restrictions. Request industrial customers minimize process water use to the extent feasible and encourage basic water conservation practices among employees. Monitor irrigation field levees, laterals, drains and other water delivery facilities to prevent wasting of water.
Moderate	When the water surface elevation in Sam Rayburn Reservoir falls below 151.5 MSL for a continuous period of five (5) days.	Request its municipal customers initiate mandatory water use restrictions. These restrictions may include prohibited outdoor water use and implementation of applicable conservation measures to minimize indoor uses. Request industrial customers minimize process water use to the extent feasible and encourage basic water conservation practices. no longer allow keep up streams to be supplied for irrigation customers, and field top-offs will be utilized. No new water sales contract.
Severe	When the water surface elevation in Sam Rayburn Reservoir falls below 149.00 MSL for a continuous period of five (5) days.	All interconnects delivering water from the Neches basin to the Devers South will be closed. Terminate the water supply to low priority customers such as small water sales.

Table 7.19 Sam Rayburn/B. A. Steinhagen System Triggers and Potential Actions (Cont.)

Drought Stage	Trigger	Potential Action
Emergency	The LNVA will recognize that an Emergency Water Shortage Condition is in progress when: a. the failure of a major component of the water supply including the pumps or canals in the LNVA's distribution system. b. the contamination of the canals or source c. water supply which substantially curtails LNVA's ability to supply water to its customers.	Assess the severity of the problem, and identify actions needed and time required to solve the problem. If necessary, notify city, county, and/or state emergency response officials for assistance. Undertake necessary actions as needed. Inform the utility director or other responsible official of each wholesale water customer by telephone or in person and suggest actions, as appropriate, to alleviate problems.

Lake Striker (Angelina Nacogdoches WCID)

The Angelina Nacogdoches WCID adopted its most recent drought contingency plan in 2019. The triggers and actions are based on water elevations in the lake. These are outlined in Table 7.20 below.

Table 7.20 Lake Striker Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	When the water level in Lake Striker Reservoir drops to 290.00 annual mean sea level (amsl).	Request that customers implement voluntary conservation measures and Stage 1 of their drought contingency plans (DCP)
Moderate	When the water level in Lake Striker Reservoir drops to 288.00 amsl.	Initiate contact with water customers to discuss water supply and pro rata allocation of water diversion. Request that customers initiate mandatory conservation measures and Stage 2 of their DCPs. May initiate pro rata allocations of water diversions for each customer.
Severe	When the water level in Lake Striker Reservoir drops to 286.00 amsl.	Initiate additional pro-rata curtailment of diversions/deliveries. Request that customers initiate additional mandatory conservation measures and Stage 3 of their DCPs.
Emergency	When the water level in Lake Striker Reservoir is at 284.00 amsl.	Initiate additional pro-rata curtailment of diversions/deliveries. Request that customers initiate additional mandatory conservation measures and additional stages of their DCPs.

Toledo Bend Reservoir (Sabine River Authority)

The SRA adopted its most recent drought contingency plan in 2019. The triggers and actions are based on water elevations in the reservoir and downstream flows in the Sabine River. These are outlined in Table 7.21 below.

The City of Hemphill and G M WSC purchase water from Toledo Bend through the Sabine River Authority. Recommendations for aligning these DCPs are presented in Section 7.2.2.

Table 7.21 Toledo Bend Reservoir Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	• The water surface elevation in Toledo Bend falls to and remains at or below 165.1 feet for fourteen consecutive days, or • The flow measured by the U.S. Geological Survey (USGS) gage on the Sabine River near Ruliff, Texas falls to and remains at or below the mild conditions flow in Table 10 of the Sabine River Authority of Texas' (SRA) drought contingency plan (DCP) for fourteen consecutive days.	Request each customer entity to follow its individual measures for mild water shortage conditions.
Moderate	• The water surface elevation in Toledo Bend falls to and remains at or below 162.2 feet for fourteen consecutive days, or • The flow measured by the USGS gage on the Sabine River near Ruliff, Texas, falls to and remains at or below the moderate conditions flow in Table 10 of the SRA DCP for fourteen consecutive days.	SRA may curtail water delivered to its customers, if necessary. If appropriate, request that customers prohibit non-essential outdoor uses, such as lawn irrigation, vehicle washing, filling of swimming pools, or routine maintenance of facilities.
Severe	• The water surface elevation in Toledo Bend falls to and remains at or below 156 feet for fourteen consecutive days, or • The flow measured by the USGS gage on the Sabine River near Ruliff, Texas, falls to the severe conditions flow in Table 10 of the SRA DCP for fourteen consecutive days.	SRA may reduce water delivery to its customers as the situation dictates. If appropriate, request that customers prohibit all outdoor water use (except for livestock watering) and initiate measures to reduce indoor water use.
Emergency	• There is a major contamination or a major required drawdown of Toledo Bend for emergency repairs of major infrastructure, or • The failure of a major component of the pumps or canals in the John W. Simmons Gulf Coast Canal System significantly impacts the supply of water to its customers.	SRA may reduce water delivery to its customers as the situation dictates. Request that customers prohibit all outdoor water use (except for livestock watering) and initiate measures to reduce indoor water use.

Lake Tyler/Lake Tyler East/Lake Bellwood (Tyler)

Tyler adopted its most recent drought contingency plan in 2019. The triggers and actions are based on water demands, production and storage capacity, and weather conditions. These are outlined in Table 7.22 below.

The Southern Utilities, Walnut Grove WSC, City of Whitehouse, Southpark Mobile Home Estates, and Community Water Co. Montgomery Garden purchase water from Tyler. Recommendations for aligning these DCPs are presented in Section 7.2.2.

Table 7.22 Lake Tyler/Lake Tyler East/Lake Bellwood Triggers

Drought Stage	Trigger	Potential Action
Mild	a. Average daily water consumption reaches 85% of production capacity. Production capacity is defined as online capacity in case of failure of a water source. b. Consumption (85%) has existed for a period of three days. c. Weather conditions are considered in drought classification determination. Predicted long, hot or dry periods are to be considered in the impact analysis.	Encourage voluntary reduction of water use. Contact commercial and industrial users and explain necessity for implementation of the Drought Contingency Plan and initiation of strict conservation methods. Implement corrections to system oversights and make adjustments required to meet changing conditions.
Moderate	a. Average daily water consumption reaches 90% of rated production capacity for a three-day period. Production capacity is defined as online capacity in case of failure or shut down of one or both water treatment plants. b. Weather conditions indicate mild drought will exist five (5) days or more. c. One or more ground storage tank is taken out of service during mild drought period. d. Storage capacity (water level) is not being maintained during period of 100% rated production period. e. Existence of any one listed condition for a duration of 36 hours.	Implement mandatory water conservation measures, including every-fourth-day outdoor water use schedule and limited outdoor water use hours. Wholesale water customers during this stage will be required to reduce their average daily demand.
Severe	a. Average daily water consumption reaches 100% of production capacity. Production capacity is defined as online capacity in case of failure or shut down of one or both water treatment facilities. b. Average daily water consumption will not enable storage levels to be maintained. c. System demand exceeds available high service pump capacity. d. Any two (2) conditions listed in moderate drought classification occurs at the same time for a 24-hour period. e. Water system is contaminated either accidentally or intentionally. Severe condition is reached immediately upon detection. f. Water system fails - from acts of God, (tornadoes, hurricanes) or man. Severe condition is reached immediately upon detection.	The City Manager will ban the use of water for: Vehicle washing, window washing, and outside watering (lawn, shrub, faucet dripping, garden, etc.). Public water uses which are not essential for health, safety and sanitary purposes. Street washing, fire hydrant flushing, filling of pools, watering of athletic fields and golf courses, and dust control sprinkling.

Table 7.22 Lake Tyler/Lake Tyler East/Lake Bellwood Triggers (Cont.)

Drought Stage	Trigger	Potential Action
Critical	a. Major water line breaks, or pump or system failures occur which cause unprecedented loss of capability to provide water service. b. Total Daily Water Demand equals or exceeds 70 million gallons a day for three (3) consecutive days. c. Natural or man-made contamination of water supply (s) has occurred.	Curtailment shall be initiated upon the existence of Critical Water Shortage Conditions. Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 4.
Emergency	a. Major line breaks, one of the water treatment facilities is rendered inoperable, or pump or system failures occur which cause unprecedented loss of capability to provide water service. b. Total Daily Water Demand equals or exceeds 70 million gallons a day for five (5) consecutive days. c. Natural or man-made contamination of water supply (s) has occurred.	Curtailment shall be initiated upon the existence of Emergency Water Shortage Condition.

Surface Water Supplies without Site-Specific Drought Contingency Plans

The ETRWPG did not receive drought contingency plans from suppliers that use water from these lakes. Therefore, the ETRWPG recommends drought triggers and response actions based primarily on the water volume stored in the reservoir (Table 7.23). These recommendations are generic in nature, and no site-specific studies have been performed to develop them. They are meant to provide guidance until site-specific drought contingency plans are developed and submitted. Drought response actions in addition to those recommended in Table 7.23 may also be appropriate. Site-specific plans may include other types of triggers, including those related to local water demands and operation of water supply systems.

Table 7.23 Recommended Triggers and Potential Actions for Lakes Without Site-Specific Drought Contingency Plans

Drought Stage	Trigger	Potential Action
Mild	Water volume stored in the lake drops to 80% of the conservation storage capacity	• Increase public education efforts on ways to reduce water use. • Encourage reduction of non-essential water use and auditing of irrigation systems. • Implement maximum twice per week watering for hose-end sprinklers and automatic irrigation systems. • Limit hours of irrigation to reduce evaporative losses. • Prohibit water waste, such as operating an irrigation system with broken spray heads or excessive runoff.

Table 7.23 Recommended Triggers and Potential Actions for Lakes Without Site-Specific Drought Contingency Plans (Cont.)

Drought Stage	Trigger	Potential Action
Moderate	Water volume stored in the lake drops to 60% of the conservation storage capacity	• Continue actions implemented in the previous stage. • Initiate engineering studies to evaluate water supply alternatives. • Accelerate public education efforts on ways to reduce water use. • Eliminate non-essential water use. • Implement maximum once per week watering for hose-end sprinklers and automatic irrigation systems.
Severe	Water volume stored in the lake drops to 40% of the conservation storage capacity	• Continue actions implemented in the previous stage. • Implement water supply alternatives. • Increase frequency of media releases explaining water supply conditions. • Prohibit outdoor watering with hose-end sprinklers and automatic irrigation systems. • Prohibit washing of paved areas or hosing of buildings (exceptions for public health and safety). • Limit vehicle washing to commercial car washes. • Prohibit permitting of new swimming pools. • Prohibit operation of ornamental fountains or ponds that use potable water except where necessary to support aquatic life. • Initiate measure to reduce indoor water use. • Initiate surcharge on excessive water use • Establish water allocations for each customer to be used if conditions worsen.
Emergency	• Water volume stored in the lake drops to 30% of the conservation storage capacity; or • Major water line breaks or pump or system failures occur; or • Natural or man-made contamination of the water supply source(s) occurs; • Water levels have declined to the point where water withdrawal is impeded or equipment could be damaged by normal operation; or • Other emergency conditions exist	• Implement water supply alternatives. • Increase frequency of media releases explaining water supply conditions. • Increase surcharge on excessive water use. • Initiate water allocation by customer.

7.5.2 Drought Trigger Conditions for Run-of-River and Ground Water Supplies

Run-of-river and ground water supplies typically serve many water users over a broad geographical area. Some water providers may have drought contingency plans, while other water users, particularly agricultural or industrial users, may not have drought contingency plans. For these water supplies, the ETRWPG proposes to use the U.S. Drought Monitor for Texas as a trigger for drought response actions [2]. This information is easily accessible through the U.S. Drought Monitor web site and is updated regularly. It does not require monitoring of well water levels or stream gages, and drought triggers can be identified on a local basis. Table 7.24 shows the drought severity classifications adopted by the U.S. Drought Monitor and the associated Palmer Drought Index.

Table 7.24 Drought Severity Classification

Category	Description	Possible Impacts	Palmer Drought Index
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less

SOURCE: U.S. DROUGHT MONITOR: HTTPS://DROUGHTMONITOR.UNL.EDU/ABOUT/WHATISTHEUSDM.ASPX

The ETRWPG recommends the following actions based on each of the drought classifications listed above:

- Abnormally Dry – Entities should review the status of supplies and demands to determine if implementation of a DCP stage is necessary.
- Moderate Drought – Entities should review the status of supplies and demands to determine if implementation of a DCP stage is necessary. Other potential actions include voluntary water conservation measures, such as restrictions on lawn watering days and hours, vehicle washing, pool filling, and non-essential water uses.
- Severe Drought – Entities should review the status of supplies and demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. Entities should begin considering alternative supplies. Other potential actions include mandatory water conservation measures, such as restrictions on lawn watering days and hours, vehicle washing, pool filling, and non-essential water uses.

- Extreme Drought – Entities should review the status of supplies and demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. Entities should begin to plan implementation of alternative supplies and prepare monthly water usage allocations in preparation for water rationing. Other potential actions include additional mandatory water conservation measures, such as more stringent restrictions on lawn watering days and hours, vehicle washing, pool filling, and non-essential water uses.

- Exceptional Drought – Entities should review the status of supplies and demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. Entities should implement alternative supplies. Other potential actions include additional mandatory water conservation measures, such as prohibition of outdoor watering and non-essential water uses. If necessary, entities should implement water rationing.

7.6 Region-Specific Model Drought Contingency Plans

Model DCPs for use by WUGs in the ETRWPA are provided on the planning group's website at www.etexwaterplan.org. Model DCPs were developed for a Public Water Supplier (municipal water use), Irrigation District (irrigation water use), and Manufacturer (manufacturing water use).

7.7 Drought Management Water Management Strategies

Drought management and emergency response measures are important planning tools for all water suppliers. They are temporary measures that are implemented when certain criteria are met and are terminated when these criteria are no longer met. They are intended to preserve water resources for the most essential uses when water supplies are threatened by extraordinary conditions, such as:

- A multi-year drought,
- An unexpected increase in demand,
- The inability to use a water supply due to a chemical spill or due to invasive species,
- A water supply system component failure, or
- A water management strategy is not fully implemented when it is needed.

The ETRWPG supports implementation of DCPs under appropriate conditions by water providers in order to prolong the availability of existing water supplies and reduce impacts to water users and local economies. However, drought management and emergency response measures are not a reliable source of additional supplies to meet growing demands. Therefore, drought management measures are not recommended as a water management strategy to provide additional supplies for the ETRWPA.

7.8 Other Drought Related Considerations and Recommendations

7.8.1 Drought Preparedness Council

Title 31 of the Texas Administrative Code, §357.42(h), requires each regional water planning group to consider recommendations from the Drought Preparedness Council. On August 1, 2019, the Drought Preparedness Council provided the ETRWPG with a letter with the following two recommendations:

- Follow the outline template for Chapter 7 provided to the regions by Texas Water development Board staff 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 loess of municipal supply.

- Develop region-specific model drought contingency plans 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.

These recommendations were considered in the development of this chapter. The sections of this chapter were developed to correspond to the sections of the Chapter 7 outline provided by the Texas Water Development Board. In addition, Safety factors were used in the development of recommended water management strategies, where possible, and extensive coordination with local water providers account for unanticipated population growth or industrial growth within the ETRWPA.

The water use categories that account for more than 10 percent of ETRWPA water demands in any decade over the planning horizon include Municipal (26 percent of 2020 demand, 29 percent of 2070 demand), Manufacturing (41 percent of 2020 demand, 42 percent of 2070 demand), and Irrigation (13 percent of demand in 2020, 12 percent of 2070 demand). Per the Drought Preparedness Council recommendations, model region-specific DCPs were created for public water suppliers, manufacturing water users, and irrigation water users as described in Section 7.6 of this chapter.

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Chapter 8

Unique Stream Segments, Unique Reservoir Sites, and Legislative and Regulatory Recommendations

This chapter of the 2021 East Texas Regional Water Plan (2021 Plan) addresses unique stream segment designation, unique reservoir site designation, and water planning recommendations to the Texas Legislature. Information relevant to these issues was considered by the East Texas Regional Water Planning Group (ETRWPG) and the group voted on each issue.

8.1 Unique Stream Segments

According to §357.43(1) of the Texas Administrative Code, the ETRWPG is obligated to consider potential river or stream segments as being of unique ecological value based upon the following criteria set forth in §358.2(6):

(1) **Biological function** – stream segments that display significant overall habitat value including both quantity and quality considering the degree of biodiversity, age, and uniqueness observed and including terrestrial, wetland, aquatic, or estuarine habitats;

(2) **Hydrologic function** – stream segments that are fringed by habitats that perform valuable hydrologic functions relating to water quality, flood attenuation, flow stabilization, or groundwater recharge and discharge;

(3) **Riparian conservation areas** – stream segments that are fringed by significant areas in public ownership including state and federal refuges, wildlife management areas, preserves, parks, mitigation areas, or other areas held by governmental organizations for conservation purposes, or stream segments which are fringed by other areas managed for conservation purposes under a governmentally approved conservation plan;

(4) **High water quality/exceptional aquatic life/high aesthetic value –** stream segments and spring resources that are significant due to unique or critical habitats and exceptional aquatic life uses dependent on or associated with high water quality; or

(5) **Threatened or endangered species/unique communities –** sites along streams where water development projects would have significant detrimental effects on state or federally listed threatened and endangered species; and sites along streams significant due to the presence of unique, exemplary, or unusually extensive natural communities.

To assist the ETRWPG with identifying potential stream segments for designation, the Texas Parks and Wildlife Department (TPWD) developed a report[1] in 2005 of ecologically significant river and stream segments in the East Texas Regional Water Planning Area (ETRWPA). The TPWD report identified 41 river and stream segments in the ETRWPA as possibly ecologically significant. A map prepared by TPWD showing the locations of the 41 river and stream segments is presented on Figure 8.1.

The planning rules do not provide guidance on how many of the criteria need to be met as a prerequisite for consideration for designation as a unique stream segment. As an initial screening tool, the ETRWPG determined that those segments that meet three or more of the criteria would be further evaluated.

Only 11 of the 41 segments have three or more applicable criteria. Table 8.1 presents a summary of the 41 segments identified by TPWD and indicates which of the five criteria are identified by TPWD for each segment. Some of the segments are categorized as having threatened or endangered species or unique communities. The specific threatened or endangered species or unique community that is the basis for this categorization is presented in Table 8.2.

The intent of the Texas Legislature regarding the purpose of the unique stream segment designation is stated in Section 16.051(f) of the Texas Water Code:

> *This designation solely means that a state agency or political subdivision of the state may not finance the actual construction of a reservoir in a specific river or stream designated by the legislature under this subsection.*

Based on this section of the law, it would be irrelevant to consider recommending a segment for designation if it does not have potential to be a reservoir site.

There continues to be concern among many regional water planning groups (including the ETRWPG) that designation of a stream segment might lead to unwarranted restrictions on the use of the segment, including water diversions and discharges of treated effluent. During the previous round of regional water planning, representatives of Region C met with Texas Commission on Environmental Quality (TCEQ), Texas Water Development Board (TWDB), and TPWD to discuss potential issues related to restrictions associated with unique stream segment designation.

Seven of the 11 stream segments identified for further evaluation are not currently considered as potentially suitable for reservoir construction. Therefore, these segments have been eliminated from further consideration at this time. These segments are as follows:

- Alazan Bayou
- Upper Angelina River (Segment 0611; Nacogdoches County)
- Lower Angelina River (Segment 0611; Nacogdoches County)
- Big Sandy Creek (Segment 0608B)
- Catfish Creek (Segment 0804G)
- Trinity River (Segment 0803/0804)
- Village Creek (Segment 0608)

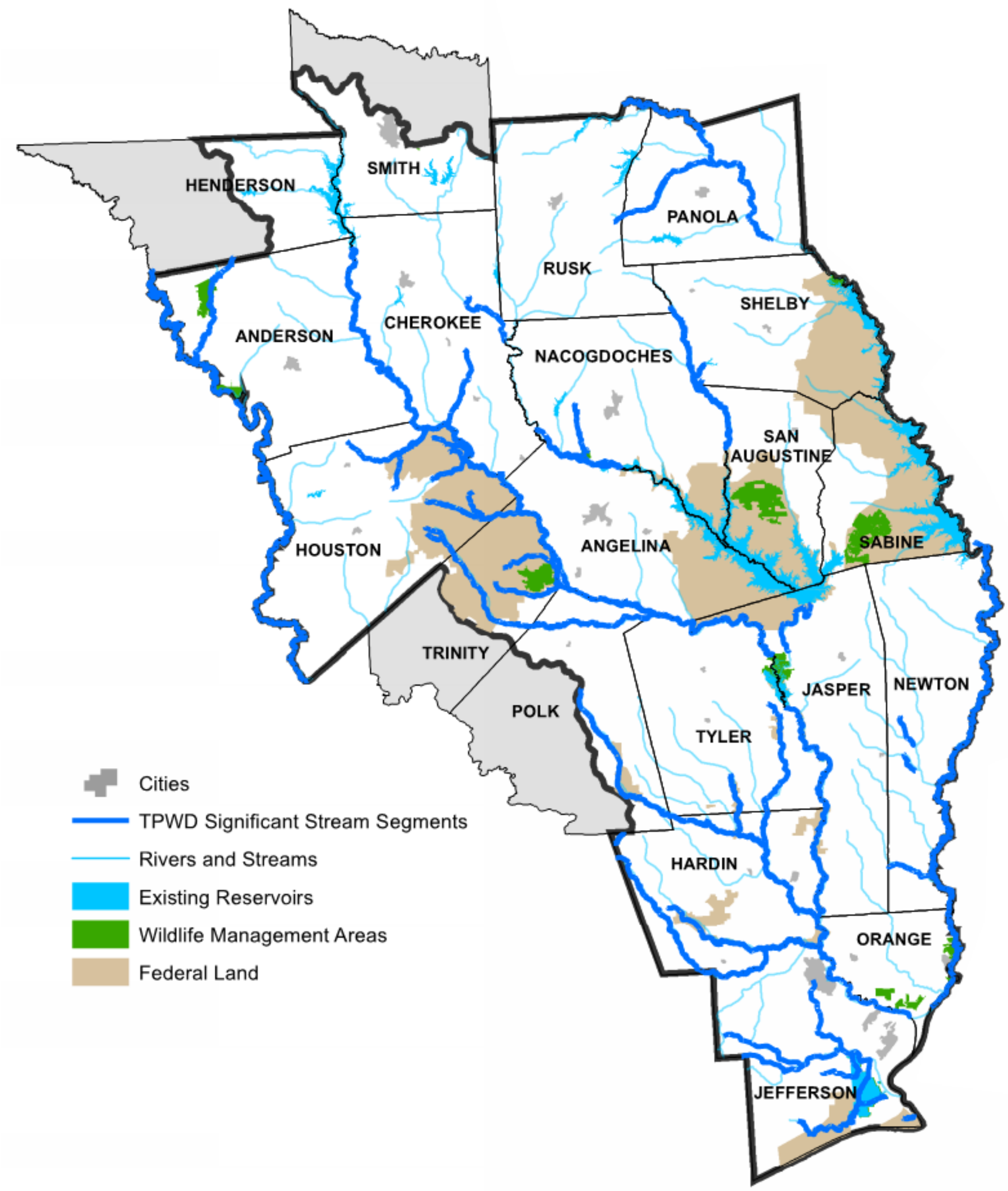

Figure 8.1 Texas Parks and Wildlife Department Ecologically Significant Stream Segments

SOURCE: TEXAS PARKS AND WILDLIFE DEPARTMENT

Table 8.1 Texas Parks and Wildlife Department Ecologically Significant River and Stream Segments

River or Stream Segment	Biological Function	Hydrologic Function	Riparian Conservation Area	High Water Quality/Aesthetic Value	Endangered Species/Unique Communities	Total # of Criteria Met
Alabama Creek			•			1
Alazan Bayou	•		•		•	3
Upper Angelina River	•		•		•	3
Lower Angelina River	•		•		•	3
Attoyac Bayou					•	1
Austin Branch			•			1
Beech Creek			•	•		2
Big Cypress Creek				•		1
Big Hill Bayou	•		•			2
Big Sandy Creek	•		•	•	•	4
Bowles Creek			•			1
Camp Creek			•		•	2
Catfish Creek			•	•	•	3
Cochino Bayou			•			1
Hackberry Creek			•		•	2
Hager Creek			•			1
Hickory Creek			•			1
Hillebrandt Bayou			•			1
Irons Bayou				•		1
Little Pine Island Bayou			•			1
Lynch Creek			•		•	2
Menard Creek			•			1
Mud Creek	•				•	2
Upper Neches River	•		•	•	•	4
Lower Neches River	•		•	•	•	4
Pine Island Bayou			•			1
Piney Creek			•	•	•	3
Upper Sabine River	•			•	•	3
Middle Sabine River	•			•		2
Lower Sabine River	•		•			2
Salt Bayou	•		•			2
San Pedro Creek			•			1
Sandy Creek (Trinity Co.)			•		•	2
Sandy Creek (Shelby Co.)					•	1
Taylor Bayou			•			1
Texas Bayou			•			1
Trinity River	•		•		•	3
Trout Creek			•			1
Turkey Creek			•			1
Village Creek	•		•	•	•	4
White Oak Creek				•		1

Table 8.2 Texas Parks and Wildlife Department Threatened and Endangered Species/Unique Communities

Threatened / Endangered Species	Angelina River	Big Sandy Creek	Catfish Creek	Upper Neches River	Lower Neches River	Piney Creek	Sabine River	Trinity River	Village Creek
Paddlefish	●			●	●		●		
Creek chubsucker				●		●			
Sandbank pocketbook freshwater mussel					●				
Texas heelsplitter freshwater mussel					●			●	
Neches River rose-mallow				●					
Rough-stem aster			●						
Unique community		●							●

Four segments include reaches that have been identified as potentially suitable for a reservoir site.

- Upper and Lower Neches River (Segment 0601/0602/0604) – Rockland Reservoir
- Piney Creek (Segment 0604D) – Rockland Reservoir
- Upper Sabine River (Segment 0505; Panola County) – Lake Stateline and Lake Carthage

Limited information exists on the relative value of using these sites for a reservoir compared to maintaining a riverine environment. Prior to proceeding with the construction of a reservoir at any of these sites, extensive environmental studies must be conducted to determine the extent and nature of potential environmental impacts and whether these impacts can be effectively mitigated. The information obtained through such environmental studies is the type of data needed to provide a basis for decisions regarding the relative merits of constructing a reservoir or preserving a riverine environment.

No regulatory purpose has been identified that would be served by a unique stream segment designation, other than precluding reservoir construction. Indeed, there are currently extensive regulations and programs to protect the environment in the ETRWPA.

The ETRWPA has a high proportion of land that has been assigned a special protective status; this land is summarized in Table 8.3 below. In addition to the land shown below, there are a number of state parks, state historic sites, and the Alabama and Coushatta Indian Reservation.

Areas of the ETRWPA that are not part of a state or federal preserve are also protected by various regulatory programs that require environmental assessments for activities that could adversely affect the environment.

Table 8.3 Land with a Special Protective Status

Name	Acreage
Alabama Creek Wildlife Management Area	14,600
Alazan Bayou Wildlife Management Area	2,100
Angelina National Forest	153,200
Big Lake Bottom Wildlife Management Area	4,100
Big Thicket National Preserve	106,300
Davy Crockett National Forest	160,600
E.O. Siecke State Forest	1,700
Engeling Wildlife Management Area	11,000
J.D. Murphree Wildlife Management Area	24,300
Lower Neches Wildlife Management Area	8,000
McFaddin and Texas Point National Wildlife Refuges	67,800
Neches National Wildlife Refuge	25,000*
Sabine National Forest	160,900
Tony Houseman Wildlife Management Area	3,300

***The current size of the Neches National Wildlife Refuge is 35 acres; ongoing land acquisitions will potentially expand the refuge to 25,000 acres.**

At its regularly scheduled meeting in January 2015, the ETRWPG considered the above information and voted not to recommend any stream segments in the region for unique status. The ETRWPG concluded that sufficient programs are already in place to protect the regions streams from inappropriate reservoir construction. In addition, the ETRWPG prefers to allow the TWDB to study issues associated with unique stream segment designation before further considering potential designations in the ETRWPA. The ETRWPG did not rescind this determination from the January 2015 meeting during the current round of planning.

8.2 Unique Reservoir Sites

Regional water planning guidelines allow regional water planning groups to recommend sites of unique value for construction where:

(1) Site-specific reservoir development is recommended as a specific water management strategy; or

(2) The location, hydrologic, geologic, topographic, water availability, water quality, environmental, cultural, and current development characteristics, or other pertinent factors make the site uniquely suited for reservoir development to provide water supply.

The ETRWPA has a long history of water supply planning and reservoir development. Numerous sites have been identified as being hydrologically and topographically ideal for reservoir development. Two sites in the ETRWPA are currently designated as unique reservoir sites: Lake Columbia and Fastrill Reservoir.

Fastrill Reservoir was designated by the 79th Legislature through 2007 Texas Legislature Senate bill 3. Lake Columbia received its unique designation by the State Legislature, Senate Bill 1362. Lake Columbia is currently being pursued for development. The ETRWPG fully supports the designation of these two reservoir sites as unique.

The ETRWPG considered other potential reservoir sites for possible designation as unique but did not recommend any additional sites. The considered sites are described in Sections 8.2.2 through 8.2.12 below. The ETRWPG agrees with past evaluations of these sites as being hydrologically and topographically unique for reservoir construction. The ETRWPG recognizes that reservoirs can have major impacts on the environment and that protection of the environment is already afforded through a process that is more thorough than the regional water planning effort. The ETRWPG is not recommending these additional sites (i.e., the proposed reservoirs other than Lake Columbia and Lake Fastrill) be designated as unique reservoir sites. The ETRWPG is recommending that these sites be recognized as potential long-term water management strategies for the time period more than fifty years in the future. The ETRWPG believes that the lengthy and thorough economic and environmental review process will determine if any of these reservoirs are constructed as opposed to any decision by the ETRWPG.

The ETRWPG has voted in previous rounds of planning to not recommend any proposed reservoir sites as unique. Proposed sites, including the two sites already designated as unique, are included in Table 8.4, following.

Table 8.4 Potential Reservoirs for Designation as Unique Reservoir Sites

Major Water Provider	Reservoir Site
Angelina Neches River Authority	Lake Columbia (Already Unique Site)
	Ponta
Lower Neches Valley Authority	Rockland Reservoir (Alternative WMS)
Sabine River Authority	Big Cow Creek
	Bon Wier
	Carthage Reservoir
	Kilgore Reservoir
	Rabbit Creek
	State Hwy. 322, Stage I
	State Hwy. 322, Stage II
	Stateline
	Socagee
Upper Neches River Municipal Water Authority	Fastrill Reservoir (Already Unique Site)

A brief description of each of the above reservoir sites follows. Appendix 8-A contains maps showing the proposed locations for each reservoir.

8.2.1 Lake Columbia

The reservoir is a project of Angelina and Neches River Authority (ANRA) located predominantly in Cherokee County but extends into the southern portion of Smith County. Figure 8-A.2 indicates the location for Lake Columbia. The reservoir would be formed by construction of a dam on Mud Creek approximately 2.5 miles downstream of the U. S. Highway 79 crossing. The dam is expected to impound water approximately 14 miles upstream with an estimated surface area of 10,133 acres. The reservoir is permitted for 85,507 ac-ft per year of water. It has a total storage volume at normal pool elevation, 315 feet above mean sea level (msl), of 195,500 acre-feet. State of Texas Senate Bill 1362 designated the site for Lake Columbia as a site of unique value for the construction of a dam and reservoir.

In January 2010, ANRA released a draft Environmental Impact Study for Lake Columbia. The Environmental Impact Study underwent public comment in 2010 and was submitted to the U.S. Army Corp of Engineers and other federal resource agencies for review and comment. ANRA is currently responding to comments of state and federal review agencies, including the TCEQ, TPWD, and Environmental Protection Agency.

8.2.2 Ponta Reservoir

The Ponta Reservoir would be located on Mud Creek in Cherokee County east of Jacksonville, Texas. The dam site is located approximately one mile upstream from the Southern Pacific Railroad crossing over Mud Creek. Figure 8-A.2 indicates the proposed location. The normal pool elevation would be about elevation 302 ft msl and would have an area of 11,000 acres. Storage capacity at normal pool elevation would be 200,000 acre-feet. Previous studies have indicated that the reservoir could provide a dependable yield of 105,000 ac-ft per year. However, with the construction of Lake Columbia the yield would be substantially less.

8.2.3 Rockland Reservoir

The Rockland Reservoir site is located on the Neches River at River Mile 160.4. The top of the flood pool would be at elevation 174 feet, msl with top of conservation pool of 165 feet, msl. It is estimated the reservoir site would affect 99,524 acres of wildlife habitat (Frye, 1990).

Rockland Reservoir was authorized for construction as a federal facility in 1945, along with Sam Rayburn, B. A. Steinhagen and Dam A lakes. A report in 1947 recommended construction of Sam Rayburn and B. A. Steinhagen with deferral of Rockland Reservoir and Dam A until such time the need develops. Rockland and Dam A were classified as inactive in 1954. A re-evaluation study performed in 1987 identified the potential for significant benefits in the areas of flood control, water supply, hydropower, and recreation.

8.2.4 Big Cow Reservoir

The Big Cow Reservoir is a proposed local water supply project on Big Cow Creek in Newton County. The Big Cow Creek dam site is located about one-half mile upstream from U.S. Hwy 190, west-northwest of the Town of Newton. It is in the Lower Sabine Basin. Figure 8-A.4 indicates the location of the proposed reservoir. The expected yield of the reservoir is 61,700 ac-ft per year with a storage capacity of 79,852 ac-ft and an area of 4,618 acres. The conservation level would be 212 feet msl.

The perennial streams that feed Big Cow Creek and abundant rainfall should provide sufficient inflow for considerable yield for a reservoir of this size.

8.2.5 Bon Wier Reservoir

The Bon Wier dam site is located on the state line reach of the Sabine River in Newton County, Texas and Beauregard Parish, Louisiana. The reservoir would extend from about 5 miles upstream of U.S. Hwy 190 to approximately Highway 63. Figure 8-A.4 indicates the location of the proposed reservoir. It was originally proposed for re-regulation of the hydropower discharges from Toledo Bend Reservoir and for the generation of hydropower. The reservoir, if constructed, would yield 440,000 ac-ft per year at a normal operating elevation of 90 feet above msl. The area and capacity would be 34,540 acres and 353,960 acre-feet, respectively.

It is estimated that the Bon Wier Reservoir would affect 35,000 acres of wildlife habitat (Frye, 1990). This includes several acid bogs/baygalls, which are unique and sensitive areas of the region. Several threatened and endangered species are known to occur in this area. No cultural resource survey has been conducted, but the site is expected to affect numerous archeological and historical sites in both Texas and Louisiana.

The Clean Rivers Program Water Quality data reported possible concerns for elevated total dissolved solids and low dissolved oxygen during the summer months. The site also requires congressional approval for construction of a dam, because it is on interstate navigable waters of the U.S.

8.2.6 Carthage Reservoir

The Carthage Reservoir is a proposed main stem project on the Sabine River in Panola, Harrison, Rusk and Gregg counties. It is located immediately upstream of the U.S. Highway 59 crossing and downstream of the City of Longview. Figure 8-A.1 indicates the proposed location. The yield of this reservoir, if constructed, would be approximately 537,000 ac-ft per year at a conservation pool elevation of 244 feet msl. The area and capacity would be 41,200 acres and 651,914 acre-feet, respectively.

Developmental concerns for Carthage Reservoir include bottomland hardwoods, aquatic life, lignite deposits, and cultural resources. The downstream half of the site encompasses a U.S Fish and Wildlife Service Priority 1 bottomland hardwood area. This portion of the Sabine River is designated a significant stream segment and is home to several protected aquatic species (Bauer, 1991). Other potential conflicts with this site include oil and gas wells. Permitting for this reservoir will require an act of Congress since the dam is located on navigable interstate waters of the U.S. There is one active lignite mine, South Hallisville Mine No. 1, near the reservoir boundary.

The water quality assessment of the Sabine River (Sabine River Authority of Texas, 1996) indicates this segment of the river has possible concerns for nutrients, but the water quality is improving. The advantage of this reservoir is its large yield. The estimated yield of 537,000 ac-ft per year would provide for all projected needs well beyond the year 2060.

8.2.7 Kilgore Reservoir

The Kilgore Reservoir is a proposed local water supply project located on the Upper Wilds Creek in Rusk, Gregg, and Smith counties. Figure 8-A.1 indicates the proposed location of the reservoir. It was originally proposed to supplement the City of Kilgore's water supply. The project would provide a yield of 5,500 ac-ft per year at the normal operating elevation of 398 feet msl. At that level, the area and capacity would be 817 acres and 16,270 acre-feet, respectively.

Construction of this reservoir has never been initiated, and the City of Kilgore is using diversions from the Sabine (purchased from Sabine River Authority of Texas and released from Lake Fork) and ground water for its water supply. However, this project still has the potential as a local water supply source in the Kilgore area should other proposed projects not be developed. Only preliminary studies have been performed for the Kilgore Reservoir and no environmental impacts have been assessed. Based on preliminary screening data, the site is not located within a priority bottomland hardwood area; there are no known water quality issues and no active mines within the reservoir site.

8.2.8 Rabbit Creek Reservoir

Several reservoir projects have been proposed on Rabbit Creek for local water supply. The latest proposal for the City of Overton and surrounding communities was completed in 1998 (Burton, 1998). The proposed reservoir project is located on Rabbit Creek in Smith and Rusk counties, and would have a firm yield of 3,500 ac-ft per year. Figure 8-A.1 indicates the proposed location of the reservoir. This is considerably less yield than the previous studies, which is due in part to the smaller storage capacity and conservative inflows that were assumed for the study. In the latest study, the area would be 520 acres and the capacity would be 8,000 acre-feet at a conservation level of 406 ft msl. However, this yield is considered satisfactory to meet the regional demands of the area. Environmental review of the site reports no significant concerns that would preclude development. There are also no significant cultural resources in the area, no known water quality issues, and no active mining within the reservoir area.

The advantages of this reservoir site are the few developmental concerns. However, it was rejected as a water supply alternative in the 1998 study due to costs. A large percentage of the total costs were associated with a water treatment and distribution system. Due to the relatively low yield of Rabbit Reservoir, this project could only be considered for local water supply.

8.2.9 State Highway 322 Stage I

The Highway 322 Reservoir is a proposed local water supply project in Rusk County, upstream of Lake Cherokee. Figure 8-A.1 indicates the proposed location. The project, as originally proposed, was to be developed in two stages: 1) a dam and reservoir on Tiawichi Creek (Stage I), and 2) a separate dam and reservoir on Mill Creek (Stage II). The reservoirs were to be joined by a connecting channel that would allow one spillway to serve both dams.

The proposed Stage I dam is located on Tiawichi Creek, approximately one mile upstream of its confluence with the upper end of Lake Cherokee. The reservoir, at its normal operating elevation of 330 feet msl, would provide a net yield of 22,000 ac-ft per year. Its area and capacity would be 4,450 acres and 82,450 acre-feet, respectively. If Stage I is operated independently from Lake Cherokee, the firm yield of the reservoir would be reduced due to Lake Cherokee’s superior water rights.

The primary developmental concern for the Stage I reservoir is active lignite mining. In 1995, the Oak Hill Mine expanded its current permit area to include approximately one third of the proposed Stage I reservoir area. There have been no environmental studies conducted for this site. Based on preliminary screening, the site is located outside priority bottomland hardwood areas, and there are no known water quality issues.

8.2.10 State Highway 322 Stage II

The State Highway 322 - Stage II reservoir is the second phase of the State Highway 322 water supply project in Rusk County. The Stage II dam would be located on Mill Creek, approximately one mile upstream of the existing Lake Cherokee. Figure 8-A.1 indicates the proposed location. Operated at the same level as Stage I (330 feet msl), this project would provide an increased yield to the Cherokee Lake system of 13,000 ac-ft per year with added storage capacity of 112,000 acre-feet. Stage II surface area would be 2,060 acres. The State Highway 322 project (Stages I and II) and Lake Cherokee could be operated as a system to provide a total yield of 53,000 ac-ft per year and maintain the recreational and aesthetic benefits currently provided by Lake Cherokee. If State Highway 322 project were operated independently from Lake Cherokee, the firm yield would be reduced due to Lake Cherokee’s superior water rights.

The primary developmental concern for Stage II is the active lignite mining. Surface mining records indicate that the Oak Hill Mine permit encompasses much of the Stage II reservoir. Preliminary screening indicates no priority bottomland hardwoods in the reservoir area, and there are no known water quality issues. The advantages to this reservoir site are its location near the areas with projected water needs and the possibility that when mining is completed, the site will already be cleared and ready for reservoir development.

8.2.11 Stateline Reservoir

The Stateline Reservoir is a proposed main stem project on the Sabine River, approximately eight miles upstream of Logansport, Louisiana and about four miles upstream from the headwaters of Toledo Bend Reservoir. Figure 8-A.1 indicates the proposed location. The project site is located in the southeastern section of Panola County and would have an estimated yield of 280,000 ac-ft per year. At the conservation level of 187 feet msl, the area and capacity would be 24,100 acres and 268,330 acre-feet, respectively.

Developmental concerns for this site include bottomland hardwoods, oil and gas wells, water quality, and permitting issues. The northern half of the site lies in a USFWS designated Priority 1 hardwood area. The southern half is a high-quality wetland area and currently being considered for a wetland mitigation bank by the Sabine River Authority of Texas. The mineral rights associated with the Carthage Oilfield significantly affect land acquisition for the reservoir. The Clean Rivers Program Water Quality data indicated possible concerns for elevated nutrient levels, metals, low dissolved oxygen, and fecal coliform. This segment of the stream is also a known habitat for several protected aquatic species. Permitting for this reservoir will require an act of Congress since the dam is located on navigable interstate waters of the U.S. (Rivers and Harbors Act, 1899). Construction of the dam and reservoir may also require consent of Louisiana for the part that will affect the state of Louisiana (Sabine River Compact). As currently proposed, the dam site is located immediately upstream of the Stateline reach and there is minimal impact to Louisiana lands. However, due to the close proximity of Toledo Bend Reservoir, it is unlikely that Stateline Reservoir would be more economical than Toledo Bend in meeting the needs of the Upper Basin.

8.2.12 Socagee Reservoir

The Socagee Reservoir site is located in the eastern portion of Panola County on Socagee Creek, approximately six miles upstream of its mouth. Figure 8-A.1 indicates the proposed location. The reservoir, at normal pool elevation, would have a yield of 39,131 ac-ft per year. The reservoir area would be approximately 9,100 acres and the capacity would be about 160,000 acres.

Approximately 40 percent of the site overlies existing lignite deposits. As of 1986, there was no known exploitation of the lignite deposits, and there currently are no active mines within the area. One cultural resource site is reported in the reservoir boundary. There are no known water quality issues or priority bottomland hardwoods that affect this reservoir site. Socagee Reservoir could be used to meet the local needs of Panola County; however, Lake Murvaul, which has been designated for Panola County use only, has adequate yield to meet the future needs of Panola County.

8.2.13 Fastrill Reservoir

Fastrill Reservoir has long been a project of the City of Dallas and Upper Neches River Municipal Water Authority and the site was designated as unique by the Texas Legislature in 2007. Subsequently, actions at the federal level to designate a wildlife refuge within the footprint of the proposed lake have called into question the lake's ultimate viability. However, because of the site's designation by the Texas Legislature, the ETRWPG has decided not to eliminate it from the list of proposed reservoirs in the ETRWPA at this time. The reservoir would be located on the Neches River in Anderson and Cherokee Counties downstream of Lake Palestine and upstream of the Weches Dam site. The dam would be located at River Mile 288. Figure 8-A.2 indicates the proposed location. Normal pool elevation would be at an elevation of 274 ft msl and would have an area of 24,950 acres based on digital topographic information. Recent analyses using the Neches River Basin Water Availability Model (WAM) indicate that the firm yield of Fastrill Reservoir may range from approximately 140,000 ac-ft per year (stand-alone operations) to about 155,000 ac-ft per year (system operations with Lake Palestine) subject to senior water rights and Consensus Criteria for Environmental Flow Needs.

8.3 Legislative and Regulatory Recommendations

Rules in 31 Texas Administrative Code 357.43(d – f) state that regional water planning groups are to consider and make recommendations to the legislature regarding regulatory, administrative, or legislative issues that the group believes are needed and desirable to achieve the stated goals of state and regional water planning, including to:

(1) Facilitate the orderly development, management, and conservation of water resources;

(2) Prepare for and respond to drought conditions; or

(3) Facilitate more voluntary water transfers in the region.

For this update of the regional water plan, the ETRWPG discussed legislative and regulatory recommendations at three meetings, beginning with the January 28, 2015, meeting of the group. The Executive Committee of the ETRWPG also reviewed previous recommendations made pursuant to the planning process and evaluated new potential recommendations. Proposed recommendations were brought to the ETRWPG at the March 11, 2015, meeting for consideration. Following is a list of recommendations adopted by the ETRWPG on April 8, 2015.

8.3.1 Flexibility in Determining Water Plan Consistency

In previous planning cycles, the ETRWPG has expressed concerned that small cities and unincorporated areas that fall under the group of "county-other" may not have specific water needs and water management strategies identified in the regional water plan due to the nature of aggregating these entities. As such, there is concern that these entities may not be eligible for state funding assistance. The ETRWPG is also concerned that there is not sufficient flexibility in identifying and implementing water management strategies as it pertains to permitting and funding such projects. Water suppliers need to have a full range of options as they seek to provide new water supplies for Texas' future. It is impossible to foresee all the possibilities for new water supplies in a planning process such as this, and changing circumstances can change the timing, amounts, and preferred options for new supplies very quickly. The inclusion of alternate strategies in regional water planning is the first step in providing this flexibility. In addition, the ETRWPG recommends that the following steps be taken to address these concerns.

- The TWDB should add language to their guidance for funding that allows entities that fall under the planning limits to retain eligibility for state funding of water related projects without having specific needs identified in the regional water plans.
- The TWDB and the TCEQ should interpret existing legislation to give the maximum possible flexibility to water suppliers as they seek to serve the public and provide new supplies. Changes in the timing of supply development, the order in which strategies are implemented, the amount of supply from a management strategy, or the details of a project should not be interpreted as making that project inconsistent with the regional plan.
- Willing buyer/willing seller transactions of water rights and treated water should not be controlled by this regulation. Such transactions may be beneficial to all concerned and may simply not have been foreseen in the planning process.
- The TWDB and TCEQ should make use of their ability to waive consistency requirements if local water suppliers elect strategies that differ from those in the regional plan.

In this round of planning, the TWDB has allowed for the use of sub-WUG planning allowing for WUGs to be subdivided into sub-WUG level units for purposes of doing more detailed analysis and accounting to better account for and present water supplies and needs within, for example, county-other WUGs. The 2021 Plan does not include any sub-WUGs, but the RWPG will consider the creation of such at the request of an existing utility, public water system, or representative of a geographic area within an ETRWPA WUG that meets the TWDB criteria for a sub-WUG.

8.3.2 Continued Funding by the State of the Regional Water Planning Process on a Five-Year Cycle

The ETRWPG believes the grassroots planning effort created by Senate Bill 1 is important to the state of Texas and should be continued. In addition, the ETRWPG believes that the most fair and efficient method of financing continuation of this effort for future planning cycles is to continue funding of this effort by the state with administrative expenses for the region being provided from sources within the region. There are important tasks that need to continue. Improvement of data for the next planning cycle is very important. State funding of those efforts needs to be made available.

8.3.3 Unique Reservoir Designation

The 79th Texas Legislature designated 19 sites as having unique value for the construction of a reservoir. Two of these sites, Lake Columbia and Lake Fastrill are located in the ETRWPA. Loss of this designation for Lake Columbia or Lake Fastrill could unnecessarily limit the ability of sponsors of these proposed reservoirs to develop these sites. The ETRWPG recommends that the designation of unique reservoir site for Lake Columbia and Lake Fastrill be retained through the current planning horizon, 2070.

8.3.4 Water Reuse

The ETRWPG recommends that current regulations as they pertain to the reuse of treated wastewater (i.e., water reuse) should be reviewed and amended, as necessary, to encourage the development of these resources.

8.3.5 Funding

In order to take advantage of the variety of funding options available through the TWDB, increased flexibility by the agency is needed. For example, TWDB guidance currently excludes the replacement of aging infrastructure from eligibility for funding through the existing Water Infrastructure Fund & State Water Implementation Fund for Texas. The ETRWPG recommends that the TWDB expand existing programs to assist entities with funding replacement and repairs to aging infrastructure and/or allow replacement of water supply infrastructure to be funded through the Water Implementation Fund program. This would include existing well fields, transmission lines, and storage facilities.

In addition, the TWDB does not provide for sufficient flexibility in categorical exclusions for Environmental Information Documents that are required for funding of water projects. Increasing flexibility regarding these exclusions could ease the crisis in funding available for water projects.

The TWDB offers the Economically Distressed Areas Program (EDAP) to certain areas in need of water projects. The EDAP provides grants, loans, or combination grant/loans when requirements are met:

- for water and wastewater services;
- in economically distressed areas; and
- present facilities are inadequate to meet residents' minimal needs.

However, requirements to meet the EDAP are very difficult for local governments and areas to administer, causing otherwise eligible local governmental entities to elect to not pursue the EDAP funding. EDAP requirements should be revised to reduce unnecessary and difficult requirements for eligibility, including requirements for model subdivision planning.

8.3.6 Uncommitted Surface Water

The Texas Water Code currently allows the TCEQ to cancel any water right, in whole or in part, for ten consecutive years of non-use. This rule inhibits long-term water supply planning. Water supplies are often developed for ultimate capacity to meet needs far into the future. Some entities enter into contracts for supply that will be needed long after the first ten years. Many times, only part of the supply is used in the first ten years of operation.

The regional water plans identify water supply projects to meet water needs over a 50-year use period. In some cases, there are water supplies that are not currently fully utilized or new management strategies that are projected to be used beyond the 50-year planning period. To support adequate supply for future needs and encourage reliable water supply planning, the ETRWPG:

- Opposes unilateral cancellation of uncommitted water contracts/rights;
- Supports long term contracts that are required for future projects and drought periods; and
- Supports "interruptible" water supply contracts as a way to meet seasonal and short-term needs before long-term water rights are fully utilized.

8.3.7 Standardized Processes for Regional Water Plan Development

The process of permitting a federal water project, such as a reservoir, is a long, detailed, and resource intensive projects that must follow federal guidelines of the National Environmental Policy Act (NEPA) process. The ETRWPG recommends that the TWDB develop guidelines for regional water planning evaluations of federally permitted water projects that will produce documentation that can be integrated and used in the NEPA process. In addition, the TWDB is encouraged to continue to develop relationships with federal authorities to allow the use of the state and regional water planning population projections in the NEPA process.

8.3.8 Funding for Additional Groundwater Modeling

The ETRWPG recommends that funding for groundwater modeling for development of desired future conditions (DFCs) and modeled available groundwater (MAGs) be provided to the TWDB. This would improve the development of DFCs and MAGs by enabling a consistent, standardized approach across Groundwater Conservation District (GCD) boundaries to groundwater modeling.

8.3.9 Clarification of Unique Stream Segment Criteria

Consideration of the designation of stream segments of unique ecological value (unique stream segments) is a component of regional water planning throughout the State. For some, however, there is a significant concern about the use of unique stream segments because of a lack of clarity about how the designation might be used in the future. In particular, there are concerns about the possibility of restriction of property rights for landowners adjacent to designated unique stream segments. House Bill 1016 of the 84th Texas Legislature proposes language specific to the Region L Water Planning Area, providing clarification by stating that the designation of a river or stream segment as being of unique ecological value:

1. means only that a state agency or political subdivision of the state may not finance the actual construction of a reservoir in the designated segment;
2. does not affect the ability of a state agency or political subdivision of the state to construct, operate, maintain, or replace a weir, a water diversion, flood control, drainage, or water supply system, a low water crossing, or a recreational facility in the designated segment;
3. does not prohibit the permitting, financing, construction, operation, maintenance, or replacement of any water management strategy to meet projected water supply needs recommended in, or designated as an alternative in, the 2011 or 2021 Regional Water Plan, and

4. does not alter any existing property right of an affected landowner.

The ETRWPA supports the proposed clarifications found in House Bill 1016 and recommends that these clarifications be incorporated into the regional water planning process on a statewide basis.

8.3.10 Recommendations Regarding Water Management Strategy Prioritization

The ETRWPG has previously commented on the prioritization process that was required in 2013 by the 83rd Texas Legislature through House Bill 4.[1] The Region's comments and concerns about the prioritization process included in the 2016 Plan are included as Appendix 8-B of this 2021 Plan. Specific recommendations of the ETRWPG associated with the referenced technical memorandum include the following:

- Project Description: Care should be taken in development of the DB22 to provide more clarity, resolve problems, and minimize risk of inappropriate scoring. In addition, a commentary section should be added to the scoring template to enable additional detail to be added by the RWPG as necessary.
- Scoring to Minimize Ties: Water planning regions should be allowed to add their own unique scoring criteria to be used specifically for the purpose of breaking scoring ties.
- Uniform Standard 2A: Uniform Standard 2A should be modified to provide for a maximum score for new surface water sources if modeling suggests a sufficient quantity of water would be available.
- Uniform Standard 3C: This standard should be modified to eliminate the advantage in scoring given to project sponsors with only one recommended WMS.
- Uniform Stand 3D: A more detailed scoring breakdown is needed to distinguish between two WUGs served and numbers of WUGs greater than two.
- Projects Shared across Regions: Clarification is needed on how projects serving more than one region will be integrated into one list.
- Evaluation across Water Type and Water Use Categories: The prioritization process should be modified to minimize the comparison of raw water and treated water strategies or water use categories.
- Rolled up Projects: The TWDB should clarify the definition of what constitutes a rolled-up project.

In addition, the ETRWPG recommends that, for purposes of prioritization of water management strategies identified in a regional water plan, the definition of a "project" be clarified to exclude strategies that do not have a capital cost associated with them. This will significantly reduce the effort required to prioritize identified projects by eliminating the requirement to prioritize strategies that will not need to seek funding anyway.

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[1] The ETRWPG provided the results of the prioritization of water management strategies identified in the 2011 Plan in a letter dated August 29, 2014, to the TWDB. The letter included a number of exhibits including a technical memorandum dated August 29, 2014, entitled Regional Water Planning Group Comments and Concerns.

These recommendations are subject to change after the prioritization of projects included in the 2021 Plan.

8.3.11 Allow Groundwater Supplies to Exceed the Modeled Available Groundwater

TWDB policy regarding the use of MAGs in regional water planning currently states that the MAG values are a cap for water supply and strategy development. However, the MAG is not necessarily considered a cap for permitting purposes by GCDs according to Chapter 36 of the Water Code. In addition, MAGs are unenforceable in areas with no groundwater regulation (i.e., with no GCDs). Chapter 36 describes the process of managing to DFCs. The MAG is an estimate of the groundwater availability based on the DFC, but Chapter 36 provides flexibility for GCDs to permit above or below the MAG based on local knowledge, usage patterns, and other factors. The ETRWPG recommends that the TWDB allow groundwater supplies to exceed the MAG in the regional water plan if the Regional Water Planning Group obtains written agreement from the relevant GCD. This approach assumes that the strategy is consistent with the management plan of the GCD, but allows for minor shortages to be covered without excessive administrative actions, such as alternate strategies that would ultimately require a plan amendment. It also allows a GCD to apply local knowledge to account for variations in permitting approaches and usage patterns, while honoring the DFCs associated with the aquifer. This approach could also be used in areas with no GCDs if the Regional Water Planning Group demonstrates compliance with the DFCs.

Chapter 9

Infrastructure Financing Report

The purpose of the Infrastructure Financing Report is to identify State funding needed to implement the water management strategies recommended in the 2021 East Texas Regional Water Plan (2021 Plan). The primary objectives of the report are:

- To assess how project sponsors (local governments, regional authorities, and other political subdivisions) in the region would finance the implementation of Water Management Strategies (WMSs) and associated Water Management Strategy Projects (WSPs); and,
- To propose what role the State should have in financing projects identified in the 2021 Plan.

The Texas Water Development Board (TWDB) developed an Infrastructure Financing Report Survey for each Water Management Strategy project sponsor with a project in the 2021 Plan. The East Texas Regional Water Planning Group and consulting team administered the survey and reported responses to the TWDB. A response to the survey is required for any entity seeking SWIFT funding for state water plan projects. More information on financial assistance programs offered by the State of Texas administered by the TWDB can be found on the TWDB website at:
http://www.twdb.texas.gov/financial/index.asp

Data collected included the following:

- Contact Information (summarized in Appendix 9-A)
    - Name
    - Phone Number
    - Email
    - Comments
- Funding Information (summarized in Appendix 9-B)
    - Planning, Design, Permitting, and Acquisition Funding: Portion of total costs, and earliest year funding would be needed, for which the project sponsor anticipates applying for state funding through a low interest loan from the TWDB for development efforts leading up to construction including all pre-construction stages of the project.
    - Construction Funding: Portion of total costs, and earliest year funding would be needed, for which project sponsor anticipates applying for state funding though a low interest loan from the TWDB during the construction stage of the project.
    - Percent State Participation in Excess Capacity of the Project: The percent share of the total projected project capacity that will not be needed within the first 10 years of the project life. For some larger projects that qualify, the state may acquire a temporary ownership interest in some percentage portion of the project which allows entities to optimally size a regional project with excess capacity that will not be needed for at least 10 years. The entity would then buy back the state's portion of the facility over time with principal and interest deferred on the state-owned portion of the project.

The results of this survey were compiled into an Excel workbook developed by the TWDB and submitted to the TWDB along with this 2021 Plan. The workbook is available for public view on the East Texas Regional Water Planning Group website at https://www.etexwaterplan.org/.

It is the recommendation of the East Texas Regional Water Planning Group for the State to provide financial assistance through programs administered by the TWDB to the project sponsors with projects identified in the 2021 Plan. Increased levels of state participation are needed for regional projects to meet needs beyond the reasonable financing capacity of project sponsors building water infrastructure in the East Texas Regional Water Planning Area.

Chapter 10

Public Participation and Adoption of Plan

Regional water planning in Texas is a public process, requiring strategy for ensuring that each region's citizens are able to participate in the process. Title 31 of the Texas Administrative Code defines the Notice and Public Participation requirements of the process in §357.21. Holding a public meeting or hearing with an opportunity for public comment is required:

- Prior to preparation of the next regional water plan;
- During declaration to pursue simplified planning (if applicable);
- When proposing major amendments to the previous regional water plan (if applicable); and
- Following adoption of an initially prepared plan (IPP).

In addition, opportunities for public participation and input have specific requirements regarding public notice and open meetings in the State of Texas. The rules call for the following:

- Public meetings and hearings noticed and held in accordance with the Texas Open Meetings Act and the Texas Public Information Act, including the following items:
    - Every regular meeting was open to the public and complied with all the requirements of the Act.
    - Meeting information was posted on the planning group's website at least 72 hours prior to the meeting.
    - Any emergency meetings to address imminent threats to public health and safety or urgent public necessity was called at least one hour in advance with a notice that identifies the nature of the emergency.
    - Meetings were convened with the presence of a quorum in the meeting room.
    - Only present members of a governmental body in the meeting were able submitted their written vote.
    - Meeting location was accessible to the public.
    - Members of the public were able to address comments on any subject to the governmental body during "public comment" or "public forum" sessions.
    - The public was not able to choose the items to be placed on the agenda for discussion at the meeting.
    - Members of the public had permission to record open meetings with a recorder or a video camera.
    - The minutes and recordings of the meeting were published for public inspection and copied on request to the governmental body's chief administrative officer or the officer's

designee. The minutes stated the subject and indicated each vote, decision, or other action taken.

- Agendas, meeting notices, materials presented or discussed at meetings, IPP, and final regional water plan published on the internet.
- Copies of the IPP made available for public viewing.

This chapter addresses the East Texas Regional Water Planning Group's (ETRWPG) strategy for public involvement and participation in the development and adoption of the 2021 East Texas Regional Water Plan (2021 Plan). The strategy included regular meetings of the ETRWPG, consultation with representatives of the major water user groups (WUG), distribution of press releases when required, and maintenance of a website for the East Texas Regional Water Planning Area (ETRWPA). Copies of public notices and corresponding press releases are included in Appendix 10-A. A description of the ETRWPG and the process follows.

10.1 East Texas Regional Water Planning Group Members

Original legislation for the 1997 Texas Legislature Senate Bill 1 and the Texas Water Development Board (TWDB) planning guidelines establish regional water planning groups (RWPG) to manage the planning process in their respective regions. The RWPGs include representatives of twelve specific community interests. Table 10.1 lists members of the ETRWPG and the interests they represent.

Table 10.1 Voting Members of the East Texas Regional Water Planning Group

Member	Interest
David Alders	Agricultural
Josh David	Agricultural
Judge Chris Davis	Counties
Fred Jackson	Counties
Randy Stanton	Electric Power
Dr. Matthew McBroom	Environmental
John McFarland	Groundwater Management Areas
John Martin	Groundwater Management Areas
Darla Smith	Industries
David Gorsich	Industries
David Brock	Municipalities
Gregory M. Morgan	Municipalities
Stevan Gelwicks	Public
Terry Stelly	Public
David Montagne	River Authorities
Monty Shank	River Authorities
Kelley Holcomb	River Authorities
Scott Hall	River Authorities
Mark Dunn	Small Business
Worth Whitehead*	Water Districts
Roger Fussell	Water Utilities

*Retired from the RWPG prior to final approval

The ETRWPG appointed a Technical Committee comprised of individuals within the planning group. The charge to the Technical Committee was to work with the ETRWPG consulting team to develop recommended population and water demand projections, review work produced by the consulting team, and provide technical advice to the planning group. Members of the Technical Committee include:

- Scott Hall
- John Martin
- Dr. Matthew McBroom

The ETRWPG also worked closely with water planning staff at the TWDB during the planning process. TWDB water planning staff provided valuable technical and regulatory guidance to the ETRWPG regarding the 2021 Plan.

10.2 Preplanning for the 2021 Plan

Rules in Title 31 of the Texas Administrative Code §357.12 define tasks that must be performed prior to development of the regional water plan. These rules include the following requirements:

- A public meeting to discuss recommendations and suggestions of issues that should be addressed in the regional or state water plan.
- Prepare a scope of work including a detailed description of tasks to be performed.
- Approve any amendments to scope of work in an open meeting.
- Designate a political subdivision as a representative of the RWPG.
- Determine a process for identifying potentially feasible water management strategies (WMS).

The ETRWPG held a public meeting, in conjunction with the regular RWPG meeting, on May 18, 2016, to discuss issues and provisions important to the ETRWPA that should be included in the 2021 Plan. As a result of this public meeting, a scope of work was prepared by the consulting team. The scope detailed tasks and activities to be performed during the planning cycle, including expense budgets, schedule, and description of reports to be developed as part of the planning process. The City of Nacogdoches was designated as the political subdivision representative of the ETRWPG, responsible for applying for financial assistance for the scope of work and regional water plan development.

On December 11, 2017, the ETRWPG held a regular public meeting to determine a process for identifying potentially feasible WMSs. The consultant team presented a proposed methodology for identifying strategies. Recommendations from the ETRWPG were incorporated into the methodology; no public comments were received. The ETRWPG approved the draft process to identify and select WMSs at a subsequent public RWPG meeting on December 11, 2017.

10.3 Opportunities for Public Input

The ETRWPG utilized various types of media and outreach to keep the public informed and to receive input throughout the development of the 2021 Plan, including the following:

- Water user group involvement

- Press releases
- ETRWPA website – www.etexwaterplan.org
- Public meetings
- Public hearings

These means of media and outreach are described below.

10.3.1 Contact with Water User Groups

The ETRWPG made special efforts to contact WUGs in the region and obtain their input in the planning process.

10.3.2 East Texas Regional Water Planning Website

The ETRWPA website, www.etexwaterplan.org was regularly updated to inform the public of scheduled meetings and to provide meeting notices, agenda, minutes, presentations, memoranda, press releases, documents submitted to the TWDB on behalf of the ETRWPG, and copies of correspondence sent to WUGs.

10.3.3 Regular Meetings of the East Texas Regional Water Planning Group

In execution of its duties as the water planning organization for the region, the ETRWPG held regular meetings during the development of the 2021 East Texas Regional Water Plan (2021 Plan), received information from the region's consultants, accepted public comment on issues relevant to water planning, reviewed proposed planning elements, and made decisions on planning efforts. ETRWPG meetings were open to the public, with notice made in accordance with the ETRWPG By-Laws, the Texas Open Meetings Act, and the Texas Public Information Act. Regular meetings were held on the following dates:

- May 18, 2016
- November 9, 2016
- August 16, 2017
- December 11, 2017
- February 21, 2018
- May 16, 2018
- August 15, 2018
- April 17, 2019
- July 17, 2019
- October 15, 2019
- November 20, 2019

- January 15, 2020
- February 19, 2020
- July 15, 2020
- September 16, 2020
- January 15, 2020
- February 19, 2020
- August 5, 2020
- September 16, 2020

10.3.4 Public Hearings for the Initially Prepared Plan

The 2021 Initially Prepared Plan was published for public review and a public hearing to receive comments was held virtually on May 14, 2020 using computer teleconferencing software. Appropriate public notice was provided for the hearing (see Appendix 10-A). The presentation and minutes from the public hearing are included in Appendix 10-B. The submittal letter to the TWDB for the 2021 Initially Prepared Plan is included in Appendix 10-C.

10.4 Public Comment

As a public planning process, the ETRWPG must accept comments by the public and state agencies regarding the plan. The public are invited to provide comments at each regularly scheduled meeting of the ETRWPG. Likewise, comment in the form of letters, emails, or by telephone may be received.

Comments received through the end of the public comment period will be reviewed and evaluated by the ETRWPG and consulting team. The ETRWPG will modify the IPP as necessary, in response to comments. Copies of written comments are provided in Appendix 10-D. A summary of the official IPP comments received by the ETRWPG and the action taken to address the comments are included in Appendix 10-E.

10.5 Final Adoption of the 2021 Plan

The ETRWPG reconvened following the public comment period to review comments and proposed modifications to the IPP. The final 2021 Plan was adopted by the ETRWPG on September 16th, 2020 and published to the internet for public viewing shortly thereafter. The final 2021 Plan was submitted electronically to the TWDB by the extended deadline of November 5th, 2020.

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Chapter 11

Implementation and Comparison to the Previous Regional Water Plan

Chapter 11 includes a summary of the level of implementation of the 2016 East Texas Regional Water Plan (2016 Plan) recommended Water Management Strategies (WMS) to meet projected needs, as well as a brief comparison of the 2016 Plan and the 2021 East Texas Regional Water Plan (2021 Plan).

11.1 Implementation of Previous Regional Water Plan

Title 31 of the Texas Administrative Code §357.45(a) requires the 2021 Plan to report the level of implementation and identified implementation impediments of recommended WMSs and Water Management Strategy Projects (WMSPs) meeting needs in the 2016 Plan.

11.1.1 Texas Water Development Board Implementation Survey

The East Texas Regional Water Planning Group and consultants were responsible for gathering information on the implementation, and reported impediments to implementation, of water management strategies included in the previous regional water plan. Methods used to gather information included:

- Contacting Recommended WMS Project Sponsors;
- Tracking changes in Water User Group (WUG) and Wholesale Water Provider (WWP) supplies since completion of the 2016 Plan;
- Identifying WMSs that are not recommended in the 2021 Plan;
- Reviewing TWDB funding records to identify projects in the region (SWIFT, WIF, State Participation, DWSRF, EDAP, etc.); and,
- Analyzing conservation implementation reports submitted to the TWDB.

The results of this survey were compiled into an Excel workbook developed by the TWDB and submitted to the TWDB along with this 2021 Plan. The workbook is available for public view on the East Texas Regional Water Planning Group website at https://www.etexwaterplan.org/.

11.2 Comparison to Previous Regional Water Plan

A comparison of the 2016 Plan to the 2021 plan follows for the following categories of water planning issues:

- Water Demand Projections
- Drought of Record
- Water Availability

- Existing Water Supplies
    - Water User Groups
    - Wholesale Water Providers
- Identified Needs
    - Water User Groups
    - Wholesale Water Providers
- Water Management Strategies (WMSs) and Water Management Strategy Projects (WMSPs)
    - Recommended Water Management Strategies
    - Alternative Water Management Strategies
- Simplified Planning

A WMS is a plan to meet a need for additional water by a discrete water user group, which can mean increasing the total water supply or maximizing an existing supply, including through reducing demands. A WMS may or may not require an associated WMSP(s) to be implemented.

A WMSP is a water project that has a non-zero capital cost and that when implemented, would develop, deliver, and/or treat additional water supply volumes, or conserve water for water user groups or wholesale water providers. One WMSP may be associated with multiple WMSs.

11.2.1 Water Demand Projections

The total demand projections for the East Texas Regional Water Planning Area (ETRWPA) decreased for every decade from the 2016 Plan to the 2021 Plan, as shown in Figure 11.1 and Table 11.1. This decrease in demand is largely due to the decrease in projected demands for Jefferson County Irrigation, Jefferson County Manufacturing, and Steam Electric Power in almost every county with a projected steam electric power demand. This is in large part due to the change in methodology the Texas Water Development Board took in developing non-municipal demand projections in this cycle of regional water planning by excluding future demands that lacked water supply contracts for projects occurring in the 2030 decade and beyond.

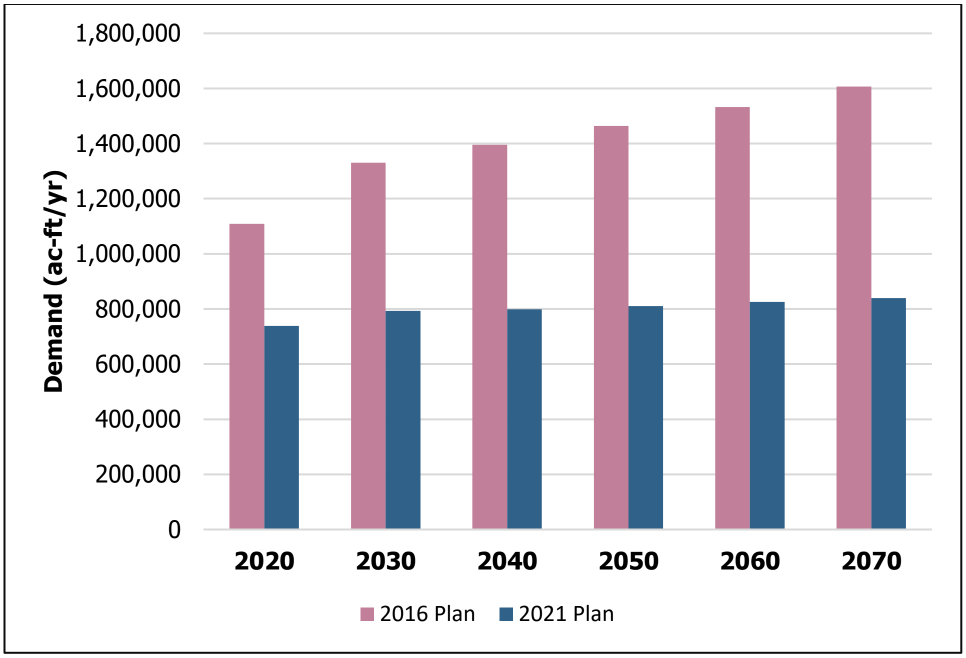

Figure 11.1 Total Projected Demand for the East Texas Regional Water Planning Area from the 2016 and 2021 Plans

Table 11.1 Summary of Projected Water Demands from the East Texas Regional Water Planning Area by Use Category and Decade

2016 Plan Projected Demands (ac-ft/yr)						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	188,646	196,302	204,157	214,540	226,622	239,607
Manufacturing	608,667	800,989	838,639	874,546	909,373	945,886
Mining	27,523	24,547	18,169	15,488	12,986	12,093
Steam Electric Power	82,018	95,544	112,035	132,137	156,640	184,714
Livestock	24,027	25,549	27,361	29,521	32,081	32,764
Irrigation	177,919	187,894	194,851	197,546	195,445	192,186
2016 Total for ETRWPA	**1,108,800**	**1,330,825**	**1,395,212**	**1,463,778**	**1,533,147**	**1,607,250**
2021 Plan Projected Demands (ac-ft/yr)						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	192,049	199,870	207,822	218,266	230,468	243,611
Manufacturing	305,973	353,415	353,415	353,415	353,415	353,415
Mining	27,523	24,547	18,169	15,488	12,986	12,093
Steam Electric Power	67,011	67,011	67,011	67,011	67,011	67,011
Livestock	47,157	50,284	54,029	58,524	63,890	65,103
Irrigation	98,368	98,368	98,368	98,368	98,368	98,368
2021 Total for ETRWPA	**738,081**	**793,495**	**798,814**	**811,072**	**826,138**	**839,601**
Percent Change in Texas Water Development Board Demand Projections from 2016 to 2021						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	2%	2%	2%	2%	2%	2%
Manufacturing	-50%	-56%	-58%	-60%	-61%	-63%
Mining	0%	0%	0%	0%	0%	0%
Steam Electric Power	-18%	-30%	-40%	-49%	-57%	-64%
Livestock	96%	97%	97%	98%	99%	99%
Irrigation	-45%	-48%	-50%	-50%	-50%	-49%
Total for ETRWPA	**-33%**	**-40%**	**-43%**	**-45%**	**-46%**	**-48%**

11.2.2 Drought of Record

The drought of the 1950’s was the drought of record that has been used for regional water planning in the 2011, 2016, and this 2021 Plan. In all three plans, surface water supplies were determined using the Texas Commission on Environmental Quality (TCEQ) approved Water Availability Models that only incorporate historical hydrologic conditions that occurred between 1940 and 1996. Chapter 7 of the 2021 Plan includes a detailed examination of more recent droughts within the region and suggests that the 2010-2012 period was one of significant drought for the ETRWPA. For a full evaluation of the impact of a potential new drought of record on surface water supply availability, the Water Availability Models should be updated by TCEQ to incorporate the hydrologic conditions that have occurred since 1996.

11.2.3 Water Availability

Available water supplies refers to the maximum amount of raw water that could be produced by a source in a drought of record during a repeat of the drought of record, regardless of whether the supply is physically connected to or legally accessible by an entity. The total water availability increased in every decade by 8 percent from the 2016 Plan to the 2021 Plan, as shown in Figure 11.2 and Table 11.2 below. This increase in availability is largely due to increased permitted surface water supplies. One major explanation for the increase is the approval of a 2016 strategy to increase supplies from Toledo Bend.

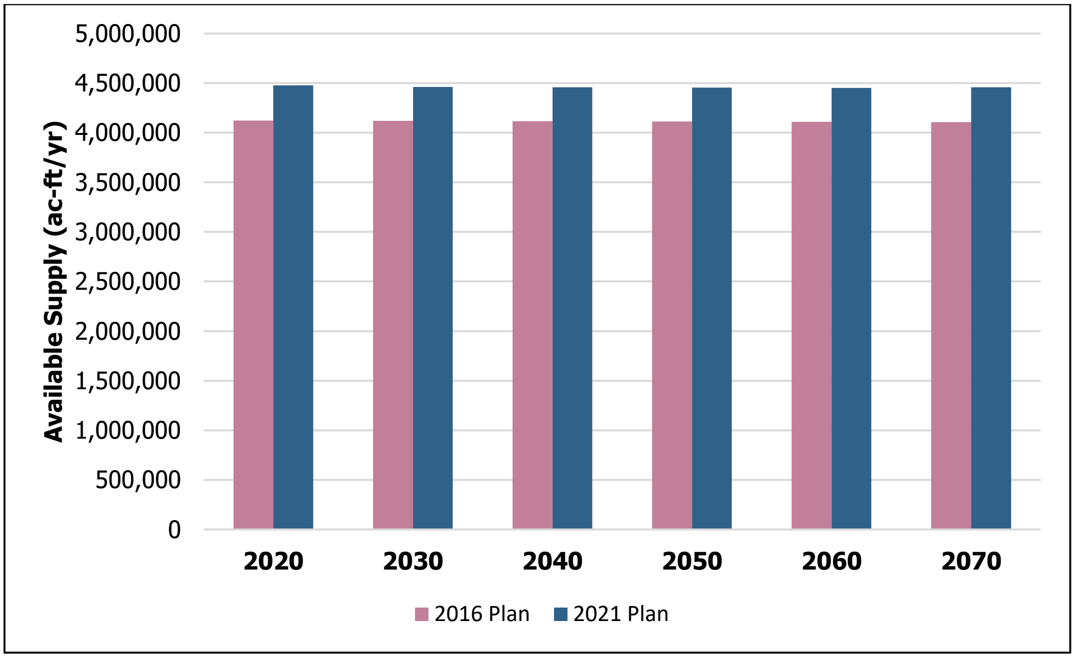

Figure 11.2 Total Available Supply for the East Texas Regional Water Planning Area from the 2016 and 2021 Plans

Table 11.2 Summary of Available Supply in the East Texas Regional Water Planning Area by Decade

2016 Plan Available Supply (ac-ft/yr)						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Reservoirs (permitted)	1,958,512	1,954,328	1,950,141	1,945,955	1,941,769	1,937,675
Run-of-the-River (freshwater)	606,346	607,145	608,083	609,290	610,720	612,001
Run-of-the-River (brackish)	1,036,462	1,036,462	1,036,462	1,036,462	1,036,462	1,036,462
Groundwater	489,876	490,090	489,478	488,732	487,696	487,696
Local Supplies	19,367	19,367	19,367	19,367	19,367	19,367
Reuse	13955	13955	13955	13955	13955	13955
2016 Total for ETRWPA	**4,124,518**	**4,121,347**	**4,117,486**	**4,113,761**	**4,109,969**	**4,107,156**
2021 Plan Available Supply (ac-ft/yr)						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Reservoirs (permitted)	2,255,265	2,251,402	2,247,600	2,243,702	2,239,008	2,233,125
Run-of-the-River (freshwater)	588,603	589,402	590,340	591,547	592,977	594,258
Run-of-the-River (brackish)	1,036,462	1,036,462	1,036,462	1,036,462	1,036,462	1,036,462
Groundwater	548,868	548,258	548,121	547,520	546,379	545,543
Local Supplies	21,783	21,783	21,783	21,783	21,783	21,783
Reuse	13,986	13,999	14,012	14,023	14,037	14,052
2021 Total for ETRWPA	**4,464,967**	**4,461,306**	**4,458,318**	**4,455,037**	**4,450,646**	**4,445,223**
Percent Change in Available Supply from 2016 to 2021						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Reservoirs (permitted)	15%	15%	15%	15%	15%	15%
Run-of-the-River (freshwater)	-3%	-3%	-3%	-3%	-3%	-3%
Run-of-the-River (brackish)	0%	0%	0%	0%	0%	0%
Groundwater	12%	12%	12%	12%	12%	12%
Local Supplies	12%	12%	12%	12%	12%	12%
Reuse	0%	0%	0%	0%	1%	1%
Total for ETRWPA	**8%**	**8%**	**8%**	**8%**	**8%**	**8%**

11.2.4 Existing Supplies of Water User Groups and Wholesale Water Providers

Existing water supply is the maximum amount of water that is physically and legally accessible from existing sources for immediate use by a water user group under a repeat of a drought of record conditions. The existing water supplies of WUGs decreased between 21 percent and 38 percent in every decade from the 2016 Plan to the 2021 Plan, as shown in Figure 11.3 and Table 11.3 below. The largest decrease in supplies occurred in water user groups from Jefferson County who collectively had an average decrease in existing supplies between 143,000 and 312,000 acre-feet per year (ac-ft per year) in every decade of the planning period.

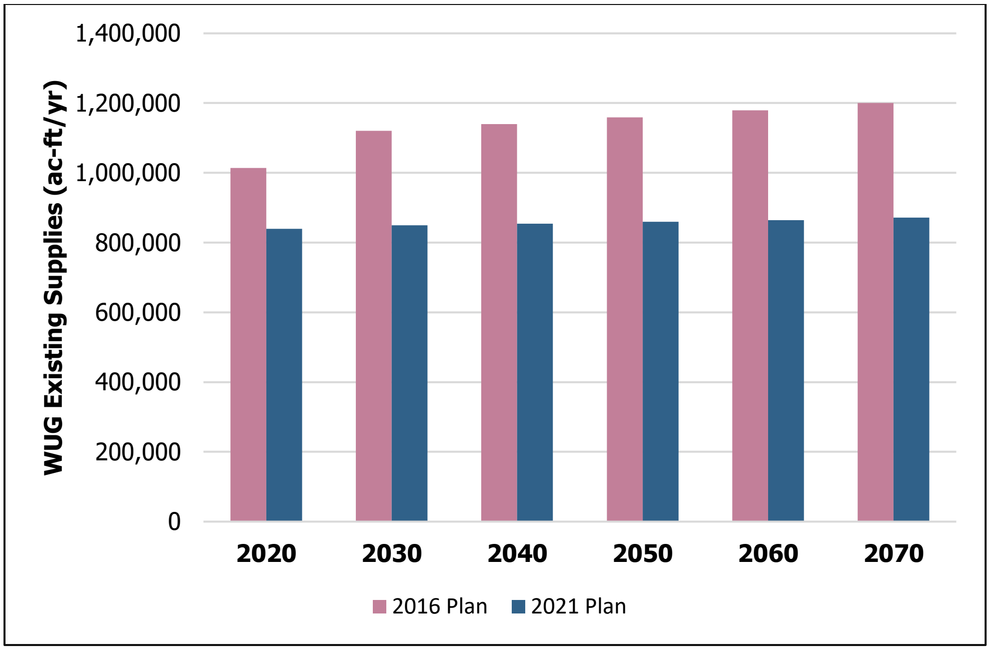

Figure 11.3 Total Existing Supplies of Water User Groups in the East Texas Regional Water Planning Area from the 2016 and 2021 Plans

Table 11.3 Summary of Existing Supplies of Water User Groups in the East Texas Regional Water Planning Area by Decade

2016 WUG Existing Supplies (ac-ft/yr)						
County	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Anderson	15,372	15,473	15,411	15,299	15,257	15,239
Angelina	40,719	41,304	41,850	42,393	42,978	43,590
Cherokee	17,454	17,563	17,683	17,922	18,243	18,852
Hardin	17,934	18,232	18,441	18,573	18,581	18,552
Henderson*	7,842	7,705	7,603	7,561	7,154	6,891
Houston	11,448	11,488	11,540	11,604	11,680	11,830
Jasper	102,073	102,015	101,942	101,884	101,847	101,833
Jefferson	512,147	613,229	629,139	643,731	658,509	673,965
Nacogdoches	28,089	28,713	29,436	30,239	31,210	32,363
Newton	17,260	17,333	17,409	17,477	17,544	17,616
Orange	80,249	80,307	80,430	80,557	80,675	80,776
Panola	16,993	17,308	17,160	16,735	17,429	17,666
Polk*	3,217	3,354	3,484	3,606	3,717	3,838
Rusk	64,294	64,652	64,668	64,677	64,693	64,738
Sabine	5,850	5,850	5,850	5,850	5,850	5,850
San Augustine	4,573	4,670	4,781	4,910	5,052	5,052
Shelby	14,667	14,677	14,670	14,972	14,317	14,663
Smith*	40,131	42,343	44,662	47,352	50,396	53,634
Trinity*	1,960	1,960	1,961	1,962	1,960	1,965
Tyler	11,998	11,959	11,922	11,904	11,905	11,910
2016 Total for ETRWPA	**1,014,270**	**1,120,135**	**1,140,042**	**1,159,208**	**1,178,997**	**1,200,823**

Table 11.3 Summary of Existing Supplies of WUGs In the ETRWPA by Decade (cont.)

2021 WUG Existing Supplies (ac-ft/yr)						
County	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Anderson	19,164	19,326	19,290	19,183	19,140	19,120
Angelina	38,612	39,004	39,301	39,640	40,009	40,349
Cherokee	17,563	17,965	18,381	18,966	19,641	20,297
Hardin	8,022	8,223	8,356	8,479	8,606	8,710
Henderson*	8,155	8,199	8,139	8,191	7,558	7,148
Houston	11,692	11,670	11,589	11,518	11,445	11,412
Jasper	85,173	96,446	96,282	96,177	96,129	96,117
Jefferson	368,771	359,445	360,495	360,859	361,389	362,053
Nacogdoches	31,947	32,716	33,499	34,400	35,427	36,601
Newton	16,846	16,876	16,915	16,973	17,037	17,109
Orange	74,632	74,688	74,713	74,770	74,840	74,900
Panola	16,937	17,252	17,105	16,680	17,375	17,612
Polk*	2,671	2,747	2,822	2,902	2,975	3,041
Rusk	61,526	65,287	65,656	66,106	66,633	67,180
Sabine	5,488	5,501	5,495	5,493	5,493	5,493
San Augustine	4,294	4,303	4,314	4,326	4,340	4,340
Shelby	16,149	16,044	15,924	16,132	15,355	15,570
Smith*	39,520	41,677	43,722	46,266	49,139	51,977
Trinity*	1,571	1,581	1,575	1,567	1,576	1,584
Tyler	10,940	10,928	10,831	10,757	10,703	10,676
2021 Total for ETRWPA	**839,673**	**849,878**	**854,404**	**859,385**	**864,810**	**871,289**
Percent Change in WUG Existing Supplies from 2016 to 2021						
County	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Anderson	20%	20%	20%	20%	20%	20%
Angelina	-5%	-6%	-6%	-7%	-7%	-8%
Cherokee	1%	2%	4%	6%	7%	7%
Hardin	-124%	-122%	-121%	-119%	-116%	-113%
Henderson*	4%	6%	7%	8%	5%	4%
Houston	2%	2%	0%	-1%	-2%	-4%
Jasper	-20%	-6%	-6%	-6%	-6%	-6%
Jefferson	-39%	-71%	-75%	-78%	-82%	-86%
Nacogdoches	12%	12%	12%	12%	12%	12%
Newton	-2%	-3%	-3%	-3%	-3%	-3%
Orange	-8%	-8%	-8%	-8%	-8%	-8%
Panola	0%	0%	0%	0%	0%	0%
Polk*	-20%	-22%	-23%	-24%	-25%	-26%
Rusk	-4%	1%	2%	2%	3%	4%
Sabine	-7%	-6%	-6%	-6%	-6%	-6%
San Augustine	-6%	-9%	-11%	-13%	-16%	-16%
Shelby	9%	9%	8%	7%	7%	6%
Smith*	-2%	-2%	-2%	-2%	-3%	-3%
Trinity*	-25%	-24%	-25%	-25%	-24%	-24%
Tyler	-10%	-9%	-10%	-11%	-11%	-12%
Total for ETRWPA	**-21%**	**-32%**	**-33%**	**-35%**	**-36%**	**-38%**

* The counties marked with an asterisk are split between two water planning regions. The available supply presented in this table represents only the portion of those counties that are within the boundaries of Region I.

The existing water supplies of WWPs increased by 7 percent in every decade in the planning period from the 2016 Plan to the 2021 Plan, as shown in Figure 11.4 and Table 11.4 below. The largest increases in supplies were incurred by the Sabine River Authority of Texas and Center which both had an average increase in existing supplies of 19 percent in every decade of the planning period.

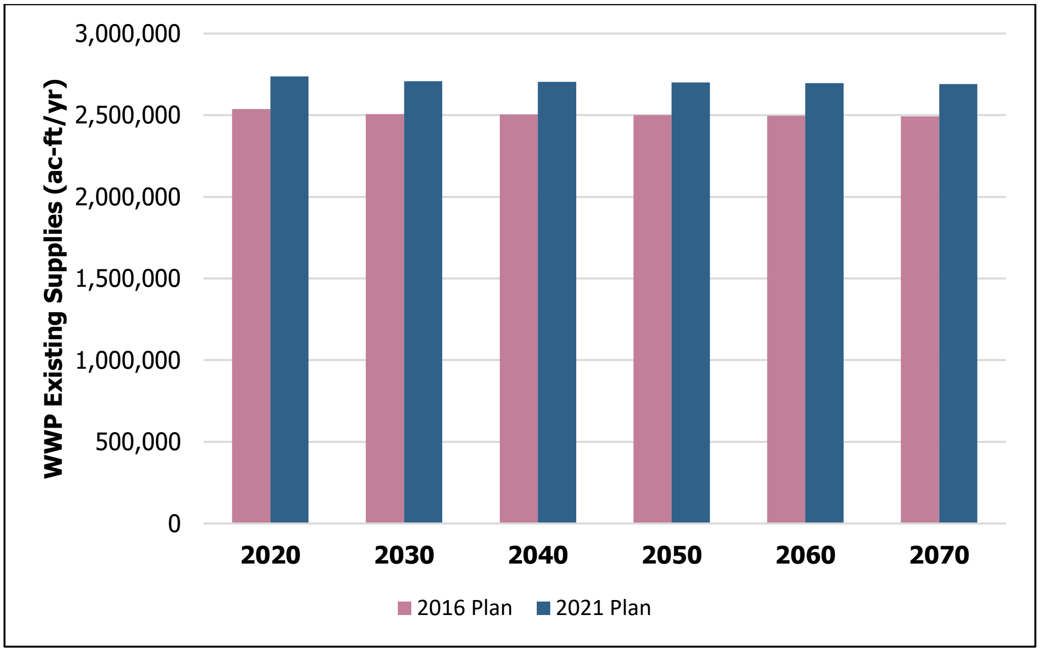

Figure 11.4 Total Existing Supplies of Wholesale Water Providers in the East Texas Regional Water Planning Area from the 2016 and 2021 Plans

Table 11.4 Summary of Existing Supplies of Wholesale Water Providers in the East Texas Regional Water Planning Area by Decade

2016 WWP Existing Supplies (ac-ft/yr)						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Angelina and Neches River Authority	65	70	70	70	70	70
Angelina-Nacogdoches Water Control & Improvement District (WCID) No. 1	19,357	18,530	17,703	16,877	16,050	15,264
Athens Municipal Water Authority	6,949	6,869	6,788	6,707	6,626	6,546
Beaumont	33,844	35,807	37,525	37,525	37,525	37,525
Carthage	5,695	5,695	5,695	5,695	5,695	5,695
Center	4,285	4,285	4,285	4,285	4,285	4,285
Houston Co. WCID 1	3,500	3,500	3,500	3,500	3,500	3,501
Jacksonville	7,391	7,391	7,391	7,391	7,391	7,391
Lower Neches Valley Authority	1,201,876	1,173,876	1,173,876	1,173,876	1,173,876	1,173,876
Lufkin	38,644	38,640	38,635	38,631	38,627	38,623
Nacogdoches	23,176	22,792	22,409	22,026	21,642	21,268

Table 11.4 Summary of Existing Supplies of WWPs in the ETRWPA by Decade (cont.)

Panola Co. Freshwater Supply District No. 1	21,203	20,615	20,027	19,438	18,850	18,279
Port Arthur	26,253	26,223	25,996	25,949	25,930	25,929
Sabine River Authority of Texas	897,100	897,100	897,100	897,100	897,100	897,100
Tyler	40,756	40,756	40,756	40,756	40,756	40,756
Upper Neches River Municipal Water Authority	205,417	203,375	201,333	199,292	197,250	195,229
Wholesale Water Provider Totals	**2,537,531**	**2,507,554**	**2,505,129**	**2,501,168**	**2,497,233**	**2,493,407**
2021 WWP Existing Supplies (ac-ft/yr)						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Angelina and Neches River Authority	65	70	70	70	70	70
Angelina-Nacogdoches Water Control & Improvement District (WCID) No. 1	20,340	19,635	18,890	18,150	16,715	14,690
Athens Municipal Water Authority	8,203	8,117	8,031	7,945	7,859	7,773
Beaumont	34,469	36,451	37,525	37,525	37,525	37,525
Carthage	5,564	5,564	5,564	5,564	5,565	5,565
Center	5,260	5,260	5,260	5,260	5,260	5,260
Houston Co. WCID 1	3,500	3,500	3,500	3,500	3,500	3,501
Jacksonville	7,391	7,391	7,391	7,391	7,391	7,391
Lower Neches Valley Authority	1,201,876	1,173,876	1,173,876	1,173,876	1,173,876	1,173,876
Lufkin	38,727	38,727	38,727	38,727	38,727	38,727
Nacogdoches	22,692	22,292	21,892	21,492	21,092	20,692
Panola Co. Freshwater Supply District No. 1	21,367	20,686	20,006	19,325	18,644	17,963
Port Arthur	25,684	25,655	25,434	25,389	25,370	25,369
Sabine River Authority of Texas	1,103,010	1,103,010	1,103,010	1,103,010	1,103,010	1,103,010
Tyler	41,056	41,056	41,056	41,056	41,056	41,056
Upper Neches River Municipal Water Authority	197,710	196,110	194,610	193,010	191,310	189,010
Wholesale Water Provider Totals	**2,736,915**	**2,707,401**	**2,704,843**	**2,701,291**	**2,696,970**	**2,691,479**

Table 11.4 Summary of Existing Supplies of WWPs in the ETRWPA by Decade (cont.)

Percent Change in WUG Existing Supplies from 2016 to 2021						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Angelina and Neches River Authority	0%	0%	0%	0%	0%	0%
Angelina-Nacogdoches Water Control & Improvement District (WCID) No. 1	5%	6%	6%	7%	4%	-4%
Athens Municipal Water Authority	15%	15%	15%	16%	16%	16%
Beaumont	2%	2%	0%	0%	0%	0%
Carthage	-2%	-2%	-2%	-2%	-2%	-2%
Center	19%	19%	19%	19%	19%	19%
Houston Co. WCID 1	0%	0%	0%	0%	0%	0%
Jacksonville	0%	0%	0%	0%	0%	0%
Lower Neches Valley Authority	0%	0%	0%	0%	0%	0%
Lufkin	0%	0%	0%	0%	0%	0%
Nacogdoches	-2%	-2%	-2%	-2%	-3%	-3%
Panola Co. Freshwater Supply District No. 1	1%	0%	0%	-1%	-1%	-2%
Port Arthur	-2%	-2%	-2%	-2%	-2%	-2%
Sabine River Authority of Texas	19%	19%	19%	19%	19%	19%
Tyler	1%	1%	1%	1%	1%	1%
Upper Neches River Municipal Water Authority	-4%	-4%	-3%	-3%	-3%	-3%
Wholesale Water Provider Totals	**7%**	**7%**	**7%**	**7%**	**7%**	**7%**

11.2.5 Identified Needs

A comparison of WUG and WWP identified needs between the 2016 Plan and the 2021 Plan follows.

Water User Groups

In the last round of planning, there were 40 WUGs with identified needs; approximately 80 percent of these needs were from the manufacturing category of water uses. In the 2021 Plan, there are 44 WUGs with identified needs; approximately 75 percent of these needs are from manufacturing. Even though there are more WUGs with an identified need in this round of planning compared to the previous round of planning, the decrease in manufacturing needs reduced the total volume of needs by an average of 50 percent in every decade of the planning period. The summary of total identified water user group needs is presented in Figure 11.5 and Table 11.5 below.

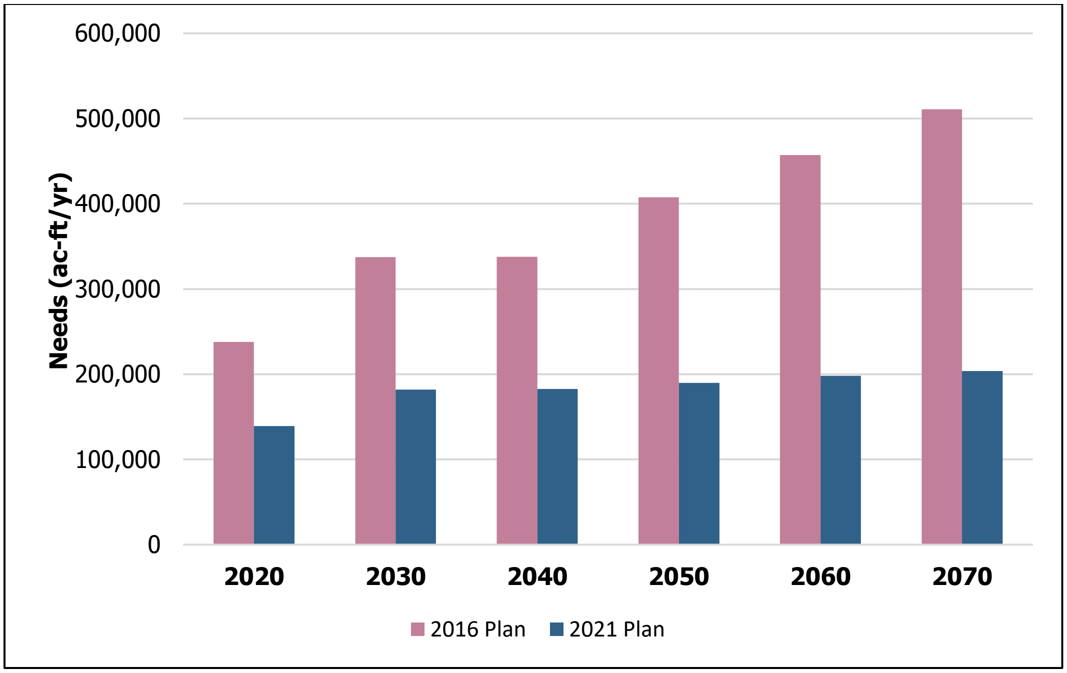

Figure 11.5 Total Identified Water User Group Needs for the East Texas Regional Water Planning Area in the 2016 and 2021 Plans

Table 11.5 Summary of Identified Water User Group Needs from the East Texas Regional Water Planning Area by Use Category and Decade

2016 Plan Identified WUG Needs (ac-ft/yr)						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	121	534	1,462	4,517	8,749	13,445
Manufacturing	196,450	287,997	278,959	330,608	349,817	370,080
Mining	9,586	7,160	2,794	2,338	2,048	1,916
Steam Electric Power	25,422	33,529	44,283	57,789	82,036	110,014
Livestock	3,011	4,212	5,663	7,419	9,541	9,983
Irrigation	3,512	4,011	4,452	4,812	5,076	5,427
2016 Total for ETRWPA	**238,102**	**337,443**	**337,613**	**407,483**	**457,267**	**510,865**
2021 Plan Identified WUG Needs (ac-ft/yr)						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	501	877	2,551	5,832	9,265	13,590
Manufacturing	102,587	145,222	145,206	145,188	145,171	145,155
Mining	8,413	5,281	903	468	308	207
Steam Electric Power	3,494	3,494	3,494	3,494	3,494	3,494
Livestock	23,708	26,613	30,128	34,381	39,483	40,666
Irrigation	526	526	526	526	556	576
2021 Total for ETRWPA	**139,229**	**182,013**	**182,808**	**189,889**	**198,277**	**203,688**
Percent Change in Identified WUG Needs from 2016 to 2021						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	314%	64%	74%	29%	6%	1%
Manufacturing	-48%	-50%	-48%	-56%	-59%	-61%
Mining	-12%	-26%	-68%	-80%	-85%	-89%
Steam Electric Power	-86%	-90%	-92%	-94%	-96%	-97%
Livestock	687%	532%	432%	363%	314%	307%
Irrigation	-85%	-87%	-88%	-89%	-89%	-89%
Total for ETRWPA	**-42%**	**-46%**	**-46%**	**-53%**	**-57%**	**-60%**

Wholesale Water Providers

In the last round of planning, there were 7 WWPs out of 16 total WWPs with identified needs; approximately 70 percent of these needs were from the Angelina Neches River Authority. In the 2021 Plan, there are 4 WWPs with identified needs; approximately 72 percent of these needs are from the Angelina Neches River Authority. The total needs for the region have increased in 2020 and 2030 by 2,629 and 1,055 acre-feet per year respectively but has decreased in every decade from 2040 to 2070, as shown in Figure 11.6 and Table 11.6 below. In both rounds of planning, the WWPs have identified multiple WMSs to obtain available water in the region to meet their identified needs. The change in needs form the last round of planning to this round of planning is largely due to changes in demand rather than changes in supply.

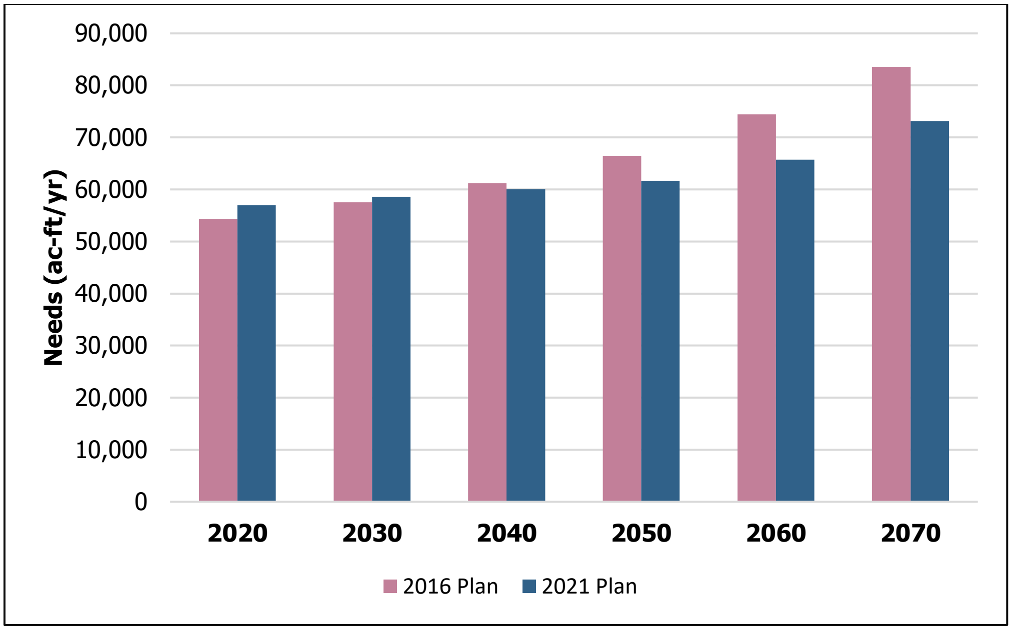

Figure 11.6 Total Identified Wholesale Water Provider Needs for the East Texas Regional Water Planning Area in the 2016 and 2021 Plans

Table 11.6 Summary of Identified Wholesale Water Provider Needs from the East Texas Regional Water planning Area by Use Category and Decade

2016 Plan Identified WWP Needs (ac-ft/yr)						
	2020	2030	2040	2050	2060	2070
AN WCID #1	1,212	2,039	2,866	3,692	4,519	5,305
ANRA	45,319	45,319	45,319	45,319	45,319	45,319
Athens MWA	2,766	3,048	3,289	3,637	6,323	9,633
Beaumont	0	0	578	2570	4994	7754
Center	0	0	0	0	0	171
HC WCID #1	244	268	296	321	352	386
Lufkin	0	0	0	0	0	0
Tyler	0	0	0	0	0	0
UNRMWA	4,831	6,849	8,869	10,892	12,919	14,940
2016 Total for ETRWPA	**54,372**	**57,523**	**61,217**	**66,431**	**74,426**	**83,508**
2021 Plan Identified WWP Needs (ac-ft/yr)						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
AN WCID #1	0	0	0	0	0	0
ANRA	44,464	44,464	44,464	44,464	44,464	44,464
Athens MWA	0	0	0	0	2,386	5,566
Beaumont	0	0	0	0	0	1,938
Center	0	0	0	0	0	0
HC WCID #1	0	0	0	0	0	0
Lufkin	0	0	0	0	0	0
Tyler	0	0	0	0	0	0
UNRMWA	12,537	14,114	15,592	17,174	18,859	21,159
2021 Total for ETRWPA	**57,001**	**58,578**	**60,056**	**61,638**	**65,709**	**73,127**
Percent Change in Identified WWP Needs from 2016 to 2021						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
AN WCID #1	N/A	N/A	N/A	N/A	N/A	N/A
ANRA	-2%	-2%	-2%	-2%	-2%	-2%
Athens MWA	N/A	N/A	N/A	N/A	-62%	-42%
Beaumont	N/A	N/A	N/A	N/A	N/A	-75%
Center	N/A	N/A	N/A	N/A	N/A	N/A
HC WCID #1	N/A	N/A	N/A	N/A	N/A	N/A
Lufkin	N/A	N/A	N/A	N/A	N/A	N/A
Tyler	N/A	N/A	N/A	N/A	N/A	N/A
UNRMWA	160%	106%	76%	58%	46%	42%
Total for ETRWPA	**5%**	**2%**	**-2%**	**-7%**	**-11%**	**-10%**

Note: Angelina-Nacogdoches Water Control & Improvement District No. 1 (AN WCID #1)
Angelina and Neches River Authority (ANRA)
Municipal Water Authority (MWA)
Upper Neches River Municipal Water Authority (UNRMWA)

11.2.6 Water Management Strategies and Water Management Strategy Projects

To the extent practical, the RWPG developed WMSs that serve multiple WUGs to achieve economies of scale. Additionally, during the project prioritization process, projects that serve multiple WUGs are given a higher score, resulting in a higher prioritization. Oftentimes, however, strategies that benefit the entire region are not financially feasible in the ETRWPA. The ETRWPG discussed during the regularly scheduled meeting on September 16th, 2020 that region-wide strategies are often unnecessary due to the abundance of water available in the area. Regionalization could become more practical as conditions change in the future.

Recommended Water Management Strategies

The 2016 Plan included 70 Recommended WMSs with a total supply of over 725,00 acre-feet per year beginning in 2020 and increasing to over 1,700,000 acre-feet per year beginning in 2070. In the 2021 Plan, there are 134 Recommended WMSs with a total supply of over 24,468 acre-feet beginning in 2020 and increasing to over 278,546 acre-feet per year beginning in 2070, as shown in Figure 11.7. Changes in WUG and WWP long term water planning account for differences observed between the 2016 and 2021 Plans. A major change in the 2021 Plan is a conservation WMS was developed for all municipal WUGs with a base water use of over 140 gpcd rather than only including conservation WMSs for WUGs with projected needs.

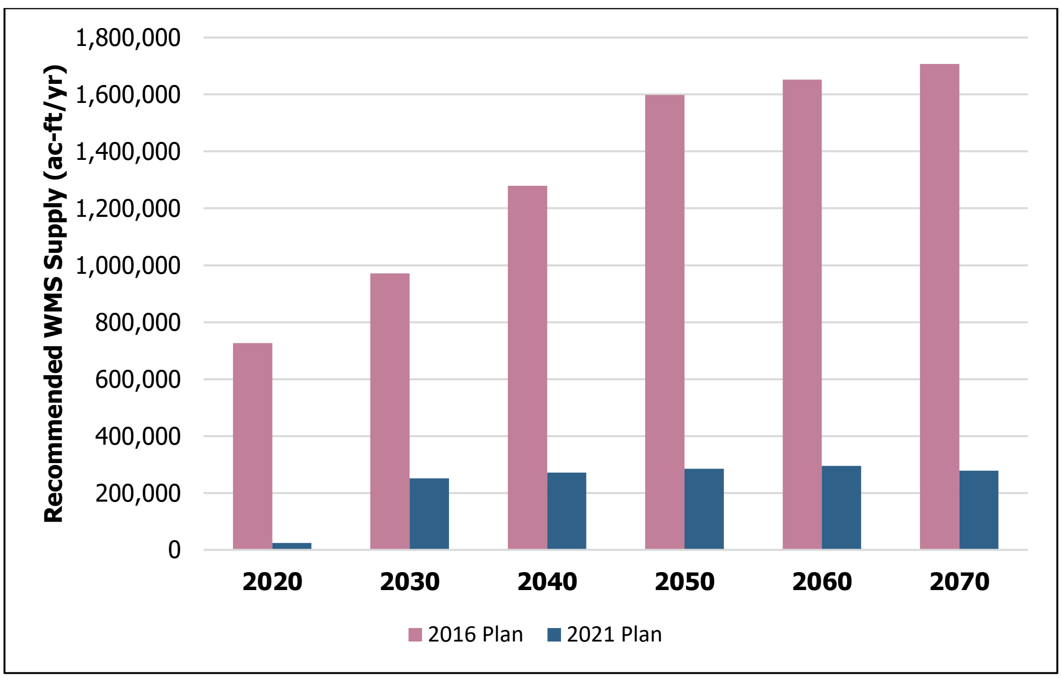

Figure 11.7 Total Supply of Recommended Water Management Strategies for the East Texas Regional Water Planning Area in the 2016 and 2021 Plans

Alternative Water Management Strategies

The 2016 Plan included four Alternative WMSs with a total of 33,574 acre-feet per year for every decade in the planning period (2020-2070). The Region I 2021 Plan includes four Alternative WMSs with a total of 24 acre-feet per year in 2020 decreasing to 10 acre-feet per year in 2070, as shown in Table 11.7 below. All four Alternative WMSs included in the Region I plan were developed by Regions C and I for WUGs in Henderson or Athens Counties. This decrease in supply from alternative strategies is largely due to project sponsors' increased level of planning to develop and confidence in the feasibility of recommended WMSs negating the need for alternative strategies.

Table 11.7 Summary of Water Management Strategies in the East Texas Regional Water planning Area by Decade

2016 Plan Water Management Strategies Supply (ac-ft/yr)						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Recommended WMSs	726,190	970,814	1,278,989	1,598,554	1,652,293	1,707,025
Alternative WMSs	33,574	33,574	33,574	33,574	33,574	33,574
2021 Plan Water Management Strategies Supply (ac-ft/yr)						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Recommended WMSs	24,468	250,791	271,865	284,718	294,829	278,546
Alternative WMSs	24	23	22	22	13	10
Percent Change in Water Management Strategy Supply from 2016 to 2021						
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Recommended WMSs	-97%	-74%	-79%	-82%	-82%	-84%
Alternative WMSs	-100%	-100%	-100%	-100%	-100%	-100%

11.2.7 Simplified Planning

The purpose of this section is to identify how simplified planning in the 2021 Plan evaluated the differences in water demands, availability, and supplies of the ETRWPA compared to the 2016 Plan to determine no significant changes had occurred in the region. In addition, this section shall identify what data was adopted directly from the previous plan for inclusion in the current, simplified plan. However, the ETRWPG made a declaration of intent to forgo simplified planning at its general meeting held August 15, 2018.

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Texas Water Development Board List of Definitions

Definitions were obtained from the document "Texas Water Development Board Second Amended Exhibit C General Guidelines for Fifth Cycle of Regional Water Plan Development, April 2018." The terms and acronyms used in the guidance document as defined in 31 TAC §357.10 have the following meanings:

Agricultural Water Conservation – Defined in 31 Texas Administrative Code (TAC) §363.1302 (relating to Definition of Terms) as "those practices, techniques or technologies used in agriculture, as defined in Texas Agriculture Code, which will improve the efficiency of the use of water and further water conservation in the state, including but not limited to those programs or projects defined in Texas Water Code §§17.871 - 17.912."

Alternative Water Management Strategy – A fully evaluated water management strategy that may be substituted into a regional water plan in the event that a recommended water management strategy is no longer recommended.

Availability – The maximum amount of raw water that could be produced by a source during a repeat of the drought of record, regardless of whether the supply is physically connected to or legally accessible by water user groups.

Board (or TWDB) – The Texas Water Development Board.

Collective Reporting Unit (CRU) – A grouping of utilities located in a regional water planning area. Utilities within a Collective Reporting Unit must have a logical relationship, such as being served by common wholesale water providers, having common sources, or other appropriate associations.

Commission (or TCEQ) – The Texas Commission on Environmental Quality.

County-Other – An aggregation of utilities that provide less than an average of 100 acre-feet per year, as well as rural areas not served by a water utility in a given county.

Drought Contingency Plan (DCP) – A plan required from wholesale and retail public water suppliers and irrigation districts pursuant to Texas Water Code §11.1272 (relating to Drought Contingency Plans for Certain Applicants and Water Right Holders). The plan may consist of one or more strategies for temporary supply and demand management and demand management responses to temporary and potentially recurring water supply shortages and other water supply emergencies as required by the Commission.

Drought Management Measures – Demand management activities to be implemented during drought that may be evaluated and included as water management strategies.

Drought Management Water Management Strategy – A drought management measure or measures evaluated and/or recommended in a state or regional water plan that quantifies temporary reductions in demand during drought conditions.

Drought of Record – The period of time when historical records indicate that natural hydrological conditions would have provided the least amount of water supply.

Executive Administrator (EA) – The executive administrator of the Texas Water Development Board or a designated representative.

Existing Water Supply – The maximum amount of water that is physically and legally accessible from existing sources for immediate use by a water user group under a repeat of drought of record conditions.

Firm Yield (reservoir availability) – The maximum water volume a reservoir can provide each year under a repeat of the drought of record using anticipated sedimentation rates and assuming that all senior water rights will be totally utilized and all applicable permit conditions met.

Initially Prepared Plan (IPP) – The draft regional water plan that is presented at a public hearing in accordance with 31 TAC §357.21(d) (relating to Notice and Public Participation) and submitted for Board review and comment.

Interbasin Transfer of Surface Water – Defined and governed in the Texas Water Code §11.085 (relating to Interbasin Transfers) as the diverting of any state water from a river basin and transfer of that water to any other river basin.

Interregional Conflict – An interregional conflict exists when:

- more than one regional water plan includes the same source of water supply for identified and quantified recommended water management strategies and there is insufficient water available to implement such water management strategies; or
- in the instance of a recommended water management strategy proposed to be supplied from a different regional water planning area, the regional water planning group with the location of the strategy has studied the impacts of the recommended water management strategy on its economic, agricultural, and natural resources, and demonstrates to the Board that there is a potential for a substantial adverse effect on the region as a result of those impacts.

Intraregional Conflict – A conflict between two or more identified, quantified, and recommended water management strategies in the same IPP that rely upon the same water source, so that there is not sufficient water available to fully implement all water management strategies and thereby creating an over-allocation of that source.

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.

Modeled Available Groundwater (MAG) Peak Factor – A percentage (e.g. greater than 100 percent) that is applied to a modeled available groundwater value reflecting the annual groundwater availability that, for planning purposes, shall be considered temporarily available for pumping consistent with desired future conditions. The approval of a MAG Peak Factor is not intended as a limit to permits or as guaranteed approval or pre-approval of any future permit application.

Planning Decades – Temporal snapshots of conditions anticipated to occur and presented at even intervals over the planning horizon used to present simultaneous demands, supplies, needs, and strategy volume data. A water management strategy that is shown as initially providing a supply in the 2040 decade, for example, is assumed to come online in the year 2040.

Political Subdivision – City, county, district, or authority created under the Texas Constitution, Article III, §52, or Article XVI, §59, any other political subdivision of the state, any interstate compact commission to which the state is a party, and any nonprofit water supply corporation created and operating under the Texas Water Code Chapter 67 (relating to Nonprofit Water Supply or Sewer Service Corporations).

Regional Water Plan (RWP) – The plan adopted or amended by a regional water planning group pursuant to the Texas Water Code §16.053 (relating to Regional Water Plans) and 31 TAC Chapter 357.

Regional Water Planning Area (RWPA) – The area designated pursuant to the Texas Water Code §16.053.

Regional Water Planning Group (RWPG) – A group designated pursuant to the Texas Water Code §16.053.

RWPG-Estimated Groundwater Availability – The groundwater availability used for planning purposes as determined by RWPGs to which 31 TAC §357.32(d)(2) (relating to Water Supply Analysis) is applicable or where no desired future condition has been adopted.

Retail Public Utility – Defined in the Texas Water Code §13.002 (relating to Water Rates and Services) as "any person, corporation, public utility, water supply or sewer service corporation, municipality, political subdivision or agency operating, maintaining, or controlling in this state facilities for providing potable water service or sewer service, or both, for compensation."

Reuse – Defined in 31 TAC §363.1302 (relating to Definition of Terms) as "the beneficial use of groundwater or surface water that has already been beneficially used." For purposes of this document:

- Indirect reuse is process water that reenters a river or stream system and is diverted and used again downstream.
- Direct reuse is process water recirculated within a given system.

State Drought Preparedness Plan – A plan, separate from the state water plan, that is developed by the Drought Preparedness Council for the purpose of mitigating the effects of drought pursuant to the Texas Water Code §16.0551 (relating to State Drought Preparedness Plan).

State Drought Response Plan – A plan prepared and directed by the chief of the Texas Division of Emergency Management for the purpose of managing and coordinating the drought response component of the State Water Plan and the State Drought Preparedness Plan pursuant to the Texas Water Code §16.055 (relating to Drought Response Plan).

State Water Plan – The most recent state water plan adopted by the Board under the Texas Water Code §16.051 (relating to State Water Plan).

State Water Planning Database – The database maintained by TWDB that stores data related to population and Water Demand projections, water availability, existing water supplies, water management strategy supplies, and water management strategy projects. It is used to collect, analyze, and disseminate regional and statewide water planning data.

Technical Memorandum – Documentation of the RWPG's preliminary analysis of water demand projections, water availability, existing water supplies, and water needs and declaration of the RWPG's intent of whether or not to pursue simplified planning.

Unmet Water Need – The portion of an identified water need that is not met by recommended water management strategies.

Water Conservation Measures – Practices, techniques, programs, and technologies that will protect water resources, reduce the consumption of water, reduce the loss or waste of water, or improve the efficiency in the use of water that may be presented as water management strategies, so that a water supply is made available for future or alternative uses. For planning purposes, water conservation measures do not include reservoirs, aquifer storage and recovery, or other types of projects that develop new water supplies.

Water Conservation Plan – The most current plan required by the Texas Water Code §11.1271 (relating to Water Conservation Plans) from an applicant for a new or amended water rights permit and from any holder of a permit, certificate, etc. who is authorized to appropriate 1,000 acre-feet per year or more for municipal, industrial, and other non-irrigation uses and for those who are authorized to appropriate 10,000 acre-feet per year or more for irrigation; the most current plan required by the Texas Water Code §13.146 from a retail public utility that provides potable water service to 3,300 or more connections; and the most current plan required by the Texas Administrative Code §363.15 from an applicant for financial assistance. These plans must include specific, quantified 5-year and 10-year targets for water savings.

Water Conservation Strategy – A water management strategy with quantified volumes of water associated with water conservation measures.

Water Demand – The volume of water required to carry out the anticipated domestic, public, and/or economic activities of a water user group during drought conditions.

Water Management Strategy (WMS) – A plan to meet a need for additional water by a discrete water user group, which can mean increasing the total water supply or maximizing an existing supply, including through reducing demands. A WMS may or may not require an associated water management strategy project(s) to be implemented.

Water Management Strategy Project (WMSP) – A water project that has a non-zero capital cost and that when implemented, would develop, deliver, and/or treat additional water supply volumes, or conserve water for water user groups or wholesale water providers. One WMSP may be associated with multiple WMSs.

Water Need – A potential water supply shortage based on the difference between projected water demands and existing water supplies.

Water User Group (WUG) – Identified user or group of users for which water demands and existing water supplies have been identified and analyzed and plans developed to meet water needs. These include:

- privately-owned utilities that provide an average of more than 100 acre-feet per year for municipal use for all owned water systems,
- water systems serving institutions or facilities owned by the state or federal government that provide more than 100 acre-feet per year for municipal use;
- all other retail public utilities not covered in paragraphs (a) and (b) that provide more than 100 acre-feet per year for municipal use;
- collective reporting units, or groups of retail public utilities that have a common association and are requested for inclusion by the regional water planning group;
- municipal and domestic water use, referred to as county-other, not included in subparagraphs (a) – (d) of this subsection; and,
- non-municipal water use including manufacturing, irrigation, steam electric power generation, mining, and livestock watering for each county or portion of a county in a regional water planning area.

Wholesale Water Provider (WWP) – Any person or entity, including river authorities and irrigation districts, that delivers or sells water wholesale (treated or raw) to WUGs or other WWPs or that the RWPG expects or recommends to deliver or sell water wholesale to WUGs or other WWPs during the period covered by the plan. The RWPGs shall identify the WWPs within each region to be evaluated for plan development.

Other definitions pertinent to regional water planning:

Aquifer – Geologic formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs. The formation could be sand, gravel, limestone, sandstone, or fractured igneous rocks.

Aquifer Recharge – Water that infiltrates to the water table of an aquifer.

Aquifer Storage and Recovery – The practice of injecting water, when available, into an aquifer where it is stored for later use.

Brackish Water – Water containing total dissolved solids between 1,000 and 10,000 milligrams per liter.

Capital Cost – Portion of the estimated cost of a water management strategy that includes both the direct costs of constructing facilities, such as materials, labor, and equipment, and the indirect costs associated with construction activities, such as engineering studies, legal counsel, land acquisition, contingencies, environmental mitigation, interest during construction, and permitting.

Conjunctive Use – Combined use of surface water, groundwater and/or reuse sources that optimizes the beneficial characteristics of each source.

Desalination – Process of removing salt and other dissolved solids from seawater or brackish water.

Desired Future Condition (DFC) – The desired, quantified condition of groundwater resources (such as water levels, spring flows, or volumes) within a management area at one or more specified future times as defined by participating groundwater conservation districts within a groundwater management area as part of the joint planning process.

Drought – Generally applied to periods of less than average precipitation over a certain period of time. 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).

Environmental flows – An environmental flow is an amount of water that should remain in a stream or river for the benefit of the environment of the river, bay, and estuary, while balancing human needs.

Estuary – A bay or inlet, often at the mouth of a river and may be bounded by barrier islands, where freshwater and seawater mix together providing for economically and ecologically important habitats and species and which also yield essential ecosystem services.

Firm Diversion (run of river availability) – Evaluated for municipal sole-source water use (i.e. not firmed up with other sources) is defined as the minimum monthly diversion amount that is available 100 percent of the time during a repeat of the drought of record. Evaluated for all other water users, the 'firm diversion' is defined as the minimum annual diversion, which is the lowest annual summation of the monthly diversions reported by the WAM over the simulation period (lowest annual summation being the calendar year within the simulation that represents the lowest diversion available).

Groundwater Availability Model (GAM) – A regional groundwater flow model approved by the Executive Administrator.

Groundwater Management Area (GMA) – Geographical region of Texas designated and delineated by the TWDB as an area suitable for management of groundwater resources.

Infrastructure – Physical means for meeting water and wastewater needs, such as dams, wells, conveyance systems, and water treatment plants.

Instream Flow – Water flow and water quality regime adequate to maintain an ecologically sound environment in streams and rivers.

Local Groundwater Supplies – Supplies found in local groundwater areas usually not associated with a major, minor, or other aquifer (e.g., a small local alluvial aquifer) that may still be used as a nonmunicipal water supply source (e.g., for livestock use), but that the GMA determined to be small enough to not go through the DFC process.

Local Surface Water Supplies – Limited, unnamed individual surface water supplies that, separately, are available only to particular non-municipal WUGs, such as livestock.

Major Aquifer – An aquifer that produces large amounts of water over a large area.

Minor Aquifer – An aquifer that produces minor amounts of water over a large area or large amounts of water over small area.

Modeled Available Groundwater (MAG) – The amount of water that the executive administrator determines may be produced on an average annual basis to achieve a desired future condition.

Non-relevant Aquifer – An Aquifer/Region/County/Basin geographic unit or a sub-portion of such a geographic aquifer unit where the GMA did not assign a DFC. This results in this geographic unit (or subportion) not having an associated availability MAG volume. In addition, this means that the associated Aquifer/Region/County/Basin geographic unit may or may not have a non-MAG groundwater availability volume (as determined by the RWPG) associated with it.

Other Aquifer – An aquifer that has not been designated as major or minor.

Rainwater Harvesting – An ancient practice involving the capture, diversion, and storage of rainwater for landscape irrigation, drinking and domestic use, aquifer recharge, and in modern times, stormwater abatement.

Relevant Aquifer – Aquifers or parts of aquifers for which groundwater conservation districts have defined desired future conditions.

Seawater – Water typically containing total dissolved solids of 35,000 milligrams per liter or greater. The volume of total dissolved solids may be lower than 35,000 milligrams per liter.

Sedimentation – Action or process of depositing sediment in a reservoir, usually silts, sands, or gravel.

Storage – Natural or artificial impoundment and accumulation of water in surface or underground reservoirs, usually for later withdrawal or release.

System Gain – The amount of permitted water a system creates that would otherwise be unavailable if the reservoirs were operated independently and this volume must be reported separately. For multireservoir systems, the minimum system gain during drought of record conditions may be considered additional water available, if permitted.

Water Availability Model (WAM) – Numerical computer program used to determine the availability of surface water within each river basin for permitting in the state.

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