East Texas
Regional Water Planning Area

2011 Update of the Regional Water Plan
Final Plan

September 1, 2010

EAST TEXAS
Regional Water Planning Group

ALAN PLUMMER ASSOCIATES, INC.

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List of Abbreviations/Acronyms

2006 Plan	2006 East Texas Regional Water Plan
2011 Plan	2011 East Texas Regional Water Plan
°F	degrees Fahrenheit
ac-ft per year	acre-feet per year
A-N WCID No. 1	Angelina-Nacogdoches Water Control & Improvement District No. 1
ANRA	Angelina and Neches River Authority
BBASC	Bay Basin and Bay Area Stakeholder Committee
BBEST	Bay and Basin Expert Science Team
bgl	below ground level
cfs	cubic feet per second
DB12	2010 Regional Water Planning Data Web Interface
DFCs	desired future conditions
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
HCWCID No. 1	Houston County Water Control & Improvement District No. 1
IFR	infrastructure financing report

List of Abbreviations/Acronyms (Cont.)

LNVA	Lower Neches Valley Authority
LNG	liquid natural gas
MAG	managed available groundwater
MCLs	maximum contaminant levels
mg/L	milligrams per liter
MGD	million gallons per day
msl	mean sea level
MW	megawatts
MWA	municipal water authority
MWD	municipal water district
No.	number
NRCS	National Resources Conservation Service
PCFWSD No. 1	Panola County Freshwater Supply District No. 1
pCi/L	picocuries per liter
ppt	parts per thousand
RWPs	Regional Water Plans
SB 1	Senate Bill 1
SB 2	Senate Bill 2
SB 3	Senate Bill 3
SDWA	Safe Drinking Water Act
SFA	Stephen F. Austin State University
SRA	Sabine River Authority
STATSGO	State Soil Geographic Database
SUD	special utility district

List of Abbreviations/Acronyms (Cont.)

SWPs	State Water Plans
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
TMDL	total maximum daily load
TPWD	Texas Parks and Wildlife Department
TSDC	Texas State Data Center
TWC	Texas Workforce Commission
TWDB	Texas Water Development Board
TXBCD	Texas Biological and Conservation Data System
µg/L	micrograms per liter
UWCD	underground water conservation district
UNRMWA	Upper Neches River Municipal Water Authority
USACE	United States Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAM	Water Availability Model
WMA	wildlife management area
WMSs	water management strategies
WSC	water supply corporation
WUGs	water user groups
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. In 2001, revised rules and guidelines from the TWDB were enacted through Senate Bill 2. 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 2011 update to the ETRWPA water plan (the 2011 Plan). The ETRWPG is currently comprised of the following voting members representing specific community interests:

- David Alders - Agriculture
- Jeff Branick - Counties
- David Brock - Municipalities
- George Campbell - Other
- Jerry Clark - River Authorities
- Josh David - Other
- Chris Davis – Counties
- Mark Dunn – Small Businesses
- Michael Harbordt - Industries
- William Heugel – Public
- Dr. Joe Holcomb – Small Businesses
- Kelley Holcomb - Water Utilities
- Bill Kimbrough - Other
- Glenda Kindle - Public
- Duke Lyons - Municipalities
- Dale Peddy - Electric Power

- Hermon Reed - Agriculture
- Monty Shank - River Authorities
- Darla Smith - Industries
- Scott Hall - River Authorities
- Worth Whitehead - Water Districts
- Leon Young - Environment

At its core, the regional water planning process involves the evaluation of water demands, identification of water supplies, and development of water management strategies designed to meet potential 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 the various water user groups 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 report document of the 2011 Plan. An electronic copy of the Final 2011 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 of the following 20 counties located in the Neches, Sabine, and Trinity River Basins, and the Neches-Trinity Coastal Basin:

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

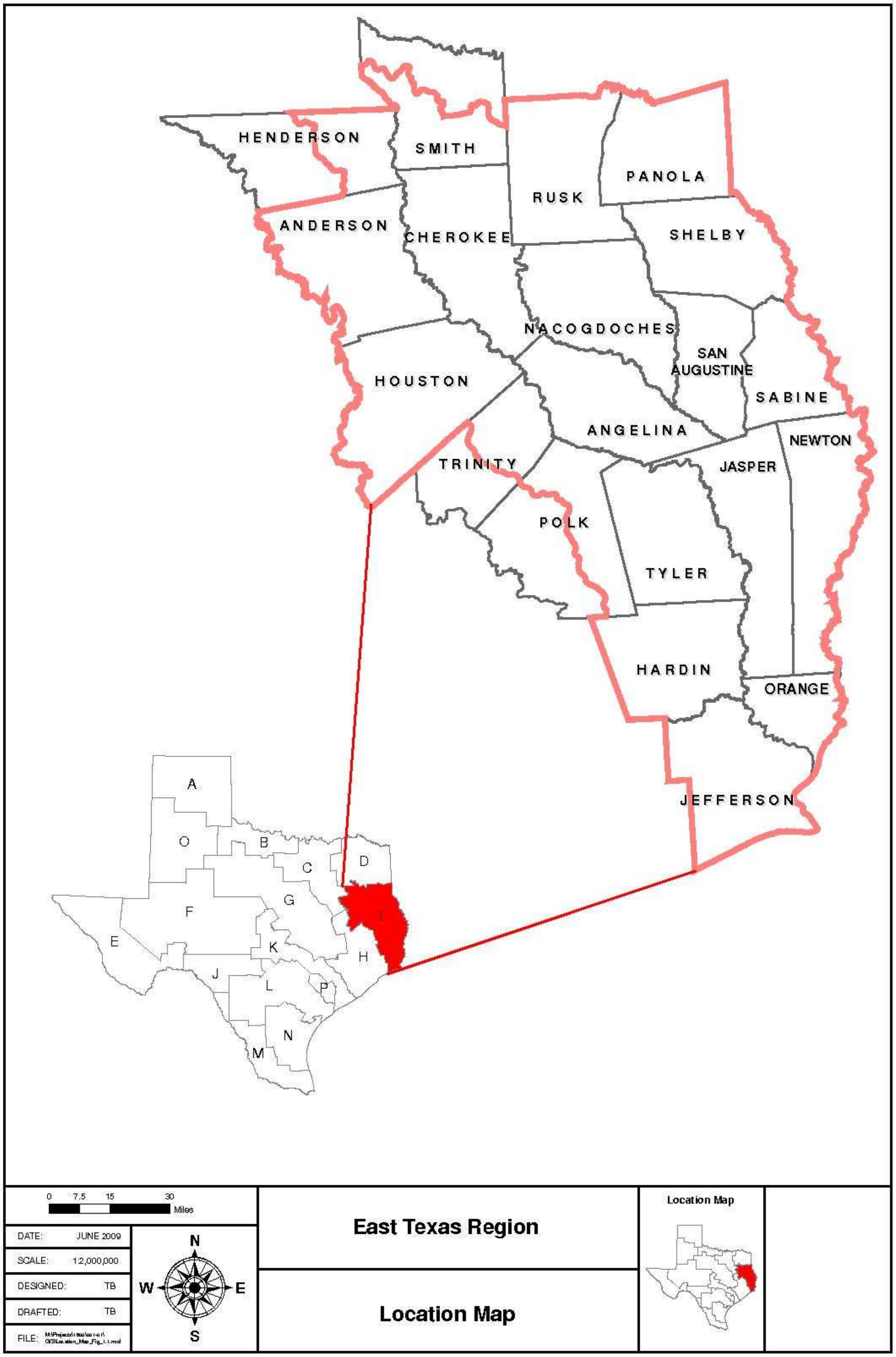
The region extends from the southeastern corner of the state for over 150 miles north and northwest as illustrated on Figure ES.1. The ETRWPA consists of approximately 10,329,800 acres of land, accounting for roughly six percent of the total area of the State of Texas.

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 throughout the region, and beef cattle are prominent. Poultry production and processing are prevalent in Shelby and Nacogdoches Counties and very significant in Angelina and Panola Counties. 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 9,000 farms with a total of over a million acres of crop land.

ES.2 Regional Population and Water Demands

Projecting the demand for water over the planning period is a crucial element of planning. Water demands were developed for six categories of use, including municipal, manufacturing, irrigation, steam-electric, mining, and livestock. Before municipal demands can be estimated, however, population projections must be developed. A summary of the population and water demand projections, as well as demand projections for wholesale water providers follows.


HENDERSON
SMITH
RUSK
PANOLA
ANDERSON
CHEROKEE
SHELBY
NACOGDOCHES
SAN AUGUSTINE
SABINE
HOUSTON
ANGELINA
NEWTON
TRINITY
JASPER
POLK
TYLER
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East Texas Region
Location Map
Location Map

ES.2.1 Population Projections. In the 2006 Plan, the population of the ETRWPA was projected to increase from approximately 1.09 million people in 2010 to almost 1.5 million in 2060. For the 2011 Plan, the TWDB directed all regions to retain the population projections from the 2006 Plan for the 2011 update. The ETRWPG decided to keep the population projections for each county in the region at the level identified in the 2006 Plan, as well. Population shifts within counties were confined to Angelina and Nacogdoches Counties, where five new water user groups (WUGs) were identified.

It should be noted that for Smith County, and particularly for the City of Tyler, population estimates for the 2011 Plan are significantly below the Texas State Data Center estimates for population. This understatement of population for the City of Tyler could present a significant problem for water planning in the ETRWPA in the future if not corrected. Other water suppliers including the City of Nacogdoches and Woodville expressed concerns regarding a possible underestimate of population. .The ETRWPG's expectation is that the population of the region's constituent cities and counties will be appropriately adjusted in the next round of planning, based on the 2010 census, and that population projections will be more accurately reflected for Smith County and the City of Nacogdoches and Woodville.

ES.2.2 Water Demand Projections. Total water demand for the ETRWPG has been projected for the 2010 to 2060 planning period for six categories of water use, and is summarized as follows:

Water User Category	2010	2020	2030	2040	2050	2060
Municipal	189,559	196,828	202,761	208,193	218,705	233,622
Manufacturing	299,992	591,904	784,140	821,841	857,902	893,476
Irrigation	151,100	151,417	151,771	152,153	152,575	153,040
Steam-Electric	44,985	80,989	94,515	111,006	131,108	155,611
Livestock	23,613	25,114	26,899	29,020	31,546	34,533
Mining	21,662	37,297	17,331	18,385	19,432	20,314
Total for Region	**730,911**	**1,083,549**	**1,277,417**	**1,340,598**	**1,411,268**	**1,490,596**

The following changes to demand are included in the 2011 Plan:

- Increased steam-electric water demand in Angelina County.
- Municipal water demands for newly identified WUGs in Angelina and Nacogdoches Counties (no net change on a county-wide basis).
- Reduced manufacturing water demand for Angelina County.
- Increased manufacturing water demand for Jefferson County.
- Reduced irrigation water demands for Hardin and Jefferson Counties.
- Increased mining water demands in Angelina, Cherokee, and Nacogdoches Counties.
- New mining water demands for Shelby and San Augustine Counties.

ES.2.3 Wholesale Water Provider Demand Projections. Wholesale water providers are those that have contracts to sell more than 1,000 acre-feet per year (ac-ft per year) of water wholesale. Water may be provided wholesale either to municipal or manufacturing customers. As required, the ETRWPG must include such entities individually in the water plan. Wholesale water providers identified in the ETRWPA include the following:

- 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

ES.3 Water Supplies in the East Texas Regional Water Planning Area

The ETRWPG identified currently available water supplies to the region by source and 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 sources of water supply, although there are other potentially significant types of sources as well. A summary of the available supplies within the ETRWPA follows:

Source of Supply	2000	2010	2020	2030	2040	2050	2060
Reservoirs (permitted)	1,966,474	1,962,698	1,958,512	1,954,328	1,950,141	1,945,955	1,941,769
Reservoirs (unpermitted)	340,300	330,874	321,857	312,841	303,825	294,808	285,790

Run-of-the-River (freshwater)	623,004	623,004	623,004	623,004	623,004	623,004	623,004
Run-of-the-River (brackish)	1,035,982	1,035,982	1,035,982	1,035,982	1,035,982	1,035,982	1,035,982
Groundwater	446,043	446,043	446,043	446,043	446,043	446,043	446,043
Local Supplies	13,094	13,094	13,094	13,094	13,094	13,094	13,094
Direct Reuse	1,518	1,518	1,518	1,518	1,518	1,518	1,518
Indirect Reuse	16,559	16,559	13,687	13,687	13,687	13,687	13,687
Total	**4,442,974**	**4,429,772**	**4,413,697**	**4,400,497**	**4,387,294**	**4,374,091**	**4,360,887**

Surface water supplies were determined using the TCEQ-approved Water Availability Models. In the ETRWPA, four river basins were evaluated: Neches, Neches-Trinity, Trinity, and Sabine.

In Texas, joint groundwater planning is conducted by Groundwater Conservation Districts. The counties in the ETRWPA fall into Groundwater Management Areas-11 or -14. The Texas Water Code now requires that the ETRWPG rely on estimates made by the Groundwater Management Areas that are determined from desired future conditions in the aquifer. However, desired future conditions were not established by the Groundwater Management Areas in the ETRWPA within the time frame required to be included in this regional water plan. Therefore, groundwater supplies have not been modified from the 2006 Plan.

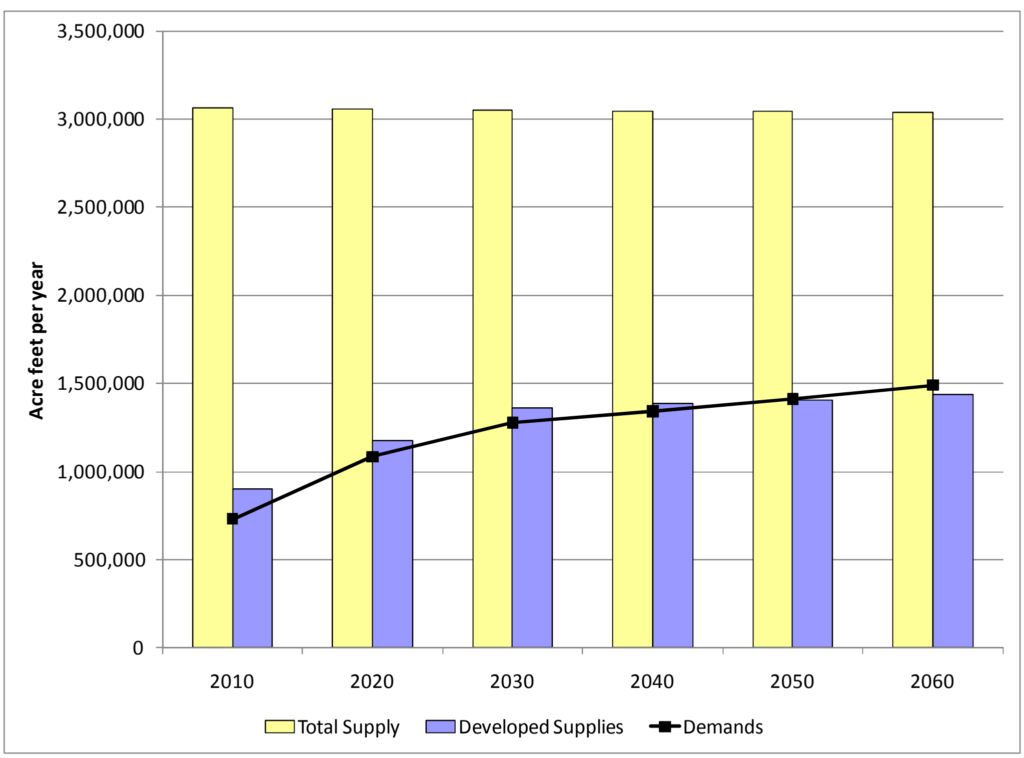
Other water supplies considered for planning purposes include reuse of treated wastewater, saline sources, and local supplies. Local supplies generally include stock ponds that do not require water rights permits, and local mining supplies. These supplies are assessed based on historical and current use.

ES.4 Water Management Strategies to Meet the Region's Needs

The development of water management strategies (WMSs) to meet projected water demands is a central element of water planning. The process of strategy development includes a comparison of demand to supplies, identification of shortages, and identification and evaluation of water management strategies to meet the shortages.

Figure ES.2 summarizes the comparison of total currently available water supply and total projected water demand for the ETRWPA. The region as a whole has a currently available surplus of 169,352 ac-ft per year in 2010, changing to a shortage of nearly 3,000 ac-ft per year by 2050, and increasing to a shortage of 55,867 by 2060. However, because not all water is available in all places, location-specific shortages can, and do, occur throughout the region. The actual total shortages of individual WUGs in the ETRWPA total 182,145 ac-ft per year by 2060.

Figure ES.2 Comparison of Regional Water Supplies to Demands



On a regional basis, sufficient supplies exist for municipal and irrigation water uses. Regional shortages are identified for manufacturing, steam-electric power, mining and livestock. The largest percentage of shortages is attributed to anticipated steam-electric power plant development in the region. The steam-electric power shortages are for projected growth that currently does not have an identified source or infrastructure. Most of the manufacturing shortages are the result of considerable growth in demands and supplies that are limited to existing contract amounts. Mining shortages are largely associated with new mining demands associated with natural gas development and mining demands in Hardin County that are no longer substantiated based on current use. Livestock water use is also expected to grow in some counties, which will require the development of additional resources and/or infrastructure. Even though the municipal water use shows a net surplus in every decade of the planning period, there are individual cities that are projected to have shortages during the planning period.

Twelve counties are identified with shortages over the planning horizon, with Anderson, Angelina, Nacogdoches, Newton, and Orange Counties having the largest projected shortages by 2060. Anderson and Angelina Counties are expected to have the largest percent shortages (52 and 57 percent) in 2060, and Tyler County is expected to have the largest percentage surplus (48 percent) in 2060. Projected surpluses and shortages by county for each decade of the planning period are summarized below.

County	Projected Shortages (ac-ft per year)					
	2010	2020	2030	2040	2050	2060
Anderson	4,230	-7,508	-9,688	-12,284	-15,428	-19,218
Angelina	-6,089	-18,070	-18,362	-23,058	-28,317	-34,632
Cherokee	4,788	3,373	4,595	4,393	4,065	3,532
Hardin	-5,080	-6,417	-7,120	-7,830	-8,645	-9,434
Henderson (P)	2,818	876	387	-89	-700	-1,455
Houston	2,012	1,536	973	370	-339	-1,154
Jasper	2,932	2,728	2,670	2,762	2,808	2,808
Jefferson	71,958	58,255	55,789	52,733	49,251	44,206
Nacogdoches	9,720	5,385	9,013	5,305	-6,827	-12,638

Newton	10,895	2,551	96	-2,930	-6,615	-11,096
Orange	19,110	13,537	6,890	141	-6,391	-13,947
Panola	4,321	4,028	3,849	3,686	3,512	3,252
Polk (P)	290	-75	-374	-602	-773	-959
Rusk	26,188	23,243	18,482	12,802	5,672	-3,305
Sabine	1,369	1,226	1,103	971	814	637
San Augustine	-1,419	-7,004	-104	-224	-380	-549
Shelby	1,059	-1,182	-1,072	-2,621	-4,504	-6,827
Smith (P)	17,874	15,669	13,707	11,744	8,163	3,167
Trinity (P)	128	94	90	73	50	25
Tyler	2,249	1,922	1,729	1,696	1,725	1,720
TOTAL	**169,352**	**94,167**	**82,653**	**47,038**	**-2,859**	**-55,867**

Note: The sum of needs by county shown in the table above is based on total supplies to the county less the total county demands. The sum of the individual needs of water user groups within a county will differ. These needs are shown in Chapter 4A, Table 4A.5

For the ETRWPA, 68 WUGs were identified with shortages that cannot be met by existing infrastructure and/or water supplies. A total of five wholesale water providers were identified as having shortages that cannot be met by existing infrastructure and/or supplies.

The ETRWPG evaluated long-term WMSs available to meet the demands in the ETRWPA. The strategies considered include the following:

- Water conservation and drought management
- Wastewater reuse
- Expanded use of existing supplies
- New supply development
- Interbasin transfers

Water management strategies and alternate water management strategies were evaluated using screening criteria established by the ETRWPG in order to assess the feasibility of the strategies. These criteria were adopted as guidelines, and strategies could be retained or dismissed at the discretion of the ETRWPG. The screening criteria included the following:

- The strategy must have an identified sponsor or authority.
- The strategy must consider the end use. This includes water quality, distance to end use, etc.
- The strategy should provide a reasonable percentage of the projected need (except conservation, which will be evaluated for all needs).
- The strategy must meet existing federal and state regulations.
- The strategy must be based on proven technology.
- The strategy must be able to be implemented.
- The strategy must be appropriate for regional water planning.

ES.5 Analysis of Impacts of Water Management Strategies

For the 2011 Plan, the ETRWPG reviewed selected water quality parameters, and addressed how water management strategies could affect water quality. In addition, potential impacts of moving water used for rural or agricultural purposes to urban uses were evaluated.

Water quality parameters selected by the ETRWPG as parameters that could be impacted by water management strategies included Total Dissolved Solids, Dissolved Oxygen, Nutrients, Metals, and Turbidity. The followig table summarizes how the various types of water management strategies could impact these key water quality parameters.

Water Quality Parameter	Water Management Strategy Types							
	Expanded Use of Surface Water	Inter-basin Transfers	New Reservoirs	Expanded Use of Ground-water	Indirect Reuse	Expanded Use of Local Supplies*	Voluntary Re-distribution **	Water Conser-vation***
TDS	•	•	•	•	•		•	
Dissolved Oxygen	•	•	•		•			
Nitrogen	•	•	•		•		•	
Phosphorus	•	•	•		•		•	
Metals	•	•	•	•	•		•	
Turbidity		•					•	

*Expanded use of local supplies would not typically be expected to have a significant impact on water quality.
**Voluntary Redistribution could have an impact on the water quality of the receiving water body
***Water conservation would not typically be expected to have a significant impact on water quality

As the population of the ETRWPA increases, municipal and industrial water demands will rise accordingly, even with the implementation of conservation measures. The largest proportion of additional municipal water supply that will be utilized in the ETRWPA over the planning period will be from expanded use of existing surface water supplies and, to some extent, development of new surface water supplies such as Lake Columbia. Surface water demand will increase for municipal and industrial water users. However, as currently planned, the expanded use of surface water is not expected to involve significant transfers of agricultural supplies to municipal or industrial supplies. The proposed increases in municipal water surface water supplies will rely on existing water rights or new water rights from currently unpermitted supplies.

ES.6 Water Conservation and Drought Management

Water conservation plans are long-term, permanent strategies to reduce water use. Drought contingency plans are similar to conservation plans in that they aim to reduce water use, but are only intended for temporary periods during drought conditions.

Some 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 the State Water-Efficiency

Plumbing Act. Within the ETRWPA, this amounts to about an 8 percent reduction in municipal water use (20,600 ac-ft per year) by the end of the planning period.

Conservation savings were also included in the steam-electric power demands. Demands for steam-electric power were developed with the assumption that long-term power needs will be met with more water-efficient facilities. The estimated water savings associated with the higher efficiency power plants is nearly 27 percent of the total demands or 57,100 ac-ft per year in the ETRWPA. Reductions in demands due to conservation were not quantified by the TWDB for manufacturing, mining, irrigation and livestock uses.

The TCEQ requires water conservation plans for all municipal and industrial water users with surface water rights of 1,000 ac-ft per year or more and irrigation water users with surface water rights of 10,000 ac-ft per year or more. Water conservation plans are also required for all water users applying for a State water right, and may also be required for entities seeking State funding for water supply projects. In the ETRWPA, 28 entities hold municipal or industrial rights in excess of 1,000 ac-ft per year and three entities have irrigation water rights greater than 10,000 ac-ft per year.

Conservation activities for municipal water users in the ETRWPA are focused primarily on education and public awareness programs, reduction of unaccounted for water through maintenance of water systems, and water rate structures that discourage water waste.

The ETRWPA is a water-rich region and water conservation in the region is driven by economics and not by lack of water supply. The 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. Currently, over one fourth of the municipal water users in the ETRWPA have per capita water use less than 100 gallons per person per day and 57 percent are less than the Water Conservation Implementation Task Force recommended state average of 140 gallons per person per day. While municipal use represents about 20 percent of the total regional water demands, the potential savings from advanced municipal conservation are relatively small. This opinion may change as economics and water supply conditions change in East Texas.

Drought management is a temporary strategy to conserve available water supplies during times of drought or emergencies. This strategy is not recommended to meet long-term growth in demands, but rather acts as a means to minimize the adverse impacts of water supply shortages during drought. The TCEQ requires drought contingency plans for wholesale water suppliers and irrigation districts, as well as retail public water suppliers serving 3,300 or more connections.

The majority of the drought contingency plans in the ETRWPA use trigger conditions based on a combination of water supply and demands placed on the water distribution system. All plans include measures that range from voluntary water restrictions in Stage I to mandatory restrictions in the final stage. Some drought contingency plans include an emergency stage not directly related to drought, but rather related to system rupture or failure.

ES.7 The 2011 Plan and Long-Term Protection of Water and Agricultural Resources

An 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. One requirement for the 2011 plan is to describe how the plan is consistent with the long-term protection of the State's water resources, agricultural resources, and natural resources.

ES.7.1. Protection of Water Resources. To be consistent with the long-term protection of water resources, the 2011 Plan must recommend strategies that minimize threats to the region's sources of water over the planning period. The water management strategies identified in Chapter 4 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. Some of the major strategies for the 2011 Plan are as follows:

- Water conservation
- Indirect reuse
- Development of Lake Columbia
- Use of water from Toledo Bend by Regions C and D
- Optimized use of existing surface water resources
- Optimized use of groundwater

ES.7.2 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. Water availability modeling for the region's river basins indicates adequate availability of surface water to meet the projected irrigation demands for the planning period.

ES.7.3 Protection of Natural Resources. The ETRWPA contains abundant natural resources, which must be considered in water planning. Natural resources include threatened or endangered species; local, state, and federal parks and public land; and energy/mineral reserves.

The ETRWPA includes twenty species of birds, six mammals, 21 reptiles/amphibians, nine fish, and thirteen mollusks that are considered species of special concern, including some species classified as threatened or endangered. In general, water management strategies planned for the ETRWPA would not affect threatened or endangered species.

The ETRWPA contains national forests, wildlife refuges, and a preserve; as well as state parks, forests, and wildlife management areas. None of the water management strategies currently proposed for the ETRWPA is expected to adversely impact state or local parks or public land.

Much of the ETRWPA is heavily forested and timber is an important economic resource for the region. In general, water management strategies for the region would not be expected to significantly affect this use.

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. These resources represent an important economic base for the region. None of the water management strategies is expected to significantly impact oil, gas, or coal production in the region.

ES.7.4 Consistency of the 2011 Plan with Water Planning Requirements. To be considered consistent with long-term protection of the State's water, agricultural, and natural resources, the ETRWPA Water Plan must also be determined to be in compliance with the regulations and guidelines pertaining to water planning. The regulations for water planning are found in 31 Texas Administrative Code Chapters 357 and 358. The information, data, evaluation, and recommendations included in the 2011 Plan were evaluated and determined to demonstrate compliance with these regulations.

ES.8 Regional Water Planning and Legislative Recommendations

The 2011 Plan includes recommendations to the Texas Legislature regarding future regional water planning activities. The ETRWPG was charged with considering recommendations for ecologically unique stream segments, unique reservoir sites, and general water planning needs.

ES.8.1 Unique Stream Segments. The ETRWPG considered available information regarding potential unique stream segments in the region and voted to not 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.

ES.8.2 Unique Reservoir Sites. The ETRWPA has a long history of water supply planning and reservoir development. There are numerous sites that have been identified as being hydrologically and topographically unique for reservoir development. Two sites in the ETRWPA are currently designated as unique: Lake Columbia and Fastrill Reservoir. Lake Columbia received its unique designation by the State Legislature through SB 1362. Fastrill Reservoir was designated by the 79th Legislature through SB 3. Other sites have not previously been recommended for designation as unique.

The ETRWPG recognizes that reservoirs can have major impacts on the environment and that protection of the environment is already afforded through a process which is more thorough than the regional water planning effort. The ETRWPG is not recommending in this planning cycle that any additional proposed sites 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.

ES.8.3 Legislative Recommendations. The ETRWPG reviewed previous legislative recommendations made pursuant to regional water planning requirements and evaluated new potential recommendations. Proposed recommendations were brought to the ETRWPG for consideration. Legislative recommendations adopted by the ETRWPG for the 2011 Plan include the following:

- **Junior Water Rights.** The ETRWPG supports legislation allowing exemptions to junior water rights by contracts that reserve sufficient surface water to meet 125% of the total projected demand of the basin of origin for the next 50 years.

- **Flexibility in Determining Water Plan Consistency.** The ETRWPG recommends that the following steps be taken to address concerns that small cities and unincorporated areas may not have specific water needs and water management strategies identified in the regional water plan due to the nature of aggregating these entities. Hence, these entities may not be eligible for state funding assistance.

- 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.

- Willing buyer/willing seller transactions of water rights and treated water should not be controlled by existing 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.

- **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.

- **Groundwater Conservation Districts.** The ETRWPG recognizes the critical importance of groundwater conservation and proper management of this resource in the ETRWPA. Therefore, as an important component of regional planning, the ETWRPG encourages those portions of the ETRWPA not presently participating in a groundwater conservation district to carefully review groundwater management practices in their area and to consider whether creating or joining a groundwater conservation district would be appropriate.

- **Unique Reservoir Designation Limitations.** The ETRWPG recommends that the designation of unique reservoir for the sites currently designated be extended to 2060, which would be through the current planning period. The ETRWPG also recommends that the United State Army Corps of Engineers Mitigation Bank Review Teams have TWDB and appropriate regional water planning agencies be added to the teams.

- **Wastewater Reuse.** The ETRWPG recommends that current regulations as they pertain to wastewater reuse should be reviewed and amended, as necessary, to encourage the reuse of wastewater effluent.

- **Funding Expansion.** 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 Infrastructure Fund program. In addition, the ETRWPG recommends that requirements for funding by the TWDB for the Economically Distressed Areas Program (EDAP) be revised to reduce unnecessary and difficult requirements for eligibility, including requirements for model subdivision planning.

- **Environmental Flows.** The ETRWPG acknowledges the importance of these studies for the future of its water resources and supports the efforts of the various advisory teams and stakeholders in this endeavor. The ETRWPG also recognizes the need for water for growth and economic development. The ETRWPG also recognizes that future flow conditions in Texas' rivers and streams must be sufficient to support a sound ecological environment that is appropriate for the area. However, the ETRWPG believes it is imperative that existing water rights be protected. In addition, SB 2 and SB 3 processes that relate to environmental flows should be closely coordinated with the SB 1 planning effort, involving regional water planning.

- **Uncommitted Water.** 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 shorter term "interruptible" water contracts as a way to meet short term needs before long-term water rights are fully utilized.

ES.9 Infrastructure Financing Recommendations

The purpose of the infrastructure financing report is to identify funding needed to implement the WMSs recommended in the 2011 Plan. A survey of WUGs with identified infrastructure needs was conducted by the ETRWPG and the TWDB. The survey was conducted after the Initially Prepared Plan was approved by the ETRWPG.

Surveys were sent to 17 municipal WUGs and seven wholesale water providers with projected water shortages. Surveys were completed and returned for eight of the municipal WUGs and six of the wholesale water providers. There were 31 WUGs with needs identified in the 2011 Plan not surveyed. These WUGs were in the manufacturing, power generation, irrigation, livestock, and mining categories. In the IFR study, $1,348,737,330 of water supply and infrastructure needs were identified. Of that, $1,236,774,491 was the estimated cost of new surface water supply projects and major transmission systems. The remaining $111,962,839 was in development of new wells, local infrastructure, and public/private partnership projects. .

ES.10 Public Participation and Adoption of Plan

Regional water planning in Texas is a public process, requiring strategy for ensuring that the region's citizens are able to participate in the process. Development and adoption of the final 2011 Plan included regular meetings of the ETRWPG, consultation with representatives of the major water user groups, publication of a region newsletter, distribution of regular press releases, and maintenance of a website for the ETRWPA. In addition, the ETRWPG held a Public Hearing to introduce the 2011 IPP and accept public comment. In all, comments were received from eight persons on behalf of various agencies or groups. These included one oral comment provided at the Public Hearing for the 2011 IPP, one hand-written response provided at the Public Hearing, and six letters received during the comment period. In four cases, the comments received related to a single issue of the commenter. The other comments received addressed multiple issues. Copies of comments and the ETRWPG responses to comments are included in Chapter 10.

The final *2011 East Texas Regional Water Plan* was submitted to the TWDB by September 1, 2010.

Chapter 1

Description of the Region

This document provides an update to the regional water plan for a portion of the State of Texas known as the East Texas Regional Water Planning Area (ETRWPA), or Region I. The region was established in 1997 as part of Senate Bill 1 (SB1), passed that year by the Texas Legislature. Pursuant to the formation of the ETRWPA a regional water planning group (known as East Texas Regional Water Planning Group or ETRWPG) was formed and charged with the responsibility to develop a plan for the management of water in the region to ensure its availability to the region's citizens for a 50-year planning horizon. Planning is performed in accordance with regional and state water planning requirements of the Texas Water Development Board (TWDB). The initial regional plan was adopted in 2001. Since that time, it has been updated one time in 2006 and amended once in 2008. This is the second update of the plan.

This second plan update (2011 Plan) will address a wide range of water planning issues, including a description of the region, population and water demand, water supply availability, water management strategies, water quality, conservation, regional resources, and infrastructure financing requirements. These elements may be found below and in subsequent chapters of the plan.

This chapter provides descriptive details for the ETRWPA. These details include a physical description of the region, climatological details, population projections, economic activities, sources of water and water demand, and regional resources. In addition, the chapter includes 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.

1.1 General Introduction to the East Texas Regional Water Planning Area and the Regional Water Planning Group

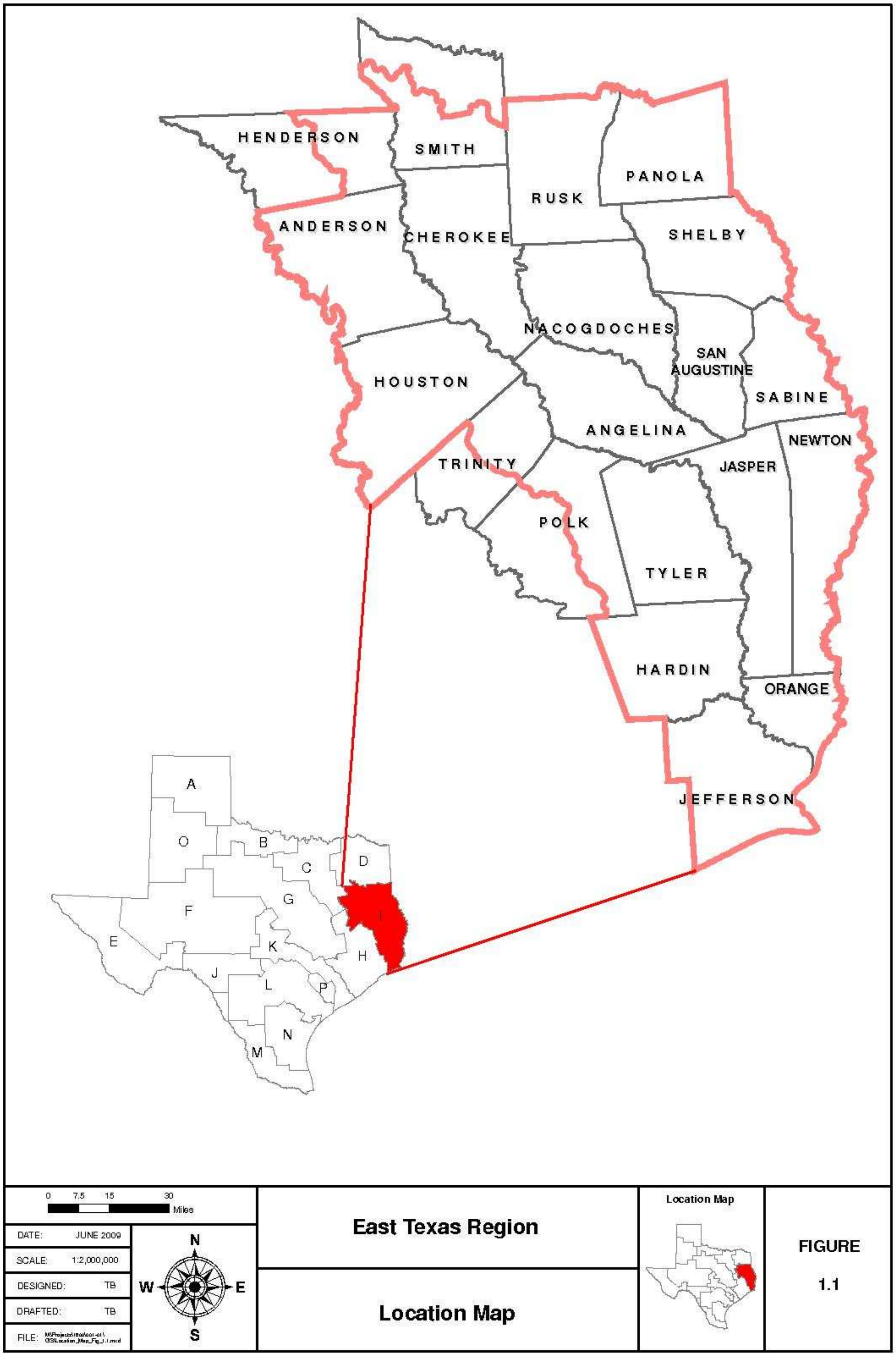
The ETRWPA consists of all or portions of 20 counties located in the Neches, Sabine, and Trinity River Basins, and the Neches-Trinity Coastal Basin. The region extends from the southeastern corner of the state for over 150 miles north and northwest as illustrated on Figure 1.1. The ETRWPA consists of approximately 10,329,800 acres of land. The ETRWPA accounts for roughly 6 percent of the total area of the State of Texas.

The ETRWPG consists of 22 representatives. These members represent the interests of the public, counties, municipalities, industries, agriculture, the environment, small businesses, electric generating utilities, river authorities, water districts, and water utilities. The City of Nacogdoches is the administrative contracting agency for the ETRWPG. The ETRWPG has retained the services of a team of engineering firms and other specialists to prepare the 2011 Plan. Table 1.1 provides a list of the ETRWPG representatives and the engineering consulting team involved in developing the 2011 Plan.

1.2 Physical Description

The ETRWPA is characterized by significant portions of several watersheds and natural geographic regions. Each watershed and area is described following.

1.2.1 River Basins. The ETRWPA includes 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 covered by 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. Figure 1.2 illustrates the boundaries of the watersheds within the



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ANDERSON
CHEROKEE
SHELBY
NACOGDOCHES
SAN AUGUSTINE
HOUSTON
SABINE
ANGELINA
NEWTON
TRINITY
JASPER
POLK
TYLER
HARDIN
ORANGE
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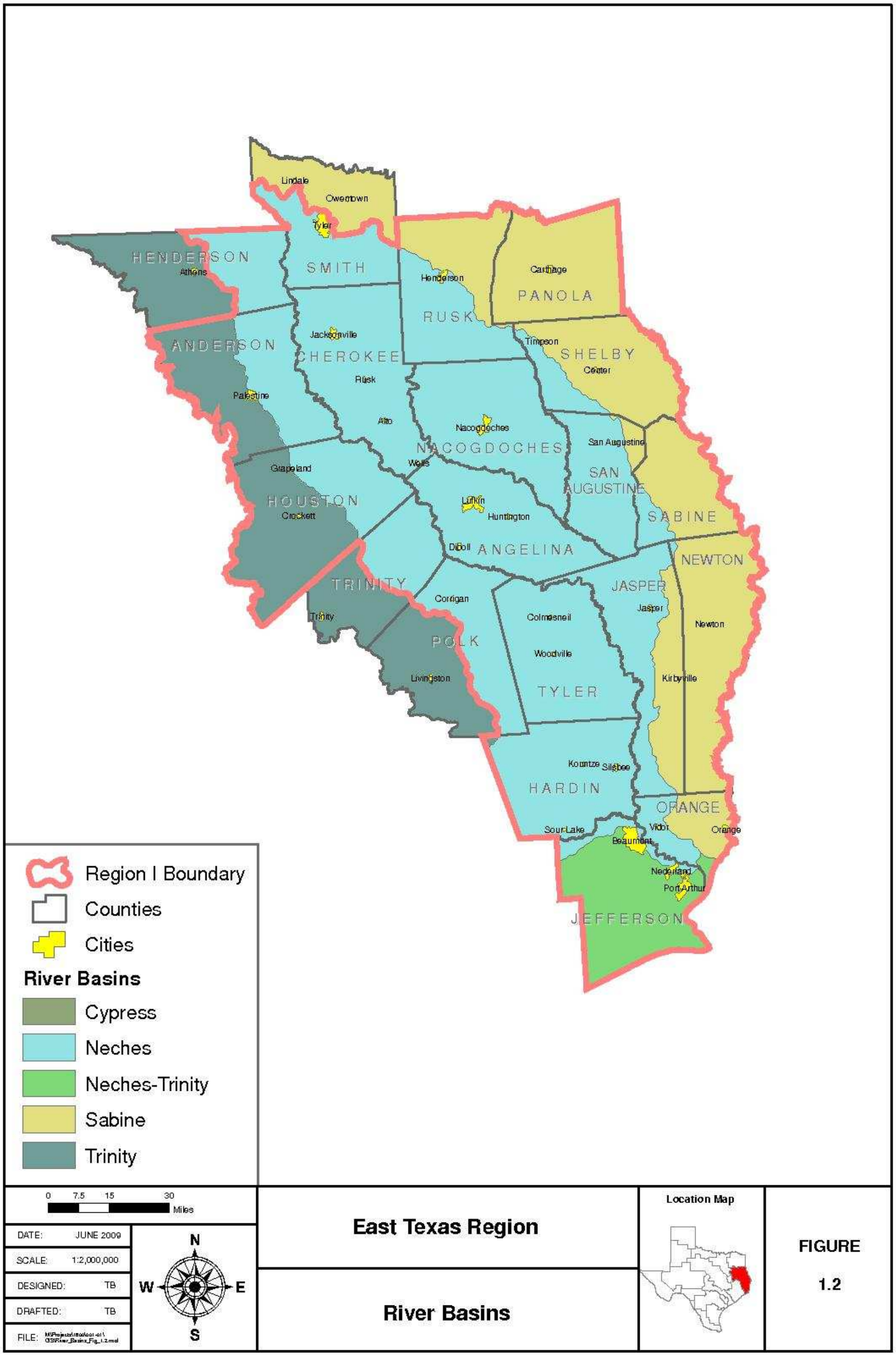
East Texas Region
Location Map
Location Map
FIGURE
1.1

Table 1.1 East Texas Regional Water Planning Group Members and Engineering Team

Executive Committee			
Chair	Kelley Holcomb		
Vice-Chair	Worth Whitehead	2nd Vice Chair	Michael Harbordt
Secretary	Jerry Clark	Assistant Secretary	David Brock
At-Large	Ernest Mosby	At-Large	David Alders
Voting Membership			
Public	Glenda Kindle – *Retired*	William Heugel - *Retired*	
Counties	Jeff Branick – *Jefferson County*	Chris Davis – *Cherokee County*	
Municipalities	David Brock – *City of Jacksonville*	Duke Lyons – *City of San Augustine*	
Industries	Michael Harbordt – *Temple Inland Forest Products*	Darla Smith – *BASF Corporation*	
Agricultural	David Alders – *Carrizo Creek Corporation*	Hermon E. Reed, Jr. – *Cattlemen*	
Environmental	Dr. J. Leon Young – *Stephen F. Austin University*		
Small Business	Mark Dunn – *Dunn's Construction, LLC*	Dr. Joseph Holcomb - *Dentist*	
Electric Generating Utilities	Dale Peddy – *Entergy*		
River Authorities	Jerry Clark – *Sabine River Authority* Scott Hall – *Lower Neches Valley Authority*	Monty Shank –*Upper Neches River MWA*	
Water Districts	Worth Whitehead – *Rusk SWCD*		
Water Utilities	Kelley Holcomb – *Angelina-Neches River Authority*		
Other	Bill Kimbrough – *Retired* Josh David – *Livestock*	George P. Campbell – *Nacogdoches County*	
Non-Voting Membership			
James Alford	Trinity County	Steve Tyler	Region H Water Planning Group
Walter Glen		Bobby Praytor	City of Dallas Water Utilities
Temple McKinnon	Texas Water Development Board	Terry Stelly	Texas Department of Parks & Wildlife
Connie Standridge	Region C Water Planning Group	Adam Bradley	Region D Water Planning Group
Cynthia Duet	Louisiana Governor's Office of Coastal Activities	Linda F. Parker	Texas Department of Agriculture
Judge Sandra Hodges	Rusk County	Judge Floyd "Dock" Watson	Shelby County
James Porter	IMCAL		
Contracting Agency			
City of Nacogdoches			
Engineering Team			
Alan Plummer Associates, Inc.	Lead Engineer	G.E. Walker & Associates, LLC	Subconsultant Engineer
Freese & Nichols, Inc.	Subconsultant Engineer	LBG - Guyton & Associates	Subconsultant Groundwater Specialist


HENDERSON
Athens
SMITH
Lindale
Overtown
Tyler
RUSK
Henderson
PANOLA
Carthage
ANDERSON
Palestine
CHEROKEE
Jacksonville
Rusk
Alto
SHELBY
Timpson
Center
NACOGDOCHES
Nacogdoches
Wells
SAN AUGUSTINE
San Augustine
SABINE
HOUSTON
Grapeland
Crockett
ANGELINA
Lufkin
Huntington
Diboll
NEWTON
Newton
TRINITY
Trinity
Corrigan
POLK
Livingston
JASPER
Jasper
Kirbyville
TYLER
Colmesneil
Woodville
HARDIN
Kountze
Silsbee
Sour Lake
ORANGE
Vidor
Orange
Beaumont
Nederland
Port Arthur
JEFFERSON
Region I Boundary
Counties
Cities
River Basins
Cypress
Neches
Neches-Trinity
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DATE: JUNE 2009
SCALE: 1:2,000,000
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East Texas Region
River Basins
Location Map
FIGURE
1.2

ETRWPA. Streams in all the basins tend to flow from northwest to southeast. Approximately one square mile of the Cypress Creek Basin lies in the northeastern portion of Panola County. Additional descriptions of the Neches, Sabine, and Trinity River Basins, as well as of Sabine Lake, follow.

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. 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 one-third of the basin area is comprised of the Angelina River Basin. Significant tributaries to the 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 six counties in the ETRWPA: Panola, Shelby, Sabine, Newton, Orange, and Jefferson 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. The Sabine River Basin contributes approximately 6.4 million acre-feet of water to Sabine Lake annually.

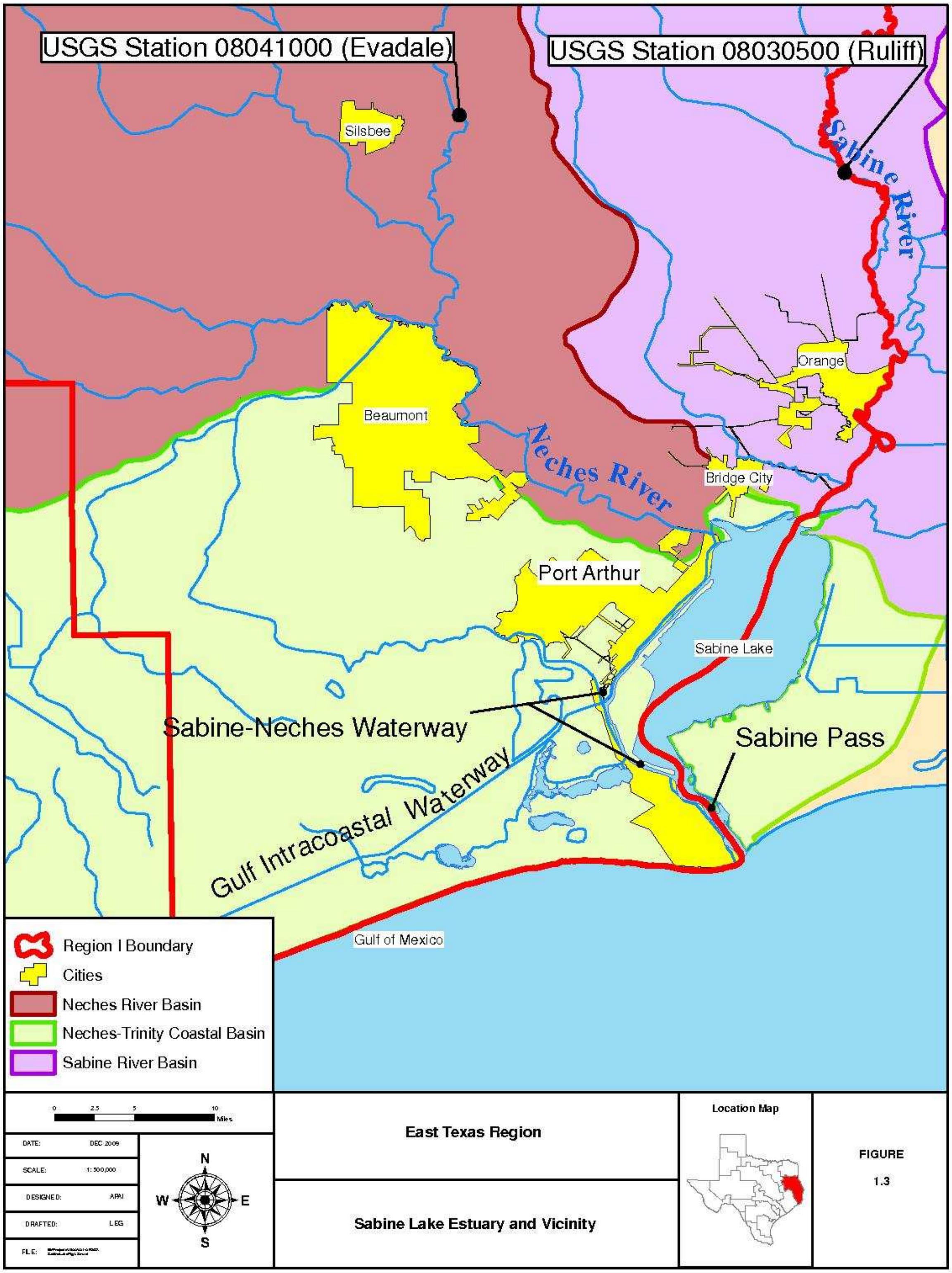
Neches-Trinity River. The coastal plain between the Neches River and Trinity River forms the Neches-Trinity Coastal Basin. The area is located in Jefferson County (in the ETRWPA) and Chambers County (in Region H). Maximum elevation in the basin is approximately 50 feet, although most of the basin is less than 25 feet in elevation. Total basin drainage area is approximately 770 square miles. In Jefferson County, the basin drains primarily to the Gulf Coast and to Sabine Lake. The Region I portion of the Neches-Trinity Coastal Basin is depicted in Figure 1.3.

Sabine Lake. Sabine Lake is a natural water body located on the Texas-Louisiana border in southeast Texas, approximately seven miles from the Gulf of Mexico. With a surface area for the main body of the lake of 55,000 to 60,000 acres, it is one of the smallest estuaries on the Texas Coast. The lake supports an extensive coastal wetland (i.e., salt marsh) system around much of the perimeter. Its small volume coupled with large freshwater inflows from the Sabine and Neches Rivers, result in a turnover rate of around 50 times per year. A map of Sabine Lake and vicinity is provided on Figure 1.3.

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.

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 Orange, upstream on the Sabine River. The waterway is some 400 feet wide and 40 feet deep. The United States Army Corps of Engineers (USACE) is currently considering whether to further expand the channel to accommodate large ship traffic. The expansion could deepen the channel to 48 feet and widen it to as much as 700 feet.

Trinity River. The Trinity River is a major water body in the State, but only forms a small portion of the western boundary of the ETRWPA. In the region, it forms a boundary for Anderson and Houston Counties.


USGS Station 08041000 (Evadale)
USGS Station 08030500 (Ruliff)
Silsbee
Sabine River
Orange
Beaumont
Neches River
Bridge City
Port Arthur
Sabine Lake
Sabine-Neches Waterway
Sabine Pass
Gulf Intracoastal Waterway
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Region I Boundary
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Neches-Trinity Coastal Basin
Sabine River Basin
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East Texas Region
Sabine Lake Estuary and Vicinity
Location Map
FIGURE
1.3

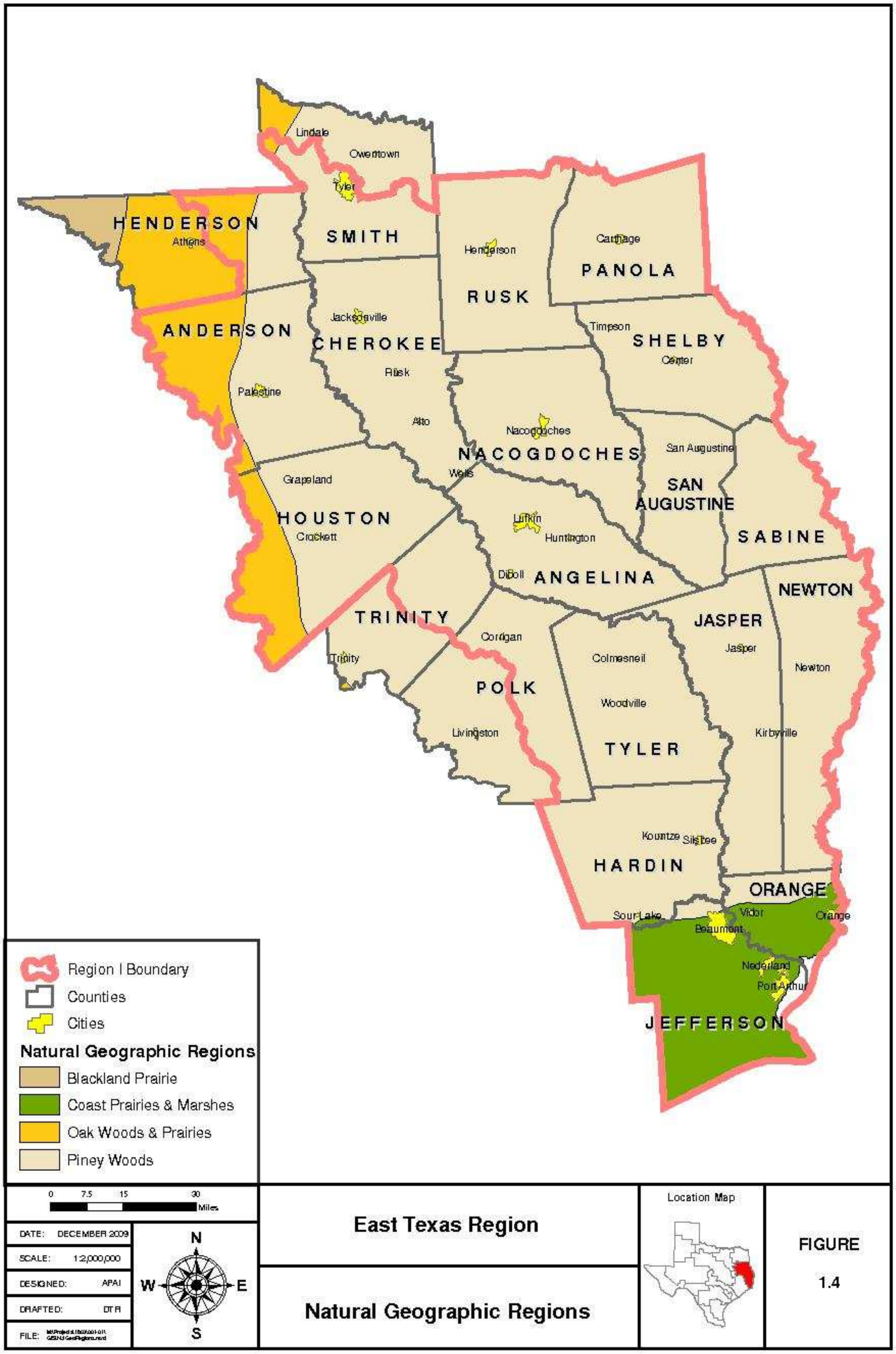
1.2.2 Topography and Geographic Areas. The ETRWPA is generally characterized by rolling to hilly surface features except near the Gulf Coast. The elevation in the region varies from sea level at its southern boundary on the Gulf of Mexico to 763 ft mean sea level (msl) at Tater Hill Mountain in Henderson County at its far northwest corner.

The area occupied by the counties of the region is further subdivided into natural geographic areas known as the Piney Woods, the Oak Woods and Prairies, the Coastal Prairies, and the Blackland Prairie. Figure 1.4 depicts the boundaries of these areas within the ETRWPA. They are further described following.

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 interspersed amongst the pines and in the valleys of rivers and creeks. Longleaf, shortleaf, and loblolly pine are native to the region and slash pine, an introduced species, is also 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, and iron deposits are also worked in Rusk County. 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, and Anderson Counties) fall within the Oak Woods and Prairies portion of the Texas Gulf Coastal Plains. Principal trees of this area are hardwoods such as post oak, blackjack oak, and elm. Riparian areas often have growths of pecan, walnut, and other trees with high water demands. Area upland soils are sandy and sandy loam,


HENDERSON
Athens
SMITH
Lindale
Owentown
Tyler
RUSK
Henderson
PANOLA
Carthage
ANDERSON
Palestine
CHEROKEE
Jacksonville
Rusk
Alto
SHELBY
Timpson
Center
NACOGDOCHES
Nacogdoches
Wells
SAN AUGUSTINE
San Augustine
HOUSTON
Grapeland
Crockett
ANGELINA
Lufkin
Huntington
Diboll
SABINE
NEWTON
Newton
Kirbyville
TRINITY
Trinity
JASPER
Jasper
POLK
Corrigan
Livingston
TYLER
Colmesneil
Woodville
HARDIN
Kountze
Silsbee
Sour Lake
ORANGE
Vidor
Orange
Beaumont
Nederland
Port Arthur
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Region I Boundary
Counties
Cities
Natural Geographic Regions
Blackland Prairie
Coast Prairies & Marshes
Oak Woods & Prairies
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East Texas Region
Natural Geographic Regions
Location Map
FIGURE
1.4

while the bottomlands are sandy loams and clays. 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 some 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 since the end of World War II. The chief concentration of this development has been from the cities of Orange and Beaumont to Houston, and much of the development has been in petrochemicals.

Blackland Prairie. The most northwest portion of the ETRWPA (Henderson County) falls in the Blackland Prairie region of the Texas Gulf Coastal Plains. This region is naturally dominated by grassland, though stands of post oak, blackjack oak, and eastern red cedar are common. Riparian areas support forests of bur oak, shumard oak, sugar hackberry, elm, ash, eastern cottonwood, and pecan. Soils are generally characterized as calcareous, alkaline, heavy clay. Development in the area consists largely of conversion of native prairies to pastureland, cropland, and urban uses.

1.2.3 Navigation.

In the ETRWPA, significant water navigation is generally limited to the coastal areas where the main stems of the Neches and Sabine Rivers and Sabine Lake are located. Navagation lanes are essentially located in tidally-influenced areas. Waters within the region used for navigation include the Sabine-Neches Waterway, Sabine Lake, and the Gulf Intercoastal Waterway, southern portions of the Neches, and Sabine Rivers. The 2011 Plan is not expected to have an adverse effect on navigation within the ETRWPA.

1.3 Climate

Data from the National Oceanic and Atmospheric Administration state climatologist indicate that the mean temperatures for the entire region varied from a minimum January temperature of 36 degrees Fahrenheit (°F) to a maximum July temperature of 93°F. Similarly, the average growing season for the entire ETRWPA was 247 days.

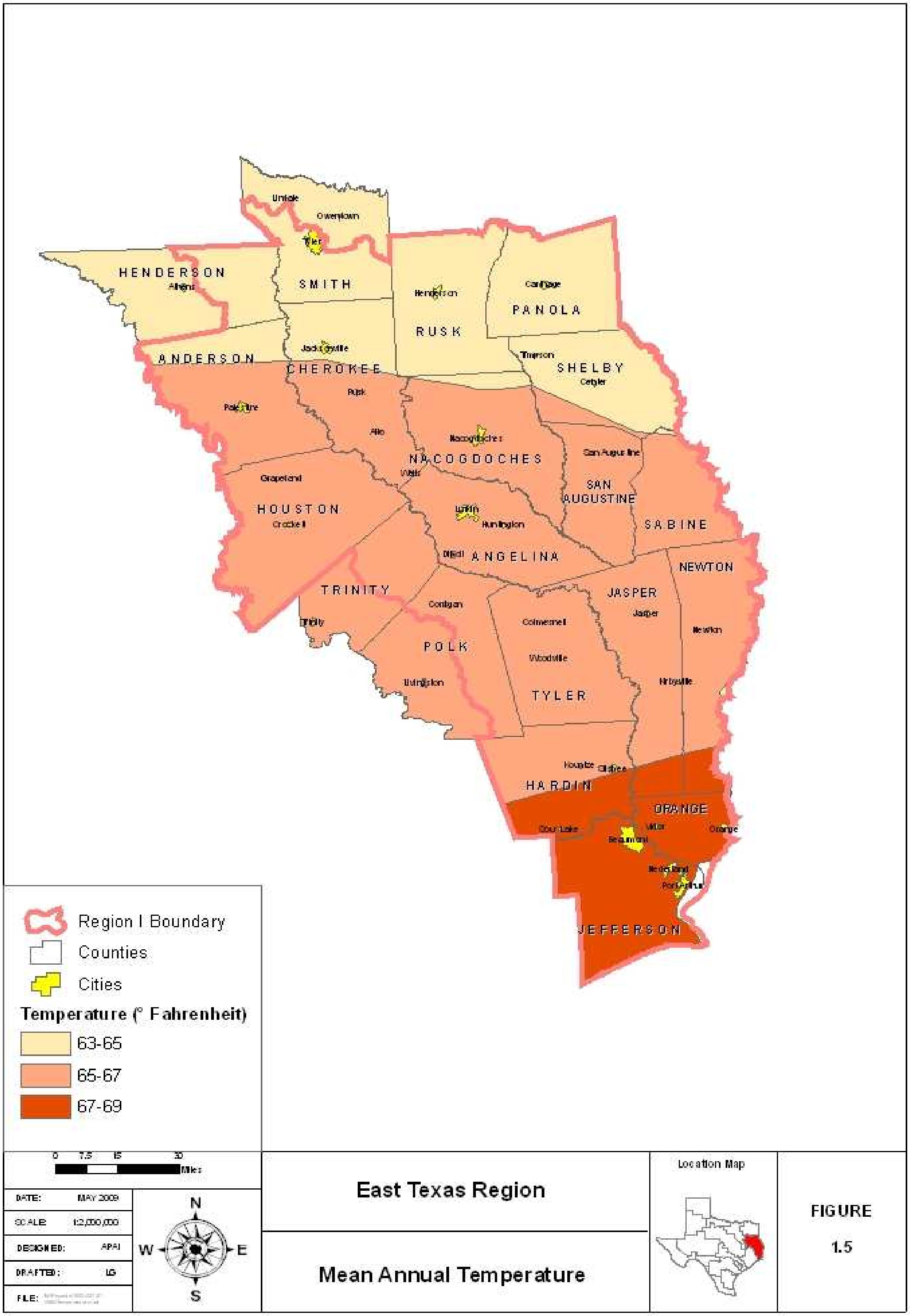
Precipitation generally increases from the northwest to southeast corners of the region, while evaporation increases in the opposite direction. Annual rainfall across the ETRWPA averaged 48.7 inches from 1971 through 2000, with the highest annual rainfall (59.04 inches) being recorded for Orange County and the lowest annual rainfall (42.03 inches) being recorded for Henderson County.[1] Average annual runoff ranges from approximately 10 inches in the northwest to 17 inches in the southeast. Average annual gross reservoir evaporation *(the rate of evaporation from a reservoir)* ranges from approximately 41 inches in the southeast to 55 inches in the northwest.

Figures 1.5 through 1.7 depict mean annual temperature, mean annual precipitation, and gross reservoir evaporation, respectively for the ETRWPA.

1.4 Population

The ETRWPA contains all or part of three metropolitan areas *(with cities of 50,000 or more population)*[2]:

- Beaumont-Port Arthur area at the south end (Jefferson, Orange, and Hardin Counties).
- Part of Longview area at the north end (portion of Kilgore).
- Most of the Tyler area at the north end (region includes the portion of Smith County in Neches basin, including most of Tyler).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SAN AUGUSTINE
SABINE
HOUSTON
ANGELINA
NEWTON
TRINITY
JASPER
POLK
TYLER
HARDIN
ORANGE
JEFFERSON
Region I Boundary
Counties
Cities
Temperature (° Fahrenheit)
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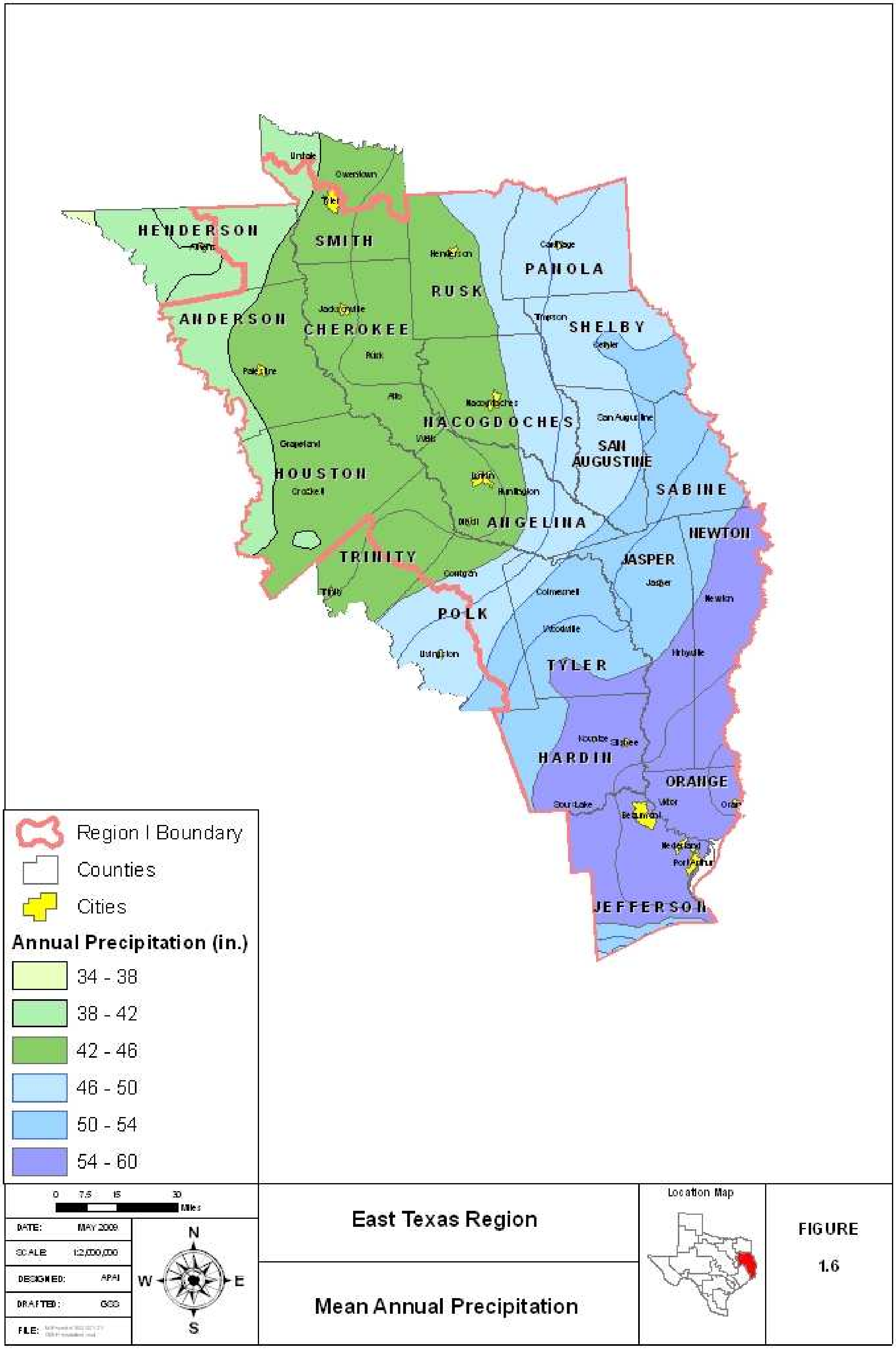
Location Map
East Texas Region
Mean Annual Temperature
FIGURE
1.5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HOUSTON
SABINE
ANGELINA
NEWTON
TRINITY
JASPER
POLK
TYLER
HARDIN
ORANGE
JEFFERSON
Region I Boundary
Counties
Cities
Annual Precipitation (in.)
34 - 38
38 - 42
42 - 46
46 - 50
50 - 54
54 - 60
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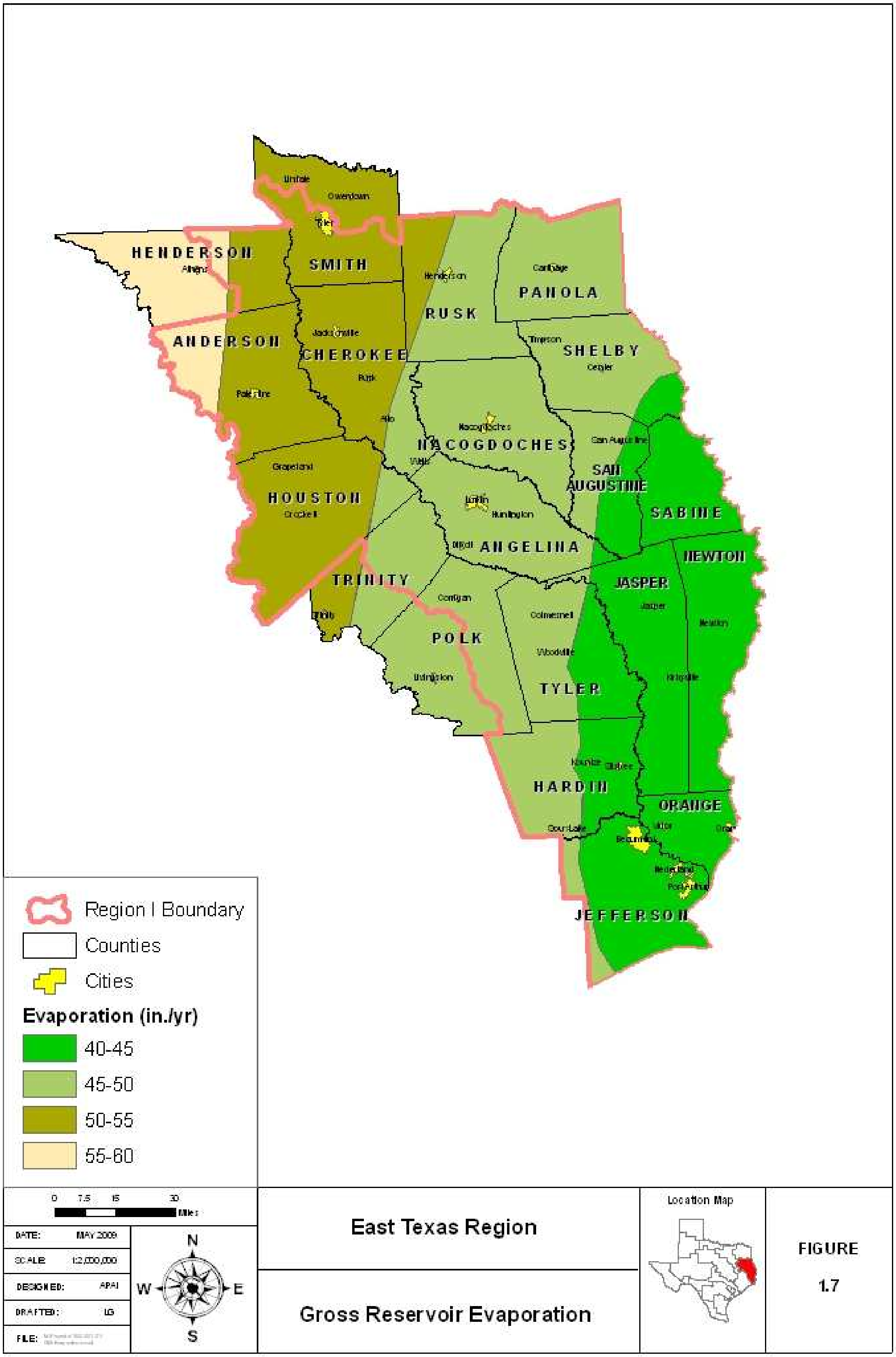
East Texas Region
Mean Annual Precipitation
FIGURE 1.6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HOUSTON
SABINE
ANGELINA
NEWTON
TRINITY
JASPER
POLK
TYLER
HARDIN
ORANGE
JEFFERSON
Region I Boundary
Counties
Cities
Evaporation (in./yr)
40-45
45-50
50-55
55-60
DATE: MAY 2009
DESIGNED: APAI
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Location Map
East Texas Region
Gross Reservoir Evaporation
FIGURE
1.7

The combined metropolitan population (as of 2008) is approximately two-thirds of the total ETRWPA population.

The population in the region increased approximately 14.5 percent from 1990 through 2000, to approximately 1.01 million people. Growth in the region is expected to continueat an average rate approximately 8 percent per decade to approximately 1.48 million by 2060. The most recent census data (2000) and 2010 through 2060 population projections for the major cities located in the region are provided in Table 1.2.

Table 1.2 Current and Projected Populations of Major Cities

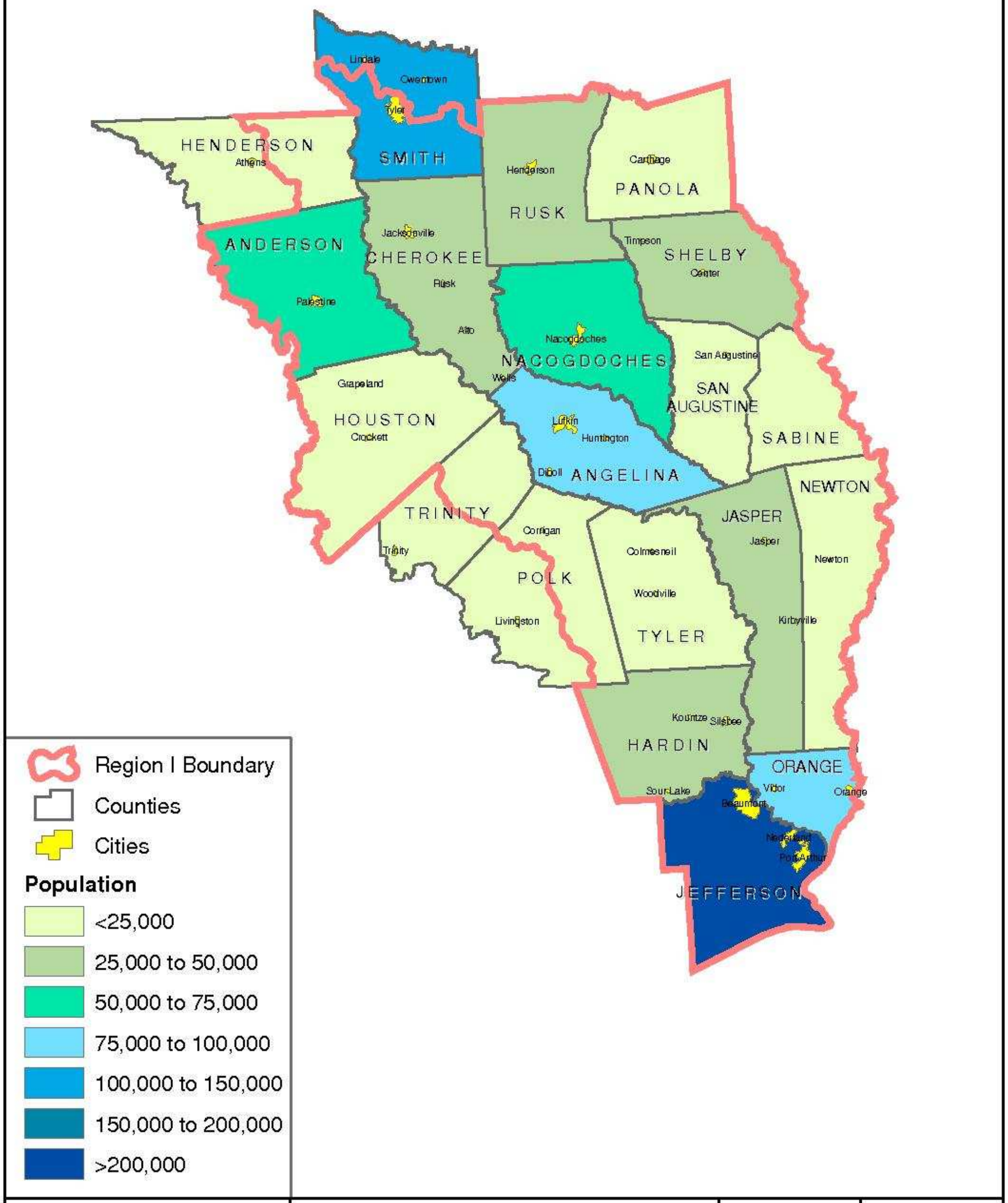
City	2000	2010[1]	2020[1]	2030[1]	2040[1]	2060[1]
Beaumont	113,866	113,866	113,866	113,866	113,866	113,866
Tyler *(Within ETRWPA),*[2,3]	83,650 *82,927*	89,571 *88,797*	93,997 *93,184*	98,409 *97,558*	102,809 *101,920*	119,994 *118,957*
Port Arthur	57,755	57,755	57,755	57,755	57,755	57,755
Nacogdoches	29,914	33,044	36,501	39,946	43,074	54,345
Lufkin	32,709	37,219	42,351	48,190	54,834	70,997
Region Total[1]	***317,171***	***330,681***	***343,657***	***357,315***	***371,449***	***415,920***

[1]Years 2010 through 2060 projections as approved by the TWDB including several revisions approved November 3, 2003, at the request of the ETRWPA.

[2]ETRWPA component disaggregated from total Tyler population.

[3]State population figures for Tyler in 2007 are somewhat higher than previously projected and would result in significantly higher projections for 2010 and beyond. Details of Tyler's increased population are addressed in Chapter 2.

Figures 1.8 and 1.9 show the relative distribution, by county, of the population in the ETRWPA. Figure 1.10 shows the anticipated growth for each county from 2000 through the end of the planning period, 2060. Additional details of population projections are provided in Chapter 2.



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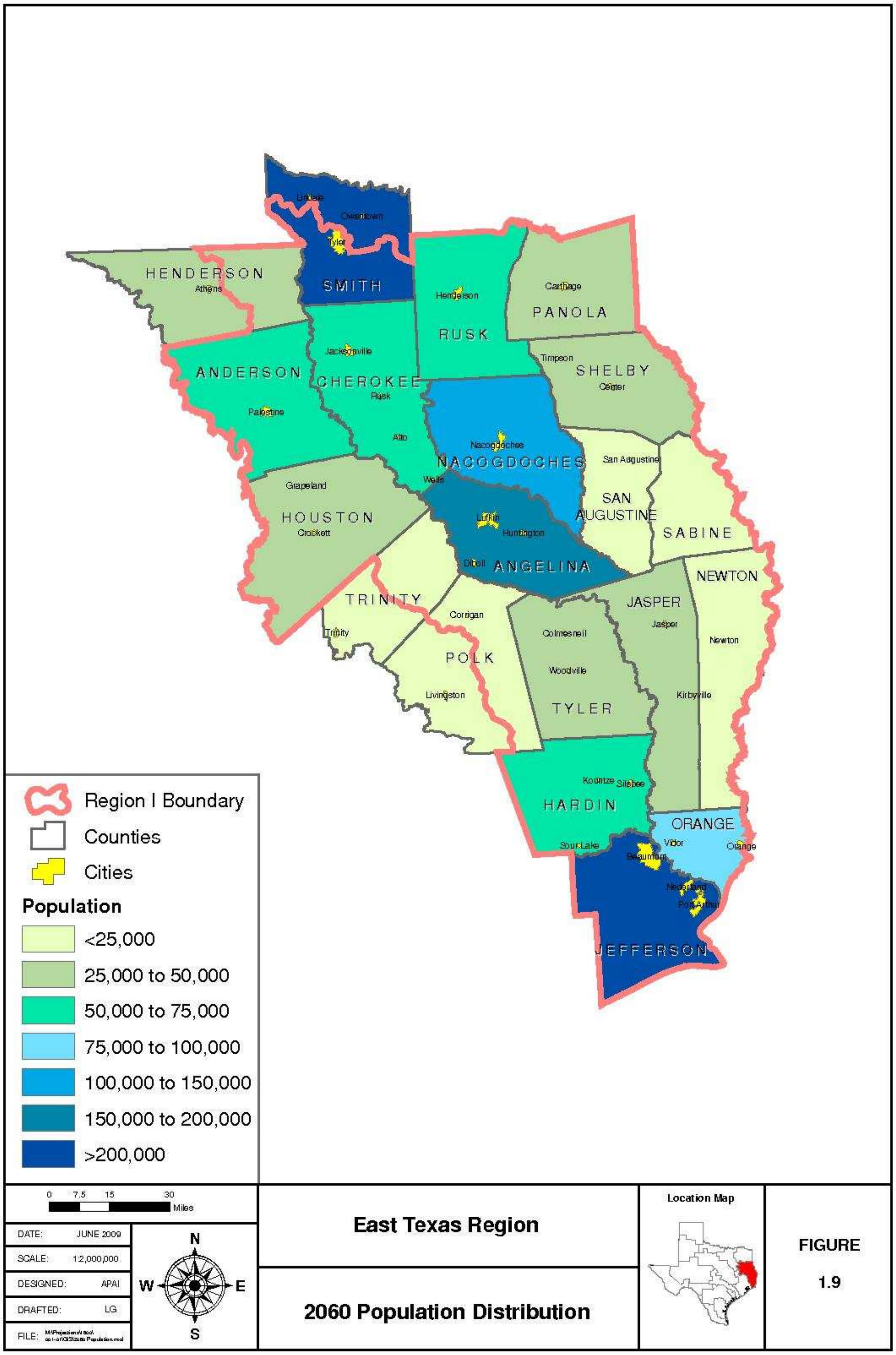
East Texas Region

2000 Population Distribution

FIGURE 1.8


HENDERSON
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SMITH
Lindale
Overton
Tyler
RUSK
Henderson
PANOLA
Carthage
ANDERSON
Palestine
CHEROKEE
Jacksonville
Rusk
Alto
SHELBY
Timpson
Center
NACOGDOCHES
Nacogdoches
San Augustine
SAN AUGUSTINE
SABINE
HOUSTON
Grapeland
Crockett
ANGELINA
Lufkin
Huntington
Diboll
Wells
TRINITY
Trinity
POLK
Corrigan
Livingston
TYLER
Colmesneil
Woodville
JASPER
Jasper
Kirbyville
NEWTON
Newton
HARDIN
Kountze
Silsbee
Sour Lake
ORANGE
Vidor
Orange
JEFFERSON
Beaumont
Nederland
Port Arthur
Region I Boundary
Counties
Cities
Population
<25,000
25,000 to 50,000
50,000 to 75,000
75,000 to 100,000
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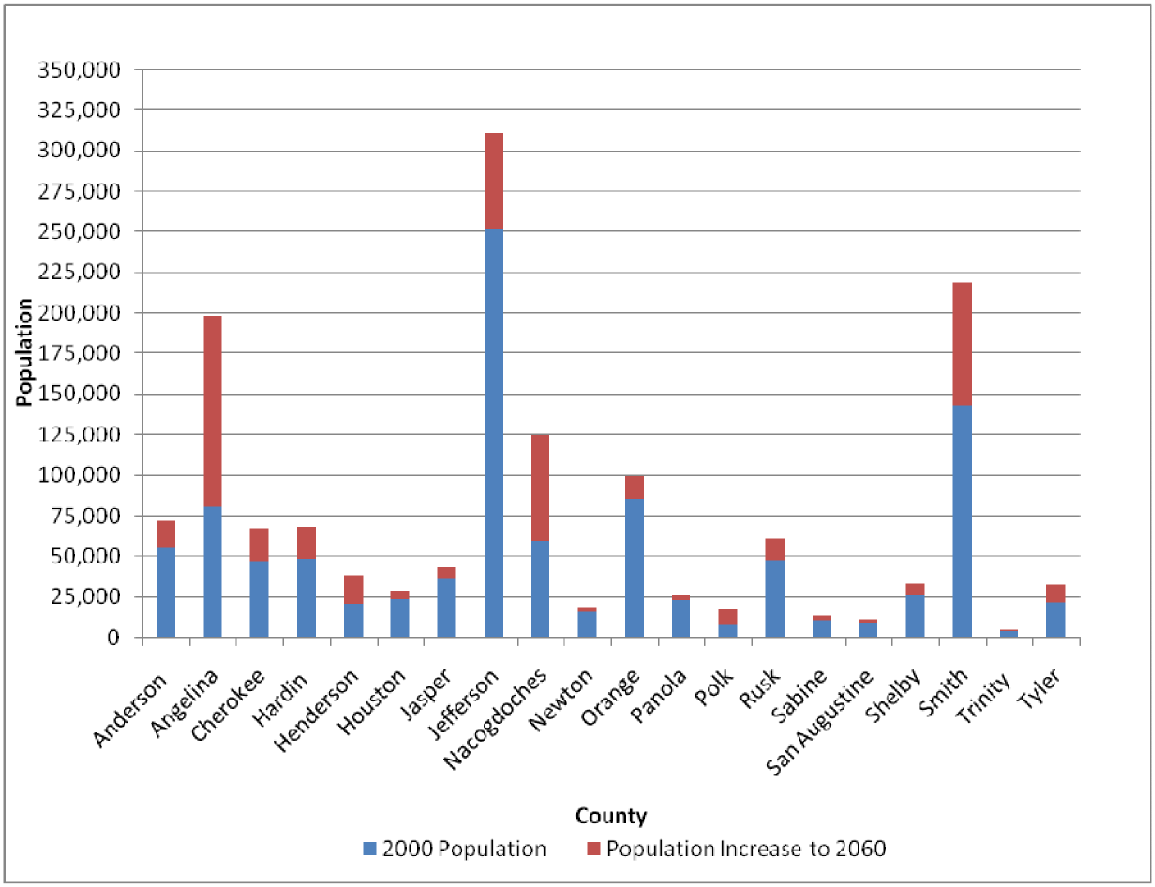
East Texas Region
2060 Population Distribution
Location Map
FIGURE
1.9

Figure 1.10 Population by County



1.5 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 are listed in Table 1.3.

Table 1.3 Major Manufacturing and Irrigation Water Uses

Industries	Crops
Petroleum Refining	Rice
Chemical and Allied Products	Soybeans
Lumber and Wood	Hay
	Vegetables

The Beaumont-Port Arthur metropolitan area, 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 County.

There are several seaports (Beaumont, Port Arthur, and Orange, plus several industrial docks), along with small amounts of shipyard activity. Industrial construction, including $3 billion in Jefferson County since 1997, has provided a significant amount of local employment in recent years. 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 Longview metropolitan area is located just outside the region, north of Rusk County. It is centered in Longview in Gregg County. However, the area contains very diversified manufacturing in the ETRWPA, particularly in Rusk County including brick manufacturing, power generation, steel fabrication, fiberglass specialties, and the timber industry. Rusk County also has state correctional facilities. No major ETRWPA cities are located in this area.

The Tyler metropolitan area, 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 region. Local manufacturing includes air conditioning/heating equipment, cast iron pipe, tires, meat packing, and oil platform. However, the area is largely a commercial, educational, and medical center. Oil production and rose farming are prevalent in the area. The University of Texas at Tyler is also located in the City of Tyler.

Lufkin and Nacogdoches, the other major cities in the ETRWPA, do not presently classify as metropolitan areas but would do so by 2040 and 2060, respectively, according to the current TWDB population projections. These cities, located in adjacent micropolitan counties, have many similarities including timber products industries, poultry processing, and higher education. Lufkin also has a foundry and a truck trailer manufacturer, while Nacogdoches has manufacturers of valves, transformers, sealing products, and motor homes. Stephen F. Austin University is located in Nacogdoches.

The remainder of the region is largely forested and has various timber industries including paper mills in Southeast Texas. Oil production is scattered throughout the region, and beef cattle are prominent, being found in all of the counties in the region. Plant nurseries are common in the north part of the region. Poultry production and processing are prevalent in Shelby and Nacogdoches Counties and very significant in Angelina and Panola Counties. 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 large reservoirs; in the southern end of the region near Sabine Lake and the Gulf of Mexico; and in many timbered areas which offer hunting opportunities.

Information from the Texas Workforce Commission (TWC) shows unemployment for the region varying from 5.2% in Nacogdoches County to 17.5% in Sabine County in 2009. Of the three workforce areas overlapping the region, the average annual wages for 2007 were as follows:[3]

- East Texas (northern counties): $28,476
- Deep East Texas (middle counties): $27,550
- South East Texas (Beaumont-Port Arthur metropolitan area): $28,911

1.6 Sources of Water

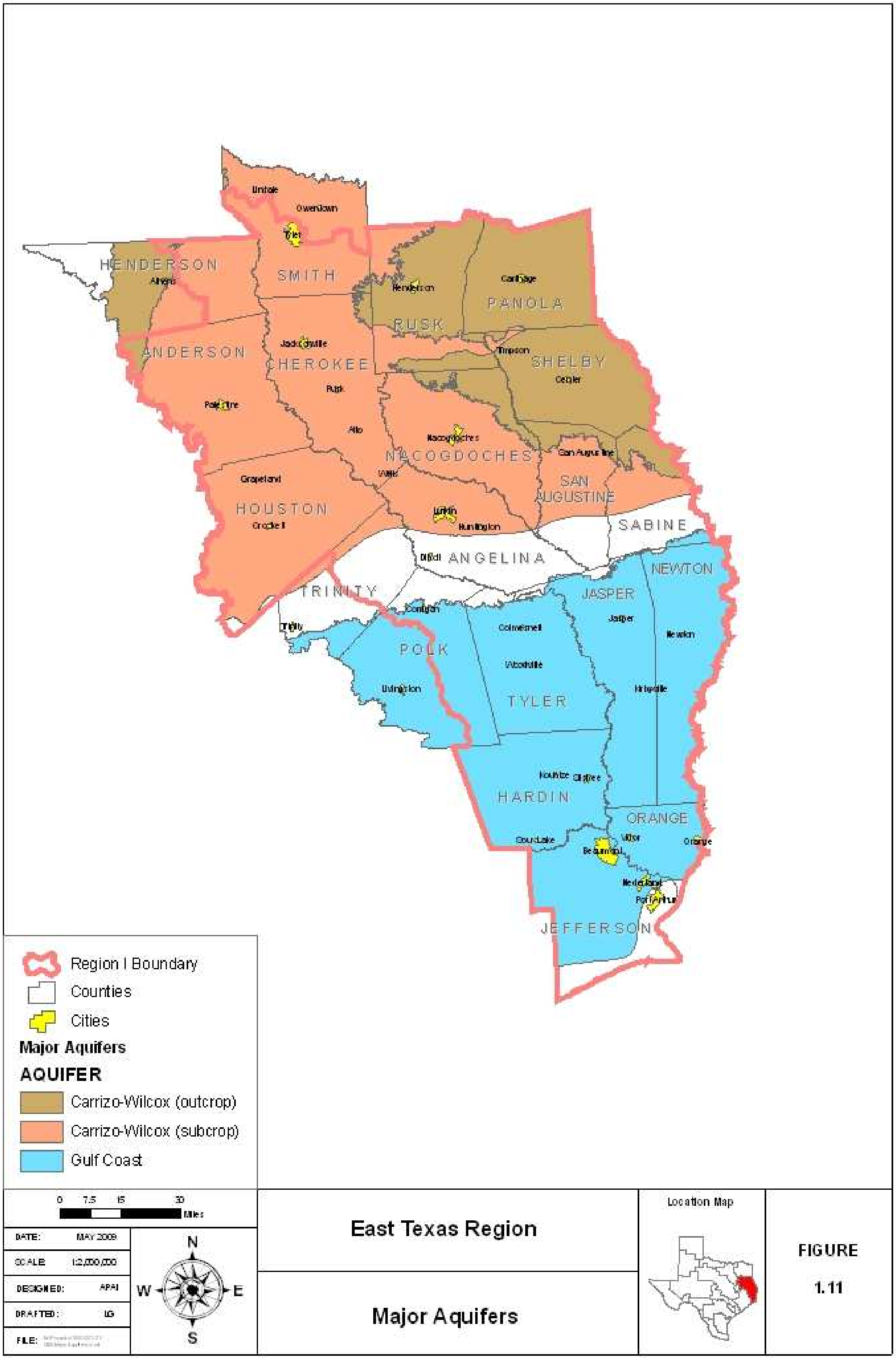
The ETRWPA obtains its supplies from both groundwater and surface water sources. Each source is described following.

1.6.1 Groundwater and Springs. 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 the total volume available.

The two major aquifers that underlie the region are known as the Carrizo-Wilcox and the Gulf Coast aquifer. The three minor aquifers, the Queen City, Sparta, and Yegua-Jackson aquifers, supply lesser amounts of water to the region. Figures 1.11 and 1.12 show the locations of the major and minor aquifers, respectively.

The following generalized descriptions of the major and minor aquifers and springs are based largely on the work of TWDB. A general discussion of water quality and groundwater availability is described in section 1.12 of this chapter. A more thorough discussion of groundwater availability is provided in Chapter 3.

Gulf Coast Aquifer. The Gulf Coast aquifer 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 10 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.


HENDERSON
SMITH
RUSK
PANOLA
ANDERSON
CHEROKEE
SHELBY
NACOGDOCHES
SAN AUGUSTINE
HOUSTON
SABINE
ANGELINA
NEWTON
TRINITY
JASPER
POLK
TYLER
HARDIN
ORANGE
JEFFERSON
Region I Boundary
Counties
Cities
Major Aquifers
AQUIFER
Carrizo-Wilcox (outcrop)
Carrizo-Wilcox (subcrop)
Gulf Coast
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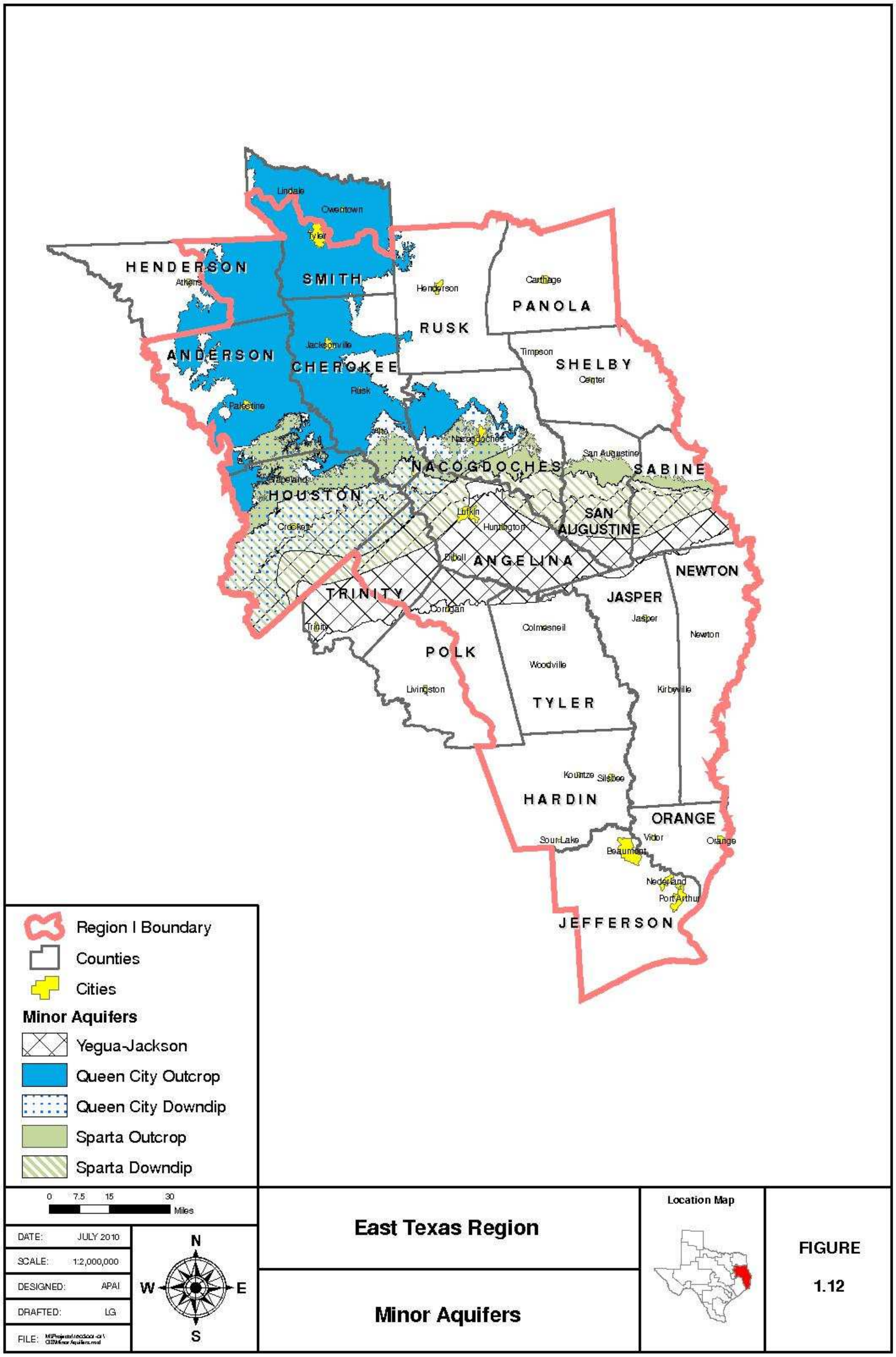
East Texas Region
Major Aquifers
Location Map
FIGURE
1.11


HENDERSON
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PANOLA
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CHEROKEE
SHELBY
NACOGDOCHES
SABINE
HOUSTON
SAN AUGUSTINE
ANGELINA
NEWTON
TRINITY
JASPER
POLK
TYLER
HARDIN
ORANGE
JEFFERSON
Region I Boundary
Counties
Cities
Minor Aquifers
Yegua-Jackson
Queen City Outcrop
Queen City Downdip
Sparta Outcrop
Sparta Downdip
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East Texas Region
Minor Aquifers
Location Map
FIGURE
1.12

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, the Jasper, the Evangeline, and the Chicot, 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 99,064 acre-feet per year (ac-ft per year) during 2001, 2002, and 2003.

Carrizo-Wilcox Aquifer. The Carrizo-Wilcox aquifer 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 Carrizo-Wilcox aquifer in the region occurs as a major trough caused by the Sabine Uplift near the Texas-Louisiana border.

Total groundwater pumpage from the Carrizo-Wilcox in the region averaged 75,219 ac-ft per year during 2001, 2002, and 2003. 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 200 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 (bgl) to 263 feet (bgl). Significant water-level declines have occurred in the region around Tyler and the Lufkin-Nacogdoches area.

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 actually increased, although the wells are still being utilized.

Sparta Aquifer. The Sparta aquifer 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.

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, but a few exceed 400 gpm.

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 aquifer has not occurred.

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 sourthern 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.

Springs. There are over 250 springs of various sizes documented in the region. A description of the springs is provided in Section 1.9.7. Most springs in the region discharge less than 10 gpm.

None of the springs are used for water supply[4]. The Jasper County spring was used as source water for a local Texas Parks and Wildlife Department (TPWD) fish hatchery in the 1970s.

Groundwater Quality. Groundwater quality is affected by natural conditions as well as man-made contamination. The Texas Water Commission (predecessor agency to the Texas Commission on Environmental Quality) has stated, "Natural contamination probably affects the quality of more groundwater in the state than all other sources of contamination combined."[5] In the Gulf Coast aquifer, salt water intrusion is an important form 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.

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 Orange and Vidor. The previously referenced Texas Water Commission 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.

Salt water is also found farther inland, but usually at greater depths than in coastal areas. Salinity problems also occur in the vicinity of salt domes.

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. 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.[5, 6] There is no current evidence indicating problems 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 for the most part has good water except for high dissolved solids and salinity in a band along its south boundary. Iron is a widespread problem in the aquifer, but sulfates and chlorides are found only in scattered locations other than chlorides along the south boundary.[6]

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. 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.

The Yegua aquifer produces good water only in a limited area. Iron is a problem, and the water from at least one location has been described as sodium bicarbonate water.

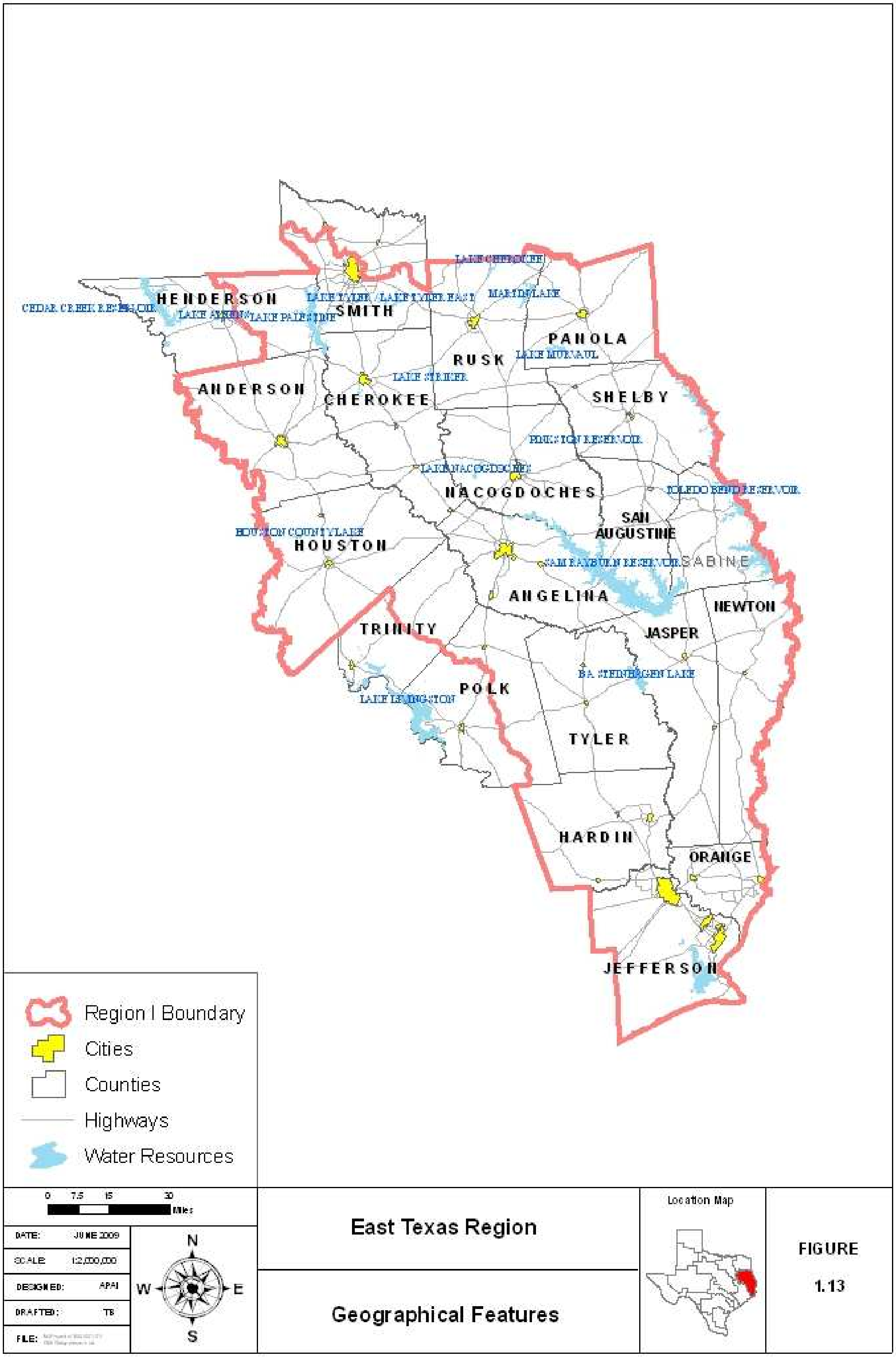
1.6.2 Surface Water. Surface water may be obtained directly from streams and rivers, but in the ETRWPA, most surface water is provided by fourteen existing water supply reservoirs. Locations of major reservoirs and geographical features are shown on Figure 1.13. Table 1.4 contains pertinent data for the major water supply reservoirs in the region including ten in the Neches River Basin, three in the Sabine River Basin, and one in the Trinity River Basin. One proposed reservoir, Lake Columbia in the Neches River Basin is also included in Table 1.4.

Surface water quality in the region varies between water bodies. Stream and lake segments with water quality problems identified by the Texas Commission on Environmental Quality (TCEQ) as impaired are discussed in Section 1.12. None of the segments in the region indicate problems as drinking water sources. Aquatic life, fish consumption, and recreation uses are sometimes not supported in the water bodies.

Fish consumption is the subject of Texas Department of State Health Services (TDSHS) advisories in a number of segments, mostly in reservoirs as a result of mercury found in certain species of fish.[7] The mercury concentration in the water was negligible and did not present problems for recreation or water supply.[8, 9]

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 includes sedimentation, filtration, and disinfection.

Salt water intrusion is a major concern in the tidal reaches of streams, especially since ship channels between the Gulf of Mexico and Sabine Lake were dredged around the beginning of the twentieth century. The salt water, being heavier than fresh water, tends to settle on the bottom of the channel similar to the way it underlies fresh water in aquifers. The horizontal and vertical extent of the salt water layer varies according to several factors including fresh water inflow and tidal influence. The salt water barrier in the Neches River keeps the salt water from reaching Lower Neches Valley Authority (LNVA) and City of Beaumont raw water supply intakes.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TRINITY
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East Texas Region
Geographical Features
Location Map
FIGURE
1.13

Table 1.4 Major Water Supply Reservoirs

Reservoir Name	Owner	Conservation Pool Elevation (ft msl)	Area (ac)	Capacity (ac-ft)	Firm Yield (ac-ft per year)[1]
Neches River Basin					
Lake Athens	Athens MWA	440	1,520	32,790	6,145
Lake Columbia[2]	ANRA	315	10,000	187,839	75,700
Lake Jacksonville	City of Jacksonville	422	1,320	30,500	6,200
Lake Nacogdoches	City of Nacogdoches	279	2,219	41,140	17,450
Lake Naconiche[3]	Nacogdoches County	348	692	8,708	3,239
Lake Palestine	Upper Neches River MWA	345	25,560	411,300	209,500
Lake Pinkston	City of Center	298	523	7,380	3,800
Lake Tyler/Tyler East	City of Tyler	375.4	4,880	73,700	30,925
Sam Rayburn	Corps of Engineers	164.4	114,500	2,898,300	820,000
B. A. Steinhagen	Corps of Engineers	83	13,700	94,200	
Striker Creek Reservoir	Angelina-Nacogdoches WCID No. 1	292	2,400	26,960	20,600
Sabine River Basin					
Lake Cherokee[4]	Cherokee Water Company	280	3,987	46,700	29,120
Lake Murvaul	Panola Co. FWSD No. 1	265	3,800	45,815	22,380
Toledo Bend Reservoir[5]	SRA	172	181,600	4,472,900	750,000
Trinity River Basin					
Houston County	Houston Co. WCID No. 1	260	1,282	19,500	3,500

[1] Firm yield is the lesser of 2000 firm yield or permitted diversion unless otherwise noted.

[2] Lake Columbia is permitted but not yet constructed. Lake Columbia is in the process of U.S. Army Corps of Engineers permitting.

[3] Lake Naconiche has been constructed and is currently filling. The firm yield for Lake Naconiche is estimated. Nacogdoches County is planning to amend its water right to add municipal users in the future.

[4] Lake Cherokee lies partially in Gregg County and is used outside the region.

[5] Capacity information obtained from SRA.

Pollution from industrial discharges has also been a major concern, although industries have been required to improve the quality of their effluent over what it was several decades ago. Salt water intrusion, which was 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.

1.6.3 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 impacted.

1.7 Wholesale Water Providers

Water is made available for use in the region by retail and wholesale water providers (WWPs). The majority of retail water comes from major water suppliers. The definition of a WWP is included in Title 31 of the Texas Administrative Code (TAC) Chapter 357.2(8) and is as follows: "Wholesale water provider - Any person or entity, including river authorities and irrigation districts, that has contracts to sell more than 1,000 ac-ft per year of water wholesale in any one year during the five years immediately preceding the adoption of the last regional water plan. The regional water planning groups shall include as WWPs others persons and entities that enter or that the regional water planning group expects or recommends to enter contracts to sell more than 1,000 ac-ft per year of water wholesale during the period covered by the plan."

1.7.1 Angelina and Neches River Authority. The Angelina and Neches River Authority (ANRA), headquartered in Lufkin, has jurisdiction over the middle portion of the Neches basin including the Angelina basin, and portions of Jasper and Orange Counties in the Neches basin. ANRA holds the permit for the proposed Lake Columbia, with rights to approximately 85,507 ac-ft per year for distribution. ANRA serves as the lead agency in the Neches River Basin for the Clean Rivers Program within its own jurisdiction as well as that of the Upper Neches River Municipal Water Authority. ANRA also owns and operates a water and sewer system in a subdivision near Jasper, a regional wastewater facility in northwestern Angelina County,[9] and a biosolids composting facility in Cherokee County.

1.7.2 Angelina-Nacogdoches Water Control & Improvement District No. 1. The Angelina-Nacogdoches Water Control & Improvement District No. 1 (A-N WCID No. 1) owns and operates Lake Striker in Rusk and Cherokee Counties. Currently, the only demand on A-N WCID No. 1 is for steam-electric power in Cherokee County. Supplies have previously been provided to a paper mill that is presently closed.

1.7.3 Athens Municipal Water Authority. The Athens Municipal Water Authority (MWA) provides water to the City of Athens, which is located in both Region C and the ETRWPA, and the Texas Freshwater Fisheries Center at Lake Athens. Athens MWA has 8,500 ac-ft per year of water rights in Lake Athens. The firm yield of the lake was estimated at 6,145 ac-ft per year. However, the intake structure for the fish hatchery does not allow the water level to drop below 431 feet msl and maintain inflow to hatchery. Using this operational constraint, the yield of Lake Athens is 2,900 ac-ft per year. The Athens MWA also has a wastewater reuse authorization, but the infrastructure is not in place to utilize this source.

1.7.4 City of Beaumont. The City of Beaumont draws water from two sources in roughly equal amounts. The three wells are located in the Loeb community in southern Hardin County a short distance north of the City. Beaumont also draws surface water from the Neches River at two points upstream from its water treatment plant. A portion of the raw water is transmitted to a refinery south of the City. The rest of the water is treated and fed into the City of Beaumont water system.

Water in the system, whether from the wells or from the river, is used for in-city municipal customers; for various industries inside and outside the City; for wholesale customers including two nearby water districts; and for state, federal, and county correctional facilities south of the City. Two other water districts have standby service from Beaumont. The City holds rights to 49,897 ac-ft per year from the Neches River. The City of Beaumont also has a reserve supply contract with LNVA for water in Sam Rayburn Reservoir.

1.7.5 City of Carthage. The City of Carthage provides wholesale water to County-Other customers in Panola County and manufacturing customers. The City currently obtains its water from groundwater from the Carrizo-Wilcox aquifer and surface water from Panola County Fresh Water Supply District (FWSD) via Lake Murvaul.

1.7.6 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. Several water supply corporations have emergency interconnections with the City, one of which receives part of its normal supply from the City of Center. Local industries include two poultry plants, a hardwood flooring plant, and manufacturers of store fixtures, shelters, and portable cooling equipment.[10] The City of Center owns and operates Lake Center, with rights to 1,460 ac-ft per year of municipal water. Water from Lake Pinkston is pumped from the Neches River Basin to the City of Center, and the City holds rights to 3,800 ac-ft per year of water in Lake Pinkston.

1.7.7 City of Jacksonville. The City of Jacksonville draws water partially from wells and partially from Lake Jacksonville, from which it holds water rights of 6,200 ac-ft per year. *(The City also holds a total of 1,200 ac-ft per year of water rights in Lake Acker.)* Jacksonville supplies several wholesale customers including the Afton Grove, Craft-Turney, Gum Creek, and North Cherokee Water Supply Corporations.

Jacksonville also supplies water to local industries including feed mills, candy manufacturing, meat packing, timber products, furniture manufacturing, medical equipment, heat exchanger cores, plastic products, printing equipment, electric signs, copper products, wooden baskets, venting, and metal fabrication.[11]

1.7.8 City of Lufkin. The City of Lufkin currently draws its water from City-owned wells. It has recently purchased the former Abitibi Bowater groundwater well field and surface water rights associated with Lake Kurth in Angelina County. The City of Lufkin also has 28,000 ac-ft per year of surface water rights in Sam Rayburn Reservoir. In addition to its own municipal customers, the City supplies water to a number of industries as well as wholesale entities, the City of Diboll, City of Huntington and the Angelina Fresh Water District.

1.7.9 City of Nacogdoches. The City of Nacogdoches draws part of its supply from wells located in and near the City, with the remainder coming from Lake Nacogdoches ten miles west of the City *(water rights of 20,162 ac-ft per year).* An increasing percentage of the water comes from the lake as water demand increases and the wells approach the end of their useful life. The City supplies water to its own municipal customers, including Stephen F. Austin State University (SFA) and several hundred retail customers outside the City. Various industries in and near the City of Nacogdoches are also supplied by the City.

Outside wholesale customers supplied by Nacogdoches on a full-time basis include one water district and one water supply corporation. One other water district and at least two other water supply corporations are interconnected for emergency use. The City of Nacogdoches has bought out one neighboring water supply corporation and taken over its system.

1.7.10 City of Port Arthur. The City of Port Arthur draws all of its water supply from the LNVA canal system that extends to the City. After treating the water in its plant constructed in the late 1990s, it supplies water to a wholesale customer (a state park) and to various nearby industries, some of which use City water only for domestic use. Port Arthur has taken over the water system for one plant just outside the City.

1.7.11 City of Tyler. The City of Tyler draws water partially from wells but primarily from surface water sources. One source consists of nearby Lake Tyler and Lake Tyler East, which are interconnected by a channel so as to function as one lake. Tyler also completed a new surface water plant on Lake Palestine in 2003.

Tyler supplies a number of local industries including steel fabrication, building fasteners, oil platforms, machine shops, plastics industries, timber industries, paper products, air conditioners, food industries, sportswear, industrial gases, signs, trailers, concrete products, tires, rubber extrusions, fishing lures, oil and gas refining, asphalt, iron pipe, refractory materials, automotive equipment, and silk flowers.[12] Tyler also provides part of the water supply for the City of Whitehouse and for a nearby water supply corporation.

An older and smaller City lake, Lake Bellwood, provides raw water for two golf courses and for a tire manufacturer.

The City of Tyler water rights include 40,000 ac-ft per year from Lake Tyler/Tyler East and 2000 ac-ft per year from Lake Bellwood. Tyler is also entitled by contract to 67,213 ac-ft per year (60 million gallons per day [MGD]) from Lake Palestine.

1.7.12 Houston County Water Control & Improvement District No. 1. The Houston County Water Control & Improvement District No. 1 (HCWCID No. 1) owns and operates Houston County Lake northwest of Crockett. It has no retail customers other than one industry, but supplies water to several wholesale customers in the county. These customers consist of three cities (Crockett, Grapeland, and Lovelady) and Consolidated Water Supply Corporation (Consolidated WSC). Consolidated WSC has a multi-county service area that includes over half of Houston County. The WSC has several thousand connections in Houston County as well as connections in neighboring counties.

The Cities of Crockett, Grapeland, and Lovelady have one well each to supplement the wholesale water supply, while the Consolidated WSC has seven wells within the county. The first two cities resell water to the Consolidated WSC to supply some of its isolated systems.

HCWCID No. 1 has a surface water treatment plant with water rights to 3,500 ac-ft per year from Houston County Lake.

1.7.13 Lower Neches Valley Authority. The LNVA has water rights to a total of 1,173,876 ac-ft per year from Sam Rayburn Reservoir/Lake B. A. Steinhagen System *(both owned and operated by the U.S. Army Corps of Engineers)* and the Neches River. LNVA draws water from the Neches River far downstream from the two lakes as well as from Pine Island Bayou. LNVA distributes, through its canal system, approximately 1.2 million acre-feet of water annually to cities, industries, and farmers in the Southeast Texas area. In particular, LNVA provides raw water for most of the cities and water districts in Jefferson County.

The LNVA has constructed a permanent salt water barrier on the Neches River, protecting its canal intakes and those of the City of Beaumont from salt water intrusion. This barrier helps conserve surface water in the reservoirs, since it is no longer necessary to release water during dry periods to keep the salt water pushed away from the intakes.

The LNVA completed, in October 2004, a regional water plant in Chambers County (just outside the region) to treat its own canal water for the Bolivar Peninsula (also outside the region).

In addition to most of the lower portion of the Neches River Basin, the LNVA has jurisdiction over the Neches-Trinity Coastal Basin. LNVA also serves as the lead agency for implementation of the Clean Rivers Program within its jurisdiction.

1.7.14 Panola County Freshwater Supply District No. 1. The Panola County Freshwater Supply District No. 1 (PCFWSD No. 1) owns and operates Lake Murvaul in the ETRWPA. Created in 1953, the district provides water exclusively to the City of Carthage from its rights to 21,280 ac-ft per year of municipal water and 1,120 ac-ft per year of industrial water in Lake Murvaul. The City of Carthage in turn, provides wholesale service to five water supply corporations and a privately owned system, in some cases as the sole supplier.

1.7.15 Sabine River Authority. The Sabine River Authority (SRA), created in 1949 by the Texas Legislature, was originally formed as a conservation and reclamation district. SRA is responsible for controlling, storing, preserving and distributing the waters of the Sabine River and its tributaries throughout the Texas portion of the Sabine River Basin for beneficial use. SRA also serves as the lead agency for implementation of the Clean Rivers Program in the basin.

Within the region, the SRA owns and operates Toledo Bend Reservoir jointly with the Sabine River Authority of Louisiana. SRA supplies raw water via contracts with municipalities, water-supply corporations and industrial users in Texas. SRA holds rights to approximately 750,000 ac-ft per year in the reservoir.

The SRA also holds run-of-the-river rights, which are associated with SRA's Canal System. Those rights include 100,400 ac-ft per year for municipal and industrial use, and 46,700 ac-ft per year for irrigation use.

1.7.16 Upper Neches River Municipal Water Authority. The Upper Neches River Municipal Water Authority (UNRMWA), headquartered at Lake Palestine, was created in 1953. The agency is the part owner, authorized agent, and operator of Lake Palestine on the Neches River. UNRMWA holds rights to some 238,000 ac-ft per year in Lake Palestine, from which it distributes raw water to municipalities and other contract buyers in the region.

Several entities participated in the construction of Lake Palestine and hold contract rights for water from the lake. These entities include the cities of Palestine and

Tyler within the ETRWPA. Additionally, Dallas Water Utilities (DWU) and the Tarrant Regional Water District (TRWD) are cooperating to construct the Integrated Pipeline, which will deliver water to Dallas and Tarrant Counties from Lake Palestine, as well as Cedar Creek Lake and Richland-Chambers Reservoir. The pipeline will have a capacity of approximately 350 MGD, with 150 MGD for Dallas and 200 MGD for TRWD. Dallas' contract with the UNRMWA and an interbasin transfer permit allowing the use of water from Lake Palestine in the Trinity River Basin provide Dallas 114,337 acre-feet per year (102 MGD) of water from Lake Palestine. TRWD's capacity in the Integrated Pipeline will deliver about 179,000 acre-feet per year (160 MGD) from Cedar Creek Lake and Richland-Chambers Lake.

1.8 Current and Projected Water Demands

The demand for water in the ETRWPA is expected to grow from 875,189 ac-ft per year in the year 2010 to a total of 1,405,971 ac-ft per year in 2060. The water demands, in the regional water planning process, is 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. The demand for the Years 2000 and 2060 for each of the major groups is shown on Figures 1.14 and 1.15.

The total demand in this planning cycle is approximately 2 percent higher than the 2006 planning cycle. The projected demand on supplies does not include future demands for supplies that are located in the ETRWPA and identified as strategies for other regions.

Most major demand in the region centers around larger cities or metropolitan areas. In particular, 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 as in the case of outlying industries and steam-power generating plants.

Figure 1.14
2000 Distribution of Water Demand

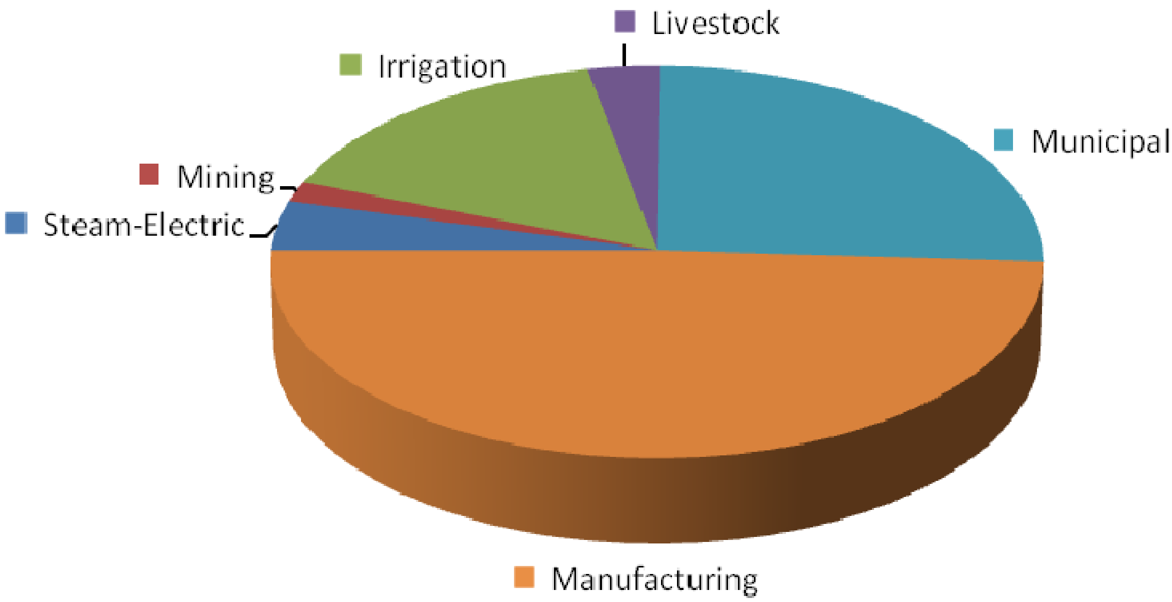
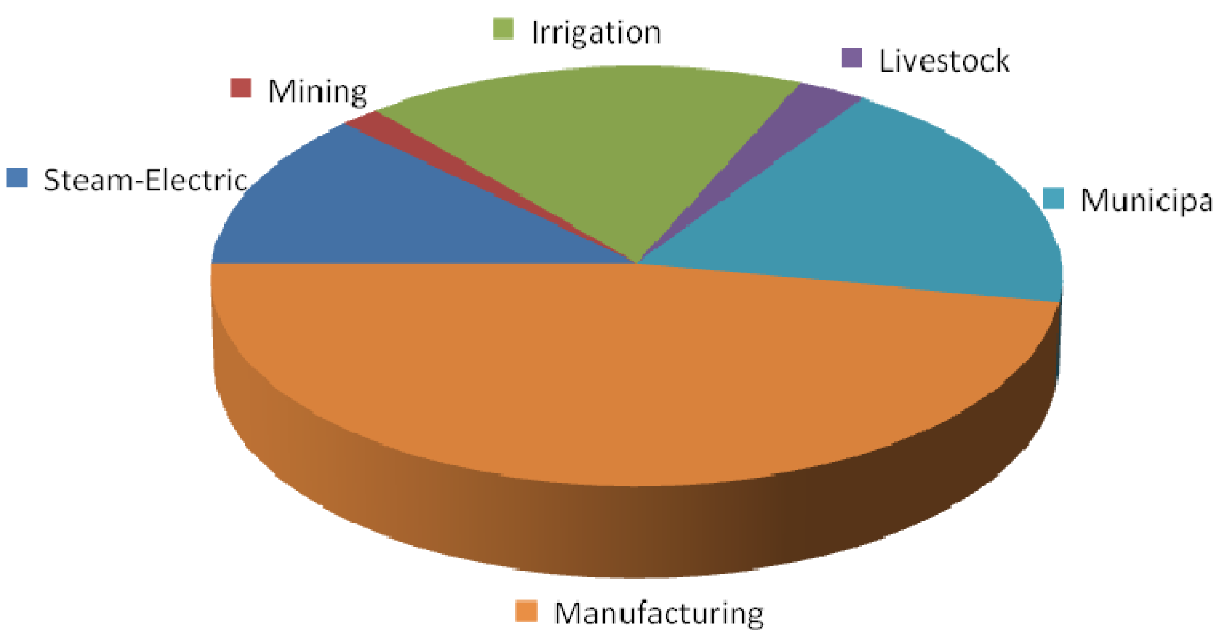


Figure 1.15
2060 Distribution of Water Demand



For purposes of this report, 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 as a whole, a single industry was selected if it had 20,000 ac-ft per year or more and represented the majority of usage in the county. Anticipated future power plants or increased usage by power plants was assumed to represent a single facility.

There are currently five major demand centers. An additional three major demand centers are expected to become prominent by 2060, are summarized in Table 1.5. Jefferson and Orange Counties are listed together as one demand center because of the unified nature of the metropolitan area. Other counties listed as demand centers are Angelina and Nacogdoches Counties in the middle of the region and Smith County at the northern end. Outside the listed counties, two existing and two anticipated industries – a paper mill and three steam-electric generating plants – are listed as demand centers in themselves. These facilities account for the vast majority of water usage in their counties, which otherwise would not constitute major demand centers.

1.9 Natural Resources and Agricultural Resources

Natural resources within the ETRWPA include timber, wetlands, estuaries, endangered or threatened species, ecologically significant streams, springs, and state or federal parkland and preserves. Agricultural resources are defined as prime farmland. Groundwater should be considered another primary resource for the region. Other natural resources include oil, natural gas, sand and gravel, lignite, salt and clay. Various major resources are described in the following subsections.

1.9.1 Timber. The primary natural resource in the region is timber. An abundance of pine and hardwood forests is evidenced by the numerous national and state parks and forests including the Angelina National Forest, Big Thicket National Preserve, Davy Crockett National Forest, and Sabine National Forest.

Table 1.5 Major Demand Centers

Description of Demand Center or User	2010 Water Use		2060 Water Use	
	Dominant Use	Ac- ft per Year	Dominant Use	Ac- ft per Year
Angelina County	Manufacturing and Steam-Electric	25,238	Manufacturing	48,356
Paper Mill in Jasper County	Manufacturing	58,916	Manufacturing	74,069
Jefferson and Orange Counties	Irrigation and Manufacturing	356,717	Irrigation, Manufacturing, and Steam-Electric	699,370
Nacogdoches County	N/A	<20,000	City of Nacogdoches and Steam-Electric	25,898
Power Plant in Rusk County	Steam-Electric	18,805	Steam-Electric	53,074
Smith County	Municipal	24,244	City of Tyler	32,253
Anderson County	N/A	<20,000	Steam-Electric	21,853
Newton County	N/A	<20,000	Steam-Electric	27,317

1.9.2 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.[13] 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.[13] There are significant wetland resources in the region, especially near rivers, lakes, and reservoirs.

Texas wetlands types and characteristics are summarized in Table 1.6. 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.[13] Table 1.7 shows the bottomland hardwood acreage associated with the four major rivers in the region.

Table 1.6 Texas Wetland Types and Characteristics

Wetland Classifications	Definition	Vegetation/Habitat Types
Palustrine	Freshwater bodies and intermittently or permanently flooded open-water bodies of less than 20 acres in which water is less than 6.6 feet dep. [3]	Predominantly trees; shrubs; emergent, rooted herbaceous plants; or submersed/floating plants. [2]
Estuarine	Tidal wetlands in low-wave-energy environments where the salinity of the water is greater than 0.5 parts per thousand (ppt) and is variable due to evaporation and mixing of freshwater and seawater. [2]	Emergent plants; intertidal unvegetated mud or sand flats and bars; estuarine shrubs; subtitdal open water bays (deep water habitat). [3]
Lacustrine	Wetlands and deepwater habitats with all of the following characteristics[4]: (1) situated in a topographical depression or in a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30% areal coverage; (3) total area exceeds 20 acres.	Nonpersistent emergent plants, submersed plants, and floating plants [3].
Riverine	Freshwater wetlands within a channel, with two exceptions [3]: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with salinity greater than 0.5 ppt.	Nonpersistent emergent plants, submersed plants, and floating plants [3].
Marine	Tidal wetlands that are exposed to waves and currents of the Gulf of Mexico and to water having salinity greater than 30 ppt [3].	Intertidal beaches, subtidal open water (deep water habitat) [3].

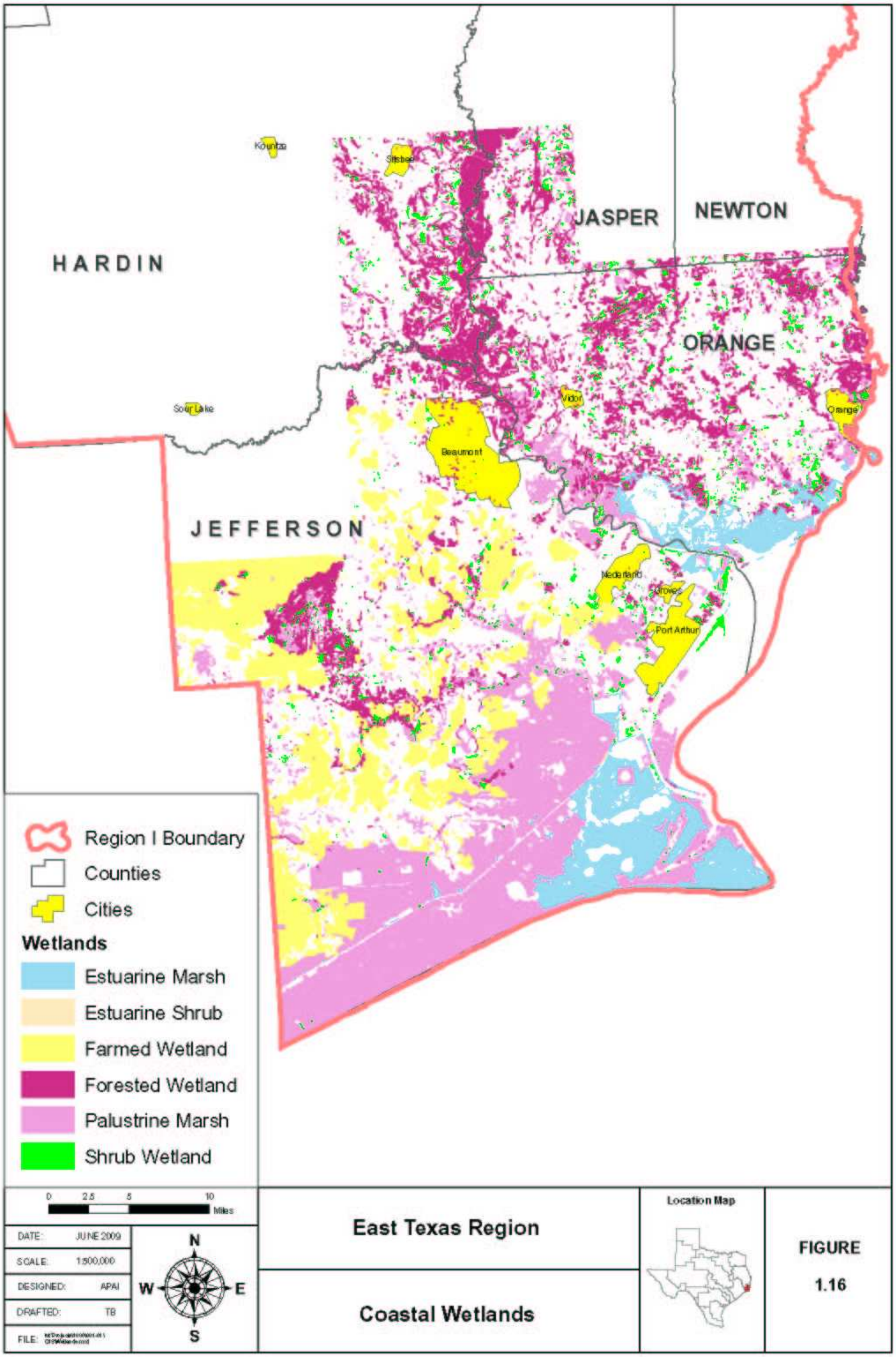
The TPWD, in a study of natural resources in Smith, Cherokee, Rusk, Nacogdoches, and Angelina Counties,[14] found the most extensive wetlands in the study area were water oak-willow and oak-blackgum forests along the Neches, Angelina, and Sabine Rivers. In the same study, TPWD noted the presence of a significant bald cypress-water tupelo swamp along the Neches River in Angelina County.[14] TPWD identified specific stream segments in the region that they classify as being priority bottomland hardwood habitat;[7] these segments will be discussed in later sections.

Table 1.7 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 located in ETRWPA.
Angelina River	88,000	All

* Information obtained from [5]

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.[13] Much of the palustrine wetlands area in Jefferson County is farmed wetlands used for rice growing. Figure 1.16 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.



East Texas Region

Coastal Wetlands

FIGURE 1.16

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,[15] particularly the emergent kind.

Three other kinds of wetlands cover a smaller area in the region but are ecologically significant:[15] lacustrine, riverine, and marine wetlands. See Table 1.6 above for a description of these types of wetlands.

Section 404 of the Clean Water Act 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 may include restoration and rehabilitation of native wetlands or construction of new wetlands. One wetland mitigation project, the Blue Elbow Swamp Mitigation Project, was identified near the mouth of the Sabine River. This mitigation project was established by the Texas Department of Transportation to compensate for future impacts to wetlands[16].

1.9.3 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 flow to the estuary.[17]

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 waves 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.

1.9.4 Endangered or Threatened Species. The TPWD has identified species of special concern in the region (See Appendix 1-A). Included are 19 species of birds, eight insects, six mammals, 15 reptiles/amphibians, nine fish, 13 mollusks, 22 vascular plants, and two crustaceans. These species are either listed as 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 Biological and Conservation Data System (TXBCD).

1.9.5 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.[18] 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 1.8 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 ecologically significant stream segments in the ETRWPA is found in Chapter 8.

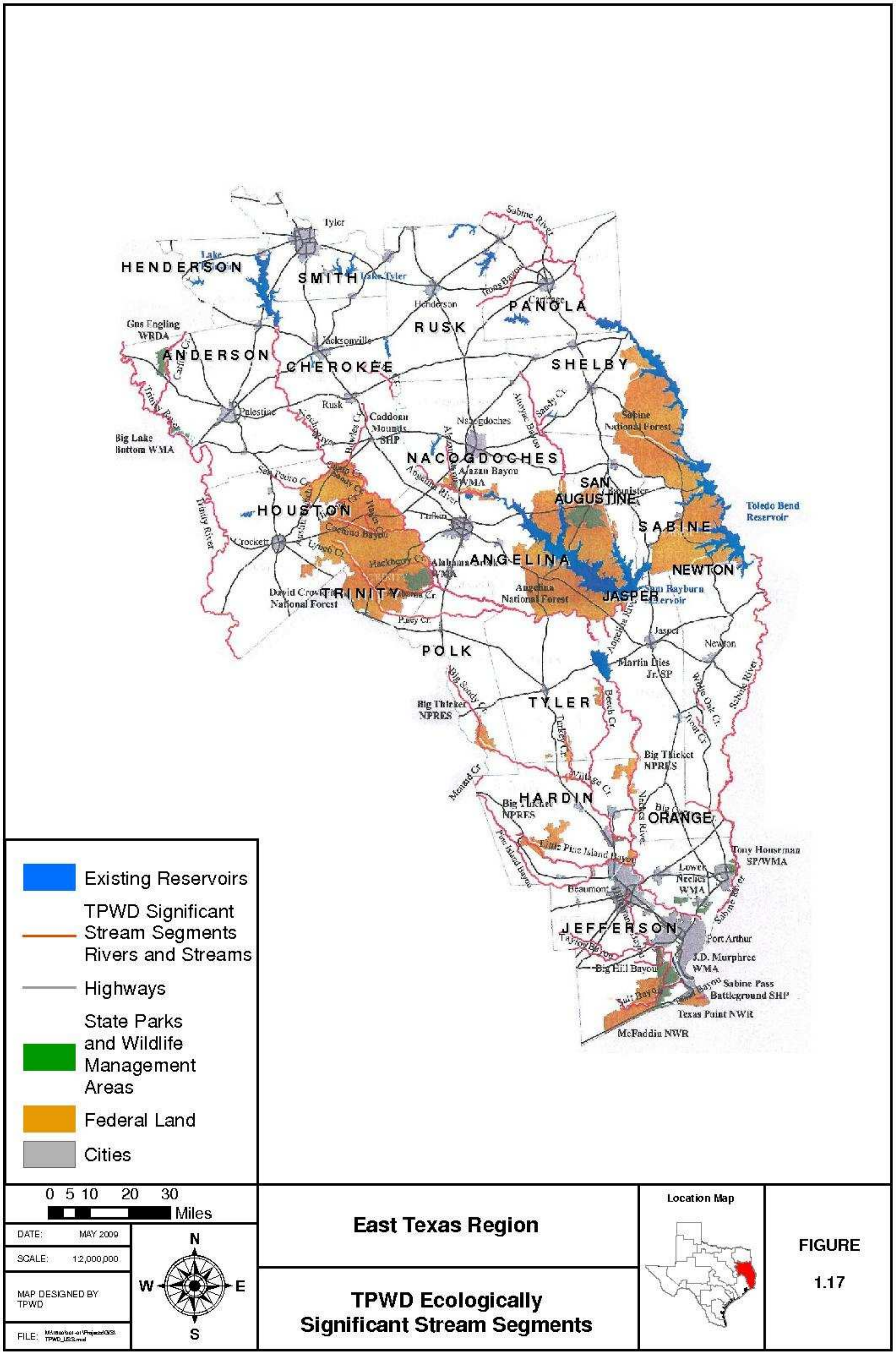
1.9.6 State and Federal Parks, Management Areas, and Preserves. The state and federal governments own and operate a number of parks, management areas, and preserves in the Region. Table 1.9 summarizes these facilities.

1.9.7 Springs. Over 250 springs of various sizes are documented in the ETRWPA.[4] 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 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. The springs identified by Brune and USGS are shown on the attached Figure 1.18.

Table 1.8 TPWD 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 # 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 SandyCreek	•		•	•		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



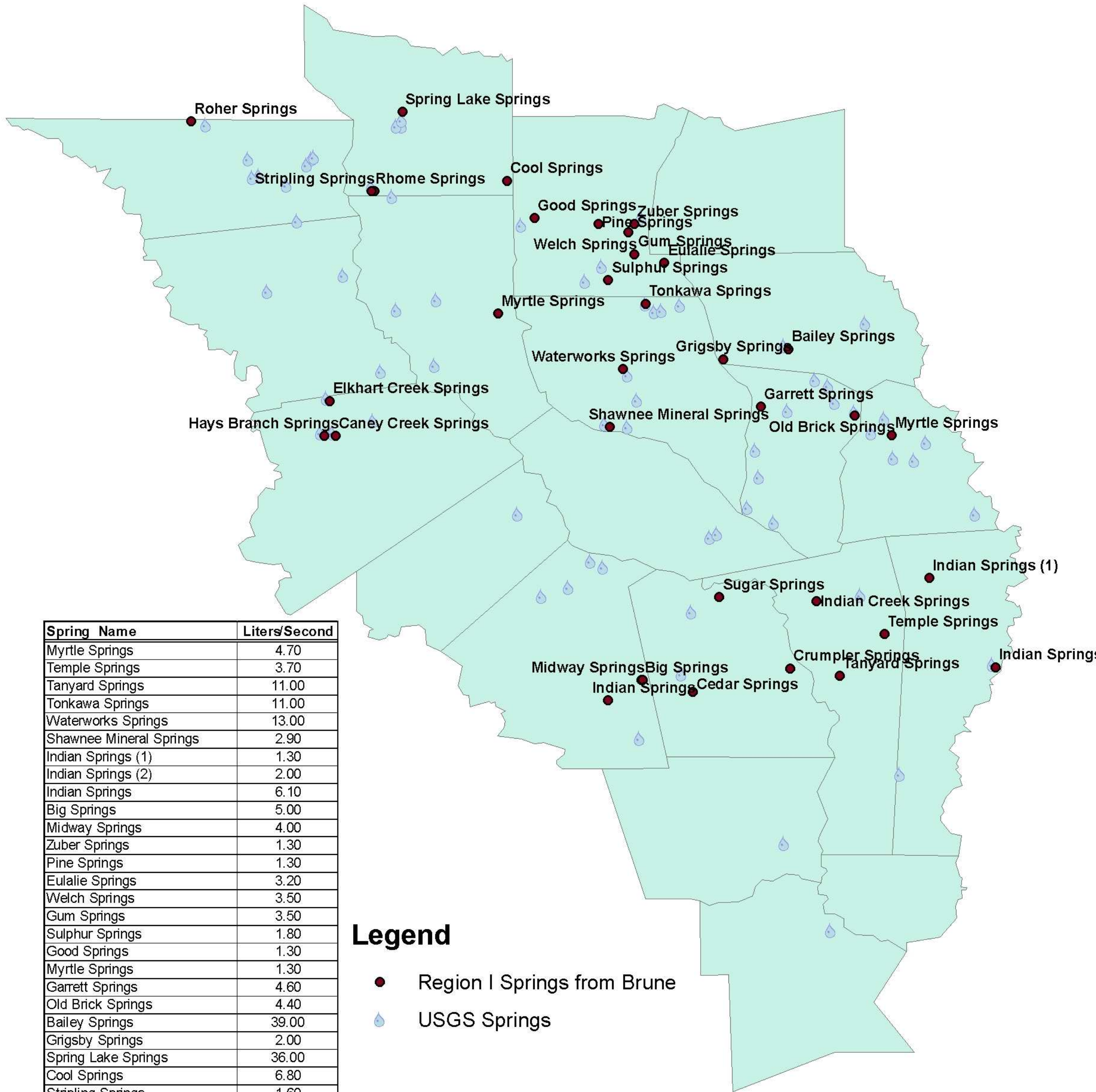
East Texas Region

TPWD Ecologically Significant Stream Segments

FIGURE 1.17

Table 1.9 State and Federal Parks, Management Areas, and Preserves

Owner/Operator	Name	County
Texas Parks and Wildlife Dept.	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
	North Toledo Bend Wildlife Management Area	Shelby
	Bannister Wildlife Management Area	San Augustine
	Moore Plantation Wildlife Management Area	Sabine and Jasper
	AngelinaNeches/Dam B. Wildlife Management Area	Jasper and Tyler
	Lower Neches Wildlife Management Area	Orange
	J.D. Murphree Wildlife Management Area	Jefferson
	Alazan Bayou Wildlife Management Area	Nacogdoches
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
	Sabine Pass Battleground State Historical Site	Jefferson
U.S. Army Corps of Engineers (USACE)	Sam Rayburn Reservoir	
	Town Bluff Dam, B.A. Steinhagen Lake	
U.S. Fish and Wildlife Service (USFWS)	Neches National Widlife 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



Spring Name	Liters/Second
Myrtle Springs	4.70
Temple Springs	3.70
Tanyard Springs	11.00
Tonkawa Springs	11.00
Waterworks Springs	13.00
Shawnee Mineral Springs	2.90
Indian Springs (1)	1.30
Indian Springs (2)	2.00
Indian Springs	6.10
Big Springs	5.00
Midway Springs	4.00
Zuber Springs	1.30
Pine Springs	1.30
Eulalie Springs	3.20
Welch Springs	3.50
Gum Springs	3.50
Sulphur Springs	1.80
Good Springs	1.30
Myrtle Springs	1.30
Garrett Springs	4.60
Old Brick Springs	4.40
Bailey Springs	39.00
Grigsby Springs	2.00
Spring Lake Springs	36.00
Cool Springs	6.80
Stripling Springs	1.60
Rhome Springs	1.30
Sugar Springs	1.60
Crumpler Springs	3.30
Cedar Springs	5.50
Roher Springs	11.67
Elkhart Creek Springs	96.28
Hays Branch Springs	50.97
Caney Creek Springs	48.14
Indian Creek Springs	360.00

Figure 1.18 Springs

East Texas Regional Water Planning Area

Brune reported a flow of 12.7 cubic feet per second (cfs) in the spring-fed Indian Creek in Jasper County, about five miles northwest of Jasper. This water was used at a 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), Elkhart Creek Springs in Houston County (1,500 gpm in 1965).

1.9.8 Agriculture/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."[19] As part of the National Resources Inventory, the NRCS has identified prime farmland throughout the country.

Figure 1.19 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 (STATSGO) 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 1.10 shows 2007 agriculture statistics for the counties in the region[20] (portions of Henderson, Smith, Polk, and Trinity Counties are located in other Regions). The following general statements may be made regarding the region:[21]

- In any one year, approximately 25% of farmland is cropland.
- In any one year, approximately 50% of cropland is harvested.
- Excluding Jefferson County, approximately 2% of cropland is irrigated. In Jefferson County, approximately 11% of cropland is irrigated.
- Poultry production generates the largest agricultural product sales in Angelina, Nacogdoches, Panola, Shelby, Sabine, and San Augustine Counties.

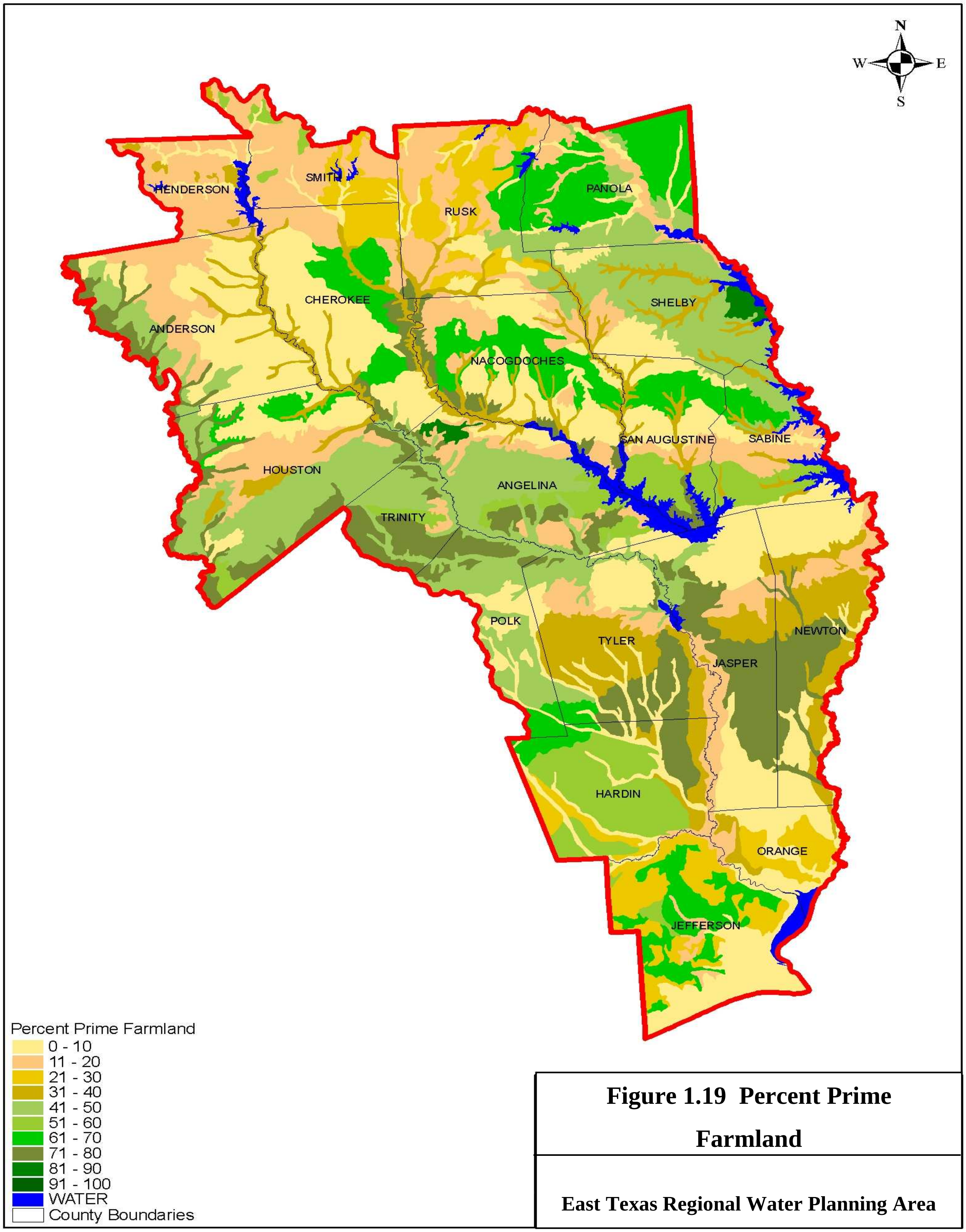


Figure 1.19 Percent Prime Farmland

East Texas Regional Water Planning Area

Table 1.10 U.S. Department of Agriculture
2007 Agricultural Statistics for Counties of the ETRWPA

Category	Anderson	Angelina	Cherokee	Hardin	Henderson	Houston	Jasper	Jefferson	Nacogdoches	Newton
Farms	1,771	1,109	1,625	699	2,109	1,562	920	793	1,277	403
Total Farm Land (acres)	346,142	115,258	294,383	91,189	318,452	440,462	95,928	333,255	265,131	59,236
Crop Land (acres)	74,892	43,253	76,592	22,100	86,495	109,201	20,192	153,620	59,353	8,083
Harvested Crop Land (acres)	46,120	15,492	49,026	7,659	57,128	59,097	11,399	32,234	30,279	4,050
Irrigated Crop Land (acres)	2,325	467	1,147	971	1,328	4,574	310	16,896	535	104
Market Value Crops ($1,000)	12,885	2,021	89,095	3,430	19,123	9,050	2,910	13,158	5,349	619
Market Value Livestock ($1,000)	26,475	27,417	51,162	2,884	25,390	31,603	3,753	13,609	311,938	1,477
Total Market Value ($1,000)	39,361	29,438	140,256	6,314	44,513	40,654	6,663	26,767	317,287	2,095
Livestock and Poultry:										
Cattle and Calves Inventory	59,917	22,293	62,691	7,773	64,535	83,948	13,657	40,693	46,328	5,354
Hogs and Pigs Inventory	(D)	233	141	235	636	(D)	100	160	197	65
Sheep and Lambs Inventory	500	317	98	258	267	(D)	201	139	90	54
Layers and Pullets Inventory	13,079	62,012	72,939	2,310	3,833	(D)	2,184	1,493	513,918	1,434
Broilers and Meat-Type Chickens Sold	(D)	7,003,357	8,628,993	170	(D)	200	(D)	0	98,366,618	(D)
Crops Harvested (acres):										
Corn for Grain or Seed	0	15	0	8	16	2,238	23	146	0	(D)
Cotton	(D)	0	(D)	0	0	(D)	0	0	0	0
Hay	42,328	14,201	45,474	5,756	53,215	47,925	9,266	16,709	29,318	3,792
Rice	0	0	0	(D)	0	0	0	13,016	0	0
Sorghum for Grain or Seed	0	0	0	0	0	(D)	0	(D)	0	0
Soybeans for beans	0	0	0	(D)	(D)	(D)	0	139	0	0
Wheat for Grain	0	0	0	175,355	(D)	(D)	0	0	(D)	0
Farms	675	1,042	812	1,521	223	346	1,123	2,514	576	792
Total Farm Land (acres)	63,748	217,757	131,664	300,900	31,724	72,640	197,791	302,359	108,974	84,253

**Table 1.10 U.S. Department of Agriculture
2007 Agricultural Statistics for Counties of the ETRWPA (Cont.)**

Category	Orange	Panola	Polk	Rusk	Sabine	San Augustine	Shelby	Smith	Trinity	Tyler
Crop Land (acres)	15,159	50,745	23,720	67,334	7,812	12,837	45,460	91,797	27,340	19,671
Harvested Crop Land (acres)	5,046	28,856	13,781	36'456	4,132	7,394	26,735	59,561	15,682	10,634
Irrigated Crop Land (acres)	553	371	1,440	848	16	114	600	2,651	310	437
Market Value Crops ($1,000)	(D)	2,704	3,923	17,456	292	1,406	4,191	42,499	1,266	(D)
Market Value Livestock ($1,000)	3,009	60,739	6,012	38,664	8,164	54,233	398,924	25,503	7,965	(D)
Total Market Value ($1,000)	(D)	63,443	9,935	56,120	8,456	55,639	403,115	68,002	9,231	21,763
Livestock and Poultry:										
Cattle and Calves Inventory	8,528	38,948	17,430	48,924	6,080	13,232	42,722	55,302	22,689	12,908
Hogs and Pigs Inventory	176	119	158	295	134	25	50	236	86	132
Sheep and Lambs Inventory	150	144	7	202	0	0	182	327	30	135
Layers and Pullets Inventory	1,501	(D)	138	(D)	236	217,840	1,371,757	5,485	362	2,080
Broilers and Meat-Type Chickens Sold	460	20,543,700	0	8,818,669	(D)	19,573,422	122,457,821	(D)	(D)	(D)
Crops Harvested (acres):										
Corn for Grain or Seed	0	(D)	(D)	0	(D)	6	0	16	0	7
Cotton	0	0	0	(D)	0	0	0	0	0	0
Hay	4,442	27,976	12,147	34,879	3,267	7,212	25,471	53,662	15,378	7,366
Rice	(D)	0	0	0	0	0	0	0	0	0
Sorghum for Grain or Seed	(D)	0	0	0	0	0	0	0	0	0
Soybeans for beans	0	0	0	0	0	0	0	(D)	0	0
Wheat for Grain	0	0	0	0	0	0	(D)	(D)	0	(D)

TOTALS FOR ALL COUNTIES:	
Total Farm Land (acres)	3,871,246
Crop Land (acres)	1,015,656
Crop Land/Total Farm Land (%)	26.23%
Harvested Crop Land (acres)	520,752
Harvested/Total Crop Land (%)	51.27%
Irrigated Crop Land (acres)	35,997
Irrigated/ Total Crop Land (%)	3.54%

SPECIAL FOR JEFFERSON COUNTY:	
Irrigated/ Total Crop Land (%)	11.0%
COUNTIES OTHER THAN JEFFERSON:	
Irrigated Crop Land (acres)	19,101
Irrigated/ Total Crop Land (%)	1.88%

(D) – Withheld to avoid disclosing data for individual farms

- Cattle and calf production generates the largest agricultural product sales in Anderson, Houston, Henderson, Rusk, Trinity, Polk, Jasper, Tyler, Orange, Hardin, and Newton Counties.

- Nursery and greenhouse crops generate the largest agricultural product sales in Cherokee and Smith Counties.

- Rice crops generate the largest agricultural product sales in Jefferson County.

1.10 Archeological Resources

The Texas Historical Commission (THC) maintains the Texas Historic Sites Atlas, a database containing historic county courthouses, National Register properties, historical markers, museums, sawmills, and neighborhood surveys.[22] This database contains a very large amount of data. The THC does not release information on archeological sites to the general public.

The most prominent archeological site in the ETRWPA is Caddoan Mounds State Historic Site, a 94-acre park in Cherokee County west of Nacogdoches. 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.[23]

1.11 Mineral Resources

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

1.11.1 Petroleum Production. Oil and natural gas fields are significant natural resources in portions of the region. There are low densities of producing oil wells in each county in the region. The East Texas Oil Field, a portion of which is located in Rusk County, ranked third in Texas in oil production in 1997. There are high densities of producing natural gas wells in Rusk, Panola, Nacogdoches, Jasper, and Newton Counties, with lesser densities in the other counties in the region. In 1997, four of the top 20 producing natural gas fields in the state are located in the region.[24]

- Carthage Gas Field in Panola County
- Oak Hill Gas Field in Rusk County
- Double A Wells Gas Field in Polk and Tyler Counties
- Brookeland Gas Field in Jasper and Newton Counties

Figures 1.20 through 1.22 depict oil and gas resources in the state, including the ETRWPA.

1.11.2 Lignite Coal Fields. Figure 1.23 shows lignite coal resources located in the region.[25] 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.

1.12 Threats to Agricultural and Natural Resources in the Region Due to Water Quality or Quantity Problems

A lack of water or lack of water of adequate quality can present a significant threat to agricultural and natural resources. Some of the most significant potential threats in the ETRWPA are described below.

1.12.1 Water Quality Threats. 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.[7] Appendix 1-B contains a list of the reaches with concerns. Appendix 1-C addresses groundwater quality issues in the region.

Figure 1.20 Top Producing Oil Wells

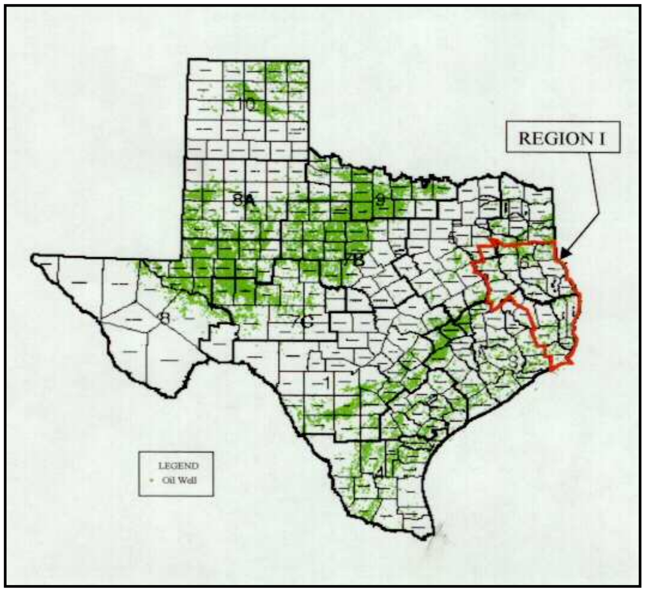


Figure 1.21 Top Producing Oil and Gas Fields

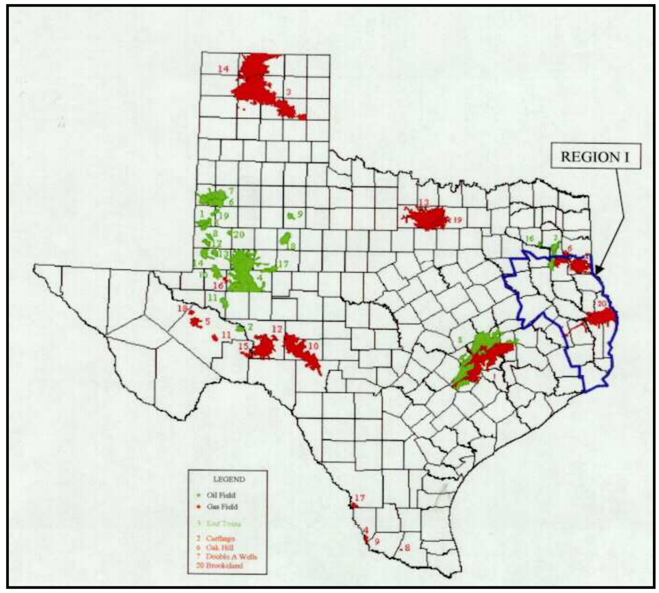


Figure 1.22 Top Producing Gas Wells

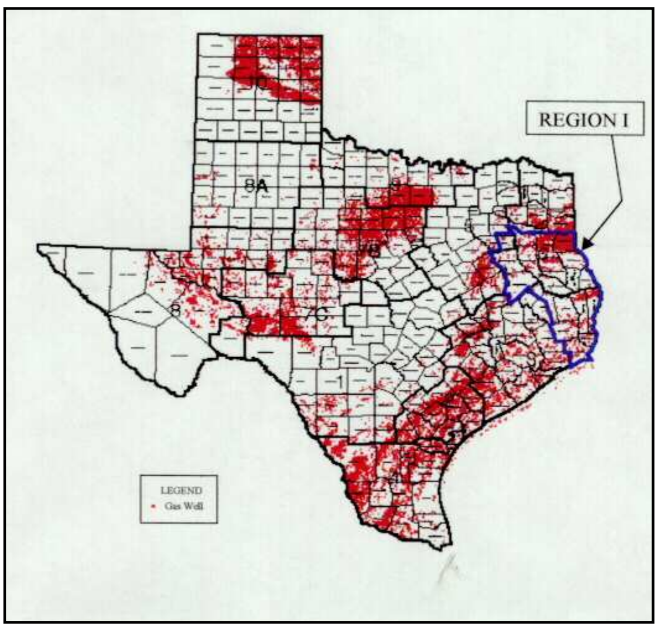
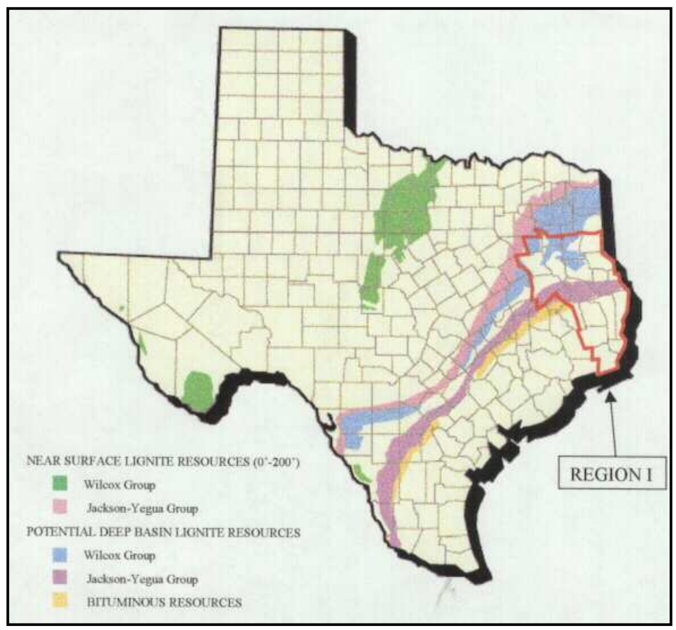


Figure 1.23 Texas Lignite Coal Resources



1.12.2 Drawdown of Aquifers. Overpumping of aquifers poses a small 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,[26] 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.[15] 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[26] and Jefferson County.

1.12.3 Insufficient Instream/Environmental Flows. Certain flow quantities and frequencies 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. Additionally, certain flow quantities or a physical barrier are required to control upstream encroachment of saltwater. Additional discussion of environmental flows is provided in Chapter 3.

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.

1.12.4 Inundation Due to Reservoir Development. The 1984 State Water Plan[27] recommended development of five reservoirs, as listed in Table 1.11. The ANRA has a state permit to construct Lake Columbia and is in the process of obtaining the necessary federal permits. The effects on natural resources of new reservoir construction at four of the five sites recommended in the 1984 State Water Plan will be discussed below, because these reservoirs appear to be the most likely to be constructed.

In addition, the 1997 State Water Plan identified alternative reservoir development sites in the region,[28] as listed in Table 1.12.

Table 1.13 shows the impacts of new reservoir development at the four potential reservoir sites on the surrounding land and on protected species.

For the reservoirs recommended in the 1984 Plan, TPWD divided the inundated acreage into Resource Categories, depending on the quality of the habitat.[27] Resource Category (1) habitat is categorized as high value habitat, unique habitat, or irreplaceable habitat for which mitigation is not possible.

Table 1.11 Recommended Development of Reservoirs (1984 State Water Plan)[8]

Reservoir, River Location	County
Lake Columbia, on Mud Creek	Cherokee
Rockland Reservoir, on the Neches River	Angelina, Trinity, Polk, Tyler, and Jasper
Fastrill Reservoir, on the Neches River	Anderson, Cherokee, and Houston
Bon Wier Reservoir, on the Sabine River	Newton County, Texas and Beauregard Parish, Louisiana.
Tennessee Colony Reservoir, on the main stem of the Trinity River	Freestone, Navarro, Henderson, and Anderson Counties *(partially in Region C)*.

Table 1.12 Recommended Alternative Reservoir Development Sites (1997 State Water Plan)[28]

Reservoir	County
Newton, Big Cow Creek, and Little Cow Creek	Newton
Dam A	Jasper
Rockland	Tyler
Cochino	Trinity
Big Elkhart, Hurricane Bayou, Gail, and Mustang	Houston
Fastrill and Catfish Creek	Anderson
Ponta	Nacogdoches, Cherokee, and Rusk
Attoyac	Nacogdoches (would overlap Shelby and/or San Augustine Counties)
Tenaha	Shelby
Stateline	Panola
Socagee Reservoir	Panola
Carthage Reservoir	Panola, Rusk, Harrison, and Gregg
Cherokee II	Rusk
Rabbit Creek	Smith and Rusk
Kilgore	Smith, Rusk, and Gregg
State Highway 322 Stages I and II*	Rusk
Fredonia Lake*	Rusk and Harrison

*Other reservoir sites[9]

Resource Category (2) habitat is categorized as high value habitat, scarce habitat or becoming scarce, for which mitigation is possible with an established goal of no net loss of in-kind habitat value. From a practical standpoint, Category (2) habitat for the proposed reservoir sites depicts types of habitats such as wetlands and riparian bottomland forest areas that reflect high natural resource values and high sensitivity regarding destruction.

Category (3) habitat includes abundant and medium to high value habitat (for the evaluation species) with a mitigation goal of no net loss of habitat value while minimizing loss of in-kind habitat value. Category (4) habitat includes remaining medium to low value habitat for which habitat value deterioration would be minimal.

The proposed Lake Columbia site is categorized as excellent habitat for turkey and gray squirrel and modest habitat for deer. In the proposed reservoir location, Mud Creek is a "pristine area that provides excellent stream habitat." TPWD has identified Mud Creek as a significant stream segment due to its high bottomland hardwood resource value.[18] It should be noted that a comprehensive environmental impact study for Lake Columbia has been prepared and was published on January 29, 2010 [29].

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 defines Priority 1 as "excellent quality bottomlands of high value to waterfowl" and Priority 2 as "good quality bottomlands with moderate waterfowl benefits."[30]

The USACE 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.[31]

Table 1.13 Potential Impacts of Development on Land Reservoir Area and Protected Species

Potential Impacts		Potential Reservoir Site			
		Columbia [29]	Rockland	Bon Weir	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	**10,133**	**99,500**	**35,100**	**85,100**
Endangered Species Potentially Impacted	Arctic peregrine falcon	•	•	•	•
	Black-capped vireo				•
	Eskimo Curlew				•
	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	•	•	•	•
	Reddish egret		•	•	
	Sandbank pocketbook	•	•	•	•
	Southern hickorynut	•	•	•	•
	Texas heelsplitter	•	•	•	•
	Texas horned lizard	•	•	•	•
	Texas pigtoe	•	•	•	•
	Timber rattlesnake	•	•	•	•
	White-faced ibis	•	•	•	•
	Wood stork	•	•	•	•

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 and/or no waterfowl benefits."[30]

Construction of the Tennessee Colony Reservoir would inundate approximately 13,800 acres of bottomland, which comprise the Richland Creek Wildlife Management Area (WMA) 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.[30] The WMA is located in Freestone County on the west side of the Trinity River within the boundaries of the proposed Tennessee Colony Reservoir.

The Tennessee Colony Reservoir is an alternative to two Region C water supply projects recommended in the 1997 state water plan. If the Tennessee Colony Reservoir were built, neither the Tehuacana Creek Reservoir (located in Region C) nor the diversion of water from the Trinity River would be necessary.[32]

1.13 Threats and Constraints on Water Supply

Water supplies in the ETRWPA may be threatened by conditions outside of the region. Some significant potential threats are discussed following.

1.13.1 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 all of the basin upstream from the state line is in Texas. However, Texas does not have completely unrestricted access to the water in that area.

The Sabine River Compact, executed in 1953, provides for allotment of the water between Texas and Louisiana.[33] 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 the water rights.

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.

1.13.2 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 by 2015. A long-range potential strategy to transfer water from Toledo Bend Reservoir to reservoirs located in Region C is under consideration. The ETRWPG undertook a study in 2008 on the potential cost and environmental impacts of a pipeline project for such a transfer. The recommendations from this study are included in Chapter 4C of this report.

1.13.3 Interception in Other Regions. It should be noted that large portions of the Sabine and Trinity basins are upstream from the region, as well as a small portion of the Neches basin. The upper Trinity basin includes the Dallas-Fort Worth area. The upper Sabine basin contains numerous medium sized cities as well as smaller communities. 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 SRA has contracts to provide over 300,000 ac-ft per year to the Dallas area from reservoirs in the upper Sabine basin.

1.14 Drought Preparation, Water Conservation, and Water Loss

Water conservation and drought contingency 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 the following subsections.

1.14.1 Drought Contingency. Many larger communities and other suppliers provide water to neighboring systems on a wholesale basis, either full time or as a standby source. Most of these water suppliers are required to have water conservation plans. Included in each water conservation plan is a drought contingency plan for acute shortages. Many entities have been required in recent years to develop drought contingency plans as a separate requirement, or to upgrade such plans which were already contained in their water conservation plans. Required elements of drought contingency plans include trigger conditions for specific actions such as requests for voluntary water reduction, surcharges, or rationing.

1.14.2 Water Conservation. The TWDB began requiring water conservation plans during the middle 1980s as a condition for TWDB funding for water or sewer facilities in excess of $500,000. The TCEQ also requires such plans for surface water users, pursuant to state legislation.

Legislation in 2003 tightened the requirements for water conservation and drought contingency plans and required the water suppliers to review the plans every five years. One requirement is that specific five- and ten- year targets for water use reduction be included in the plans. Additionally, drought contingency plans must include specific targets for water reduction during various stages of emergency. Most requirements in the new law became effective May 1, 2005.

Wholesale water suppliers must pass water conservation and drought contingency requirements on to their wholesale customers. The wholesale customer may be required to develop its own plan or alternatively to follow the requirements in the supplier's plan. These requirements must be included in any new, renewed, or amended water supply contracts. Contracts must include provisions to pass on the requirements to any lower tier water suppliers to which the wholesale customer resells water, so that they will apply to any systems being supplied either directly or indirectly from the initial wholesale supplier.

Water conservation and drought contingency plans in the ETRWPA must now be coordinated with the ETRWPG. Drought contingency plans for water user groups and wholesale water providers must be updated, if necessary, to remain consistent with the regional water plan.

1.14.3 Water Loss and Water Audit. 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. The TWDB established new requirements for water audit reporting, which require public utilities to audit their water system once every five years and report water loss data to the TWDB. The first set of water loss data was to be submitted to the TWDB by March 31, 2006. The TWDB funded a study to evaluate water loss survey responses from all retail utilities in Texas, and published the report, *An Analysis of Water Loss as Reported by Public Water Suppliers in Texas*[34] in 2007. The Executive Summary of this report and a comparison of water loss on a regional basis is provided in Appendix 1-D.

The study evaluated water loss survey responses to determine water loss performance by regional water planning area. Based on data from responding utilities, the study reported that the ETRWPA demonstrates one of the highest average non-revenue water percentages at approximately 25%. Of this percentage, 5.5% may be attributed to unbilled, unmetered water use. Unbilled, unmetered water use is the amount of authorized water consumption that was neither metered nor billed and represents the amount of water for which the utility does not receive compensation. The report recommends that regions with high average non-revenue water percentages consider steps to recover lost revenue from unbilled authorized consumption.

1.14.4 Groundwater Conservation Districts and Groundwater Management Areas. 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 ten-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.

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 (DFCs), and estimate Managed Available Groundwater (MAG) for permitting purposes.

The boundaries of the ETRWPA encompass 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.

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 headquarted 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.

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

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, headquartered northeast of Henderson, covers Rusk County. The District was created by the legislature in 2003.

Counties Not Covered by Groundwater Conservation Districts. Houston, Jefferson, Orange, Sabine, San Augustine, Shelby, Smith, and Trinity Counties are not covered by any confirmed or pending GCD.

1.15 Consideration of Existing Water Planning Efforts and Programs

The ETRWPA published its first round of regional water planning in 2001. This plan was updated on schedule in 2006. The 2011 Plan makes up the second update to the regional water plan. 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. Following is a summary of planning efforts and existing programs that have been considered and utilized by the ETRWPG.

1.15.1 State, Regional, and Local Water Management Planning. Water planning in the ETRWPA incorporates a mixture of 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 water management strategies 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 water management strategies 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 economic or environmentally appropriate 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 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 ETRWPG 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. In addition, groundwater conservation districts within the region have prepared groundwater management plans as well as 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 1.14.4 of Chapter 1.

1.15.2 Texas Clean Rivers Program. The Texas Clean Rivers Program (TCRP) was established with the promulgation of the Clean Rivers Act of 1991. TCRP provides for biennial assessments of water quality to identify and prioritize water quality problems within each watershed and subwatershed. In addition, TCRP seeks to develop solutions to water quality problems identified during the biennial assessments. The TCEQ administers the program.

The TCEQ contracts with fifteen regional agencies to conduct the required stream assessments in the various river basins. With the exception of the International Boundary and Water Commission and one water district, these agencies are river authorities. Each agency posts recent assessment reports for its territory on its web site.

Agencies conducting the stream assessments within ETRWPA are:

- Angelina and Neches River Authority (Lufkin) (upper portion of Neches River Basin).
- Lower Neches Valley Authority (Beaumont) (lower portion of Neches River Basin plus Neches-Trinity Coastal Basin).
- Northeast Texas Municipal Water District (Hughes Springs) (Cypress Creek Basin).
- Sabine River Authority of Texas (Orange) (Sabine River Basin).
- Trinity River Authority of Texas (Arlington) (Trinity River Basin).

1.15.3 Safe Drinking Water Act. The Safe Drinking Water Act (SDWA), passed in 1974 and amended in 1986 and 1996, allows the U.S. Environmental Protection Agency to set drinking water standards. These standards are divided into two categories: National Primary Drinking Water Regulations (primary standards that must be met by all public water suppliers) and National Secondary Water Regulations (secondary standards that are not enforceable, but are recommended). Primary standards protect water quality by limiting contaminant levels that are known to adversely affect public health and are anticipated to occur in water. Secondary standards have been set for contaminants that may pose a cosmetic or aesthetic risk to the public (e.g., taste, odor, or color).

Standards cover various categories of parameters which have been determined to be harmful if present in more than specified concentrations. These include certain organic, inorganic, and radioactive substances; and pathogens as indicated by coliform bacteria. Surface water treatment must achieve a specified removal or inactivation of other designated pathogens (*Cryptosporidium* oocysts, *Giardia* cysts, and viruses).

Minimum and maximum disinfectant residuals must be maintained. Disinfection byproducts, which increase as the water travels through the distribution system, have limits. Turbidity and total organic carbon are regulated for surface water. Lead and copper must not leach out from home plumbing in more than trace amounts. Other standards cover qualitative parameters including color, corrosivity, odor, and pH.

Additionally, certain unregulated substances must be monitored in an effort to determine whether they should become regulated. The lists of regulated and monitored parameters are revised from time to time as more is learned about them. A candidate list of additional parameters for regulation must be published every five years. The draft 2004 list includes ten microbial and 42 chemical parameters.[35]

The TCEQ requires public water systems to meet primary standards and, when practical, secondary standards. A water system must meet a number of requirements, including all primary standards to gain recognition as an Approved Public Water System. To be recognized as a Superior Public Water System, the system must also meet all secondary standards.

1.15.4 Water for Texas. Developed by the TWDB, this comprehensive State Water Plan identifies current and prospective water uses, water supplies, and water users. The plan also identifies needed water-related management measures, facility needs, and costs, and offers recommendations to better manage the State's water resources through Year 2050. This plan was adopted by the TWDB in August 1997.

The first cycle of regional water planning, which was completed in 2001, resulted in an updated state water plan, *Water for Texas 2002*, which addressed the same issues but was developed on a regional basis. SB1 had established sixteen planning regions within the state. In each region, local representatives worked with consultants to develop a regional water plan to submit to the TWDB by 2001. The TWDB, after review and approval of each regional plan, consolidated the plans into a state plan which was finalized in 2002. The second comprehensive state plan was finalized in 2007.

Each regional plan includes a section in which water supply strategies are recommended for each water user group *(such as a city or industrial sector within a county),* which has a forecast water shortage. Strategies may be as simple as renewing a contract for purchased water, or as involved as constructing a new water supply reservoir.

The plan is being updated every five years by the regions on an ongoing basis. The third five-year cycle, which includes this report, will result in regional plans in 2011 and a state plan in 2012.

1.15.5 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. 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.

1.15.6 Water Availability Modeling for the Neches River Basin. This report dated April 1999, was prepared for the Texas Natural Resource Conservation Commission (predecessor agency to the TCEQ) by Brown and Root, Inc., Freese and Nichols, Inc., Espey Padden Consultants, Inc., and Crespo Consulting Services, Inc. The study determined naturalized stream flows *(the flows which would occur without the effects of human activity such as consumption and return flows)* and developed a model to determine water available to meet water rights.

Naturalized stream flows averaged 6.3 million ac-ft per year, with a minimum of 1.4 million ac-ft per year in 1967. Water rights total 4 million ac-ft per year. Cancellation of selected water rights would have little effect on reliability for the remaining rights.

1.15.7 Trinity River Basin Master Plan. This study has been updated various times, most recently 2001. Water use projections show water use in the Upper Basin (*all counties north of Freestone and Anderson*) to increase from 904,000 ac-ft per year to 2,165,000 ac-ft per year from 1990 to 2040. Middle and Lower Basin use is shown to increase from 141,100 ac-ft per year to 302,400 ac-ft per year from 1990 to 2040. The groundwater component of the Middle and Lower Basin usage is shown to increase from 40 MGD to 63 MGD during the same period.

The firm yield of existing and under-construction major reservoirs within the Trinity Basin was 2,325,100 ac-ft per year. Several new reservoirs were recommended, including Tennessee Colony. The Tennessee Colony reservoir *(partially within the ETRWPA)* is not shown as an immediate need. The plan recommended construction of the reservoir when needed for flood control and/or water supply. Coordination with lignite mining was also pointed out, so that all feasible lignite mining within the reservoir area could be performed before construction.

A number of other recommended reservoirs are included in the plan, including several smaller reservoirs within the ETRWPA in Anderson and Houston Counties.

1.16 Special Studies

In 2008 and early 2009, the TWDB funded five special projects for the ETRWPA, to be conducted prior to preparation of the 2011 Plan. The studies were undertaken by the ETRWPG consulting team. To the extent practical, these studies have been considered in the development of the 2011 Plan and their findings incorporated into the plan. Their findings are summarized below.

1.16.1 Special Study No. 1: Interregional Coordination on the Toledo Bend Project. The 2007 State Water Plan recommends moving water from Toledo Bend Reservoir in East Texas to water providers in Region C to satisfy primarily projected increased water demands in the Dallas-Fort Worth Metroplex. The project consists of transporting up to 500,000 to 700,000 acre-feet per year of water from Toledo Bend Reservoir to other lakes in Texas. The Toledo Bend Project is a recommended water management strategy for the North Texas Municipal Water District, Tarrant Regional Water District and the Sabine River Authority, and it is an alternative water management strategy for Dallas Water Utilities and the Upper Trinity Regional Water District. Since this study was recommended in the 2007 State Water Plan, there have been on-going developments regarding future water supplies for the participants of this project.

This study was conducted to better understand the impacts of these developments on the proposed Toledo Bend Project, and update the strategy descriptions. The major tasks included: 1) coordination with the major participants and confirmation of supply amounts and delivery locations, 2) review and update schematic transmission routes, 3) identify potential impacts to receiving reservoirs, 4) review naturalized flows to Sabine Lake and compare these flows to the Texas Parks and Wildlife Department's recommended freshwater inflows, and 5) update capital costs and develop life cycle costs for the refined project. This special study was utilized in the 2011 Plan primarily in the development of costs used by Region C in development of this strategy for use in the Region C plan. However, the study also enabled the ETRWPG to better consider potential environmental impacts associated with the potential transfer of water from one basin to another.

1.16.2 Special Study No. 2: Regional Solutions for Small Water Suppliers. The purpose of this study was to identify small municipal water suppliers that do not meet certain requirements of the Texas Administrative Code (30 TAC 290) and to determine the feasibility of a regional water strategy to meet the deficiencies. Only the systems meeting both the applicable size and needs criteria were covered in the study.

Small WUGs are defined for purposes of state and regional water planning as those serving a population of less than 1500 (typically, 500 connections). Smaller systems typically have fewer resources to use in their long range planning. The needs addressed in this study are limited to facility sizing and drinking water quality. More specifically, the sizing issues consist of quantity of water supply and total water storage. Water quality problems for the purpose of this study are any violations of the primary (health related) drinking water standards. This study supports regional water planning by increasing the degree of participation of applicable small water systems in the regional water plan. These systems are afforded an opportunity to consider regional solutions for their problems, involving wholesale purchase of water from another supplier. Alternately they could propose other types of solutions. In either case, they were made more conscious of alternate solutions. In many cases, the local system operators provided valuable input to the Regional Water Planning Group and its consultants. As individual strategies are selected, the overall strategy for the Region can be formed more accurately.

1.16.3 Special Study No. 3: Study of Municipal Water Uses to Improve Water Conservation Strategies and Projections. This study provided for a survey of WUGs in the ETRWPA in order to gain an improved understanding of current water conservation practices and to use the findings for development of conservation strategies and projections of water conservation savings in the region.

In August 2008, water production and sales surveys were mailed to 65 WUGs in the ETRWPA with approximately 1,000 connections or more. A total of 27 WUGs returned the completed survey with useable information, constituting a 42% response rate. Survey data were received from a diverse range of WUGs. In 2007, the number of connections for responding WUGs ranged from approximately 880 connections to 41,500 connections. Approximately one half of the WUGs had less than 2,000 connections. Three surveys were received from WUGs with more than 10,000 connections. In aggregate, the response represents roughly 39% of the total population of the ETRWPA.

The survey results suggest that current water use among responding WUGs in Region I is efficient and may be generally lower than other areas of the state on a per capita basis. These data suggest that the identification and development of cost-intensive measures for additional active water conservation in Region I may not be justified at this time. The results of this study were considered in the update to Chapter 6 of the 2011 Plan, regarding water conservation in the ETRWPA.

1.16.4 Special Study No. 4: Lake Murvaul Study. The 2006 Plan indicated a projected deficit for steam electric power in Rusk County beginning in 2020. This deficit is attributed to increased demands at the Luminant Martin Lake facility located in northeast Rusk County. The proposed strategies to meet these needs include: 1) exercise a contract option with the city of Dallas for water from Lake Fork, and 2) increase the supply from Toledo Bend Reservoir. Collectively, these strategies provide 28,074 acre-feet per year. For this study, Lake Murvaul was considered as an alternate source of water for the Luminant facility in lieu of some of the other recommended surface water supplies or local groundwater.

Lake Murvaul is owned by the City of Carthage and the sale of water from this project could be a potential revenue source for the City. Considering these factors, the ETRWPG authorized Special Study No. 4 to evaluate the feasibility of using water from Lake Murvaul for steam electric power demands at the Luminant Energy Martin Lake facility.

Luminant Energy was contacted regarding the concept of using unpermitted yield from Lake Murvaul to supply water to the steam electric plant at Martin Lake. However, Luminant Energy indicated that at this time Luminant has no plans for obtaining water from Lake Murvaul to supply Martin Lake. Luminant Energy has exercised its contract option with the City of Dallas and can now transfer 12,000 acre-feet per year from Lake Fork to the station at Martin Lake. Luminant has built a pipeline to use this water. Based on this information, further work on this study was suspended, with permission of the TWDB and the ETRWPG.

1.16.5 Special Study No. 5: Liquid Natural Gas Refinery Expansions in Jefferson County. The LNVA provides water supply for the majority of industrial users in Jefferson County. Near the end of the planning cycle for the 2006 Plan, a number of significant proposed industrial expansions related to refining liquid natural gas (LNG) came to the attention of the ETRWPG. The impact of these potential expansions on water supply could not be defined prior to the completion of the 2006 Plan. However, the need for water for these facilities could be significant. Therefore, the ETRWPG authorized a study to identify the potential impact of the proposed LNG facilities on water resources in the ETRWPA.

Water management strategies were evaluated for impacts as addressed in Chapter 4D of the 2006 Plan. The evaluation was based on a numeric evaluation from most desirable (1) to least desirable (5) and is provided in the following table. The major potential impact was determined to 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 WMS in Chapter 4C of the 2011 Plan.

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 demand for water is based, in part, on population projections for the region. In this chapter, projected population growth for the ETRWPA is examined. Water demand projections have also been developed for the various categories of water use and for WWPs.

2.1 Methodology for Updating Demands

For the 2006 Plan, the TWDB provided initial population and demand projections for water users in the region. The ETRWPG forwarded the population projections to the respective entities within the ETRWPA Region 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 the projected populations and current gallons per capita per day (gpcd) usages, allowing for reduction in demands associated with water conservation achieved through eventual compliance with plumbing codes. Demands for other use categories (manufacturing, irrigation, steam-electric, livestock, and mining) were developed with input from representatives of these areas.

For the 2011 Plan update, the population and water demand projections adopted for the 2006 water plan were reviewed in light of changed conditions and new water user groups (WUGs). No changes were made to the total regional population. Five new WUGs were identified in the region. These WUGs are water supply corporations that were found to meet the TWDB criteria for designation as a WUG. New population and demands projections were developed for these entities.

The following changes to water demands are included in the 2011 Plan:

- Increased steam-electric water demand in Angelina County.
- Municipal water demands for newly identified WUGs in Angelina and Nacogdoches Counties (no net change on a county-wide basis).
- Reduced manufacturing water demand for Angelina County.
- Increased manufacturing water demand for Jefferson County.
- Reduced irrigation water demands for Hardin and Jefferson Counties.
- Increased mining water demands in Angelina, Cherokee, and Nacogdoches Counties.
- New mining water demands for Shelby and San Augustine Counties.

Correspondence related to these changes is provided in Appendix 2-A. A summary of population estimates and water demands by county and basin are shown in Appendix 2-B.

2.2 Population Growth

The population in the ETRWPA is projected to increase from 1,011,317 to 1,482,448 from 2000 to 2060. The major centers of population – Jefferson, Smith and Angelina Counties – comprise nearly 50% of the population through the entire planning period. The projection of population growth from 2010 to 2060 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 the Nacogdoches, Angelina, and Polk County areas. The distribution of population by county and individual entity is provided in Table 2.1.

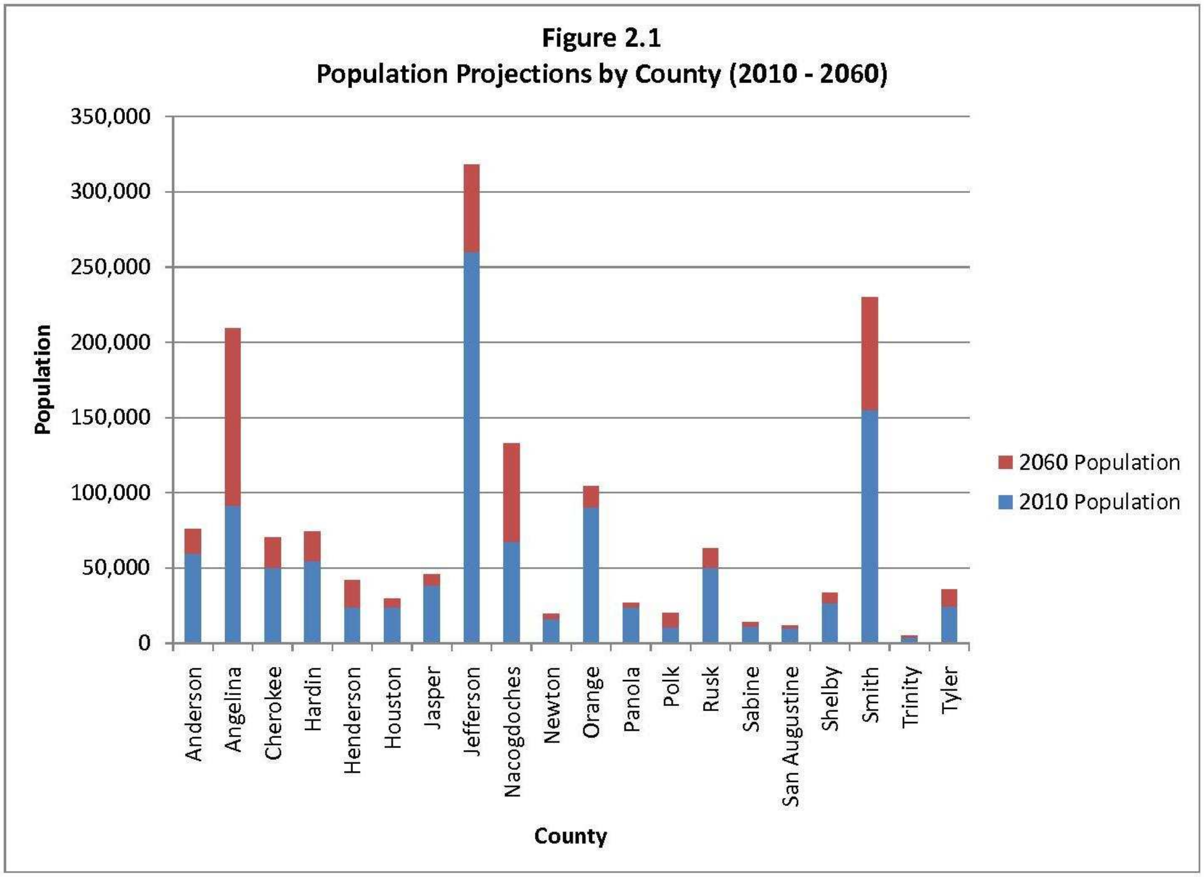
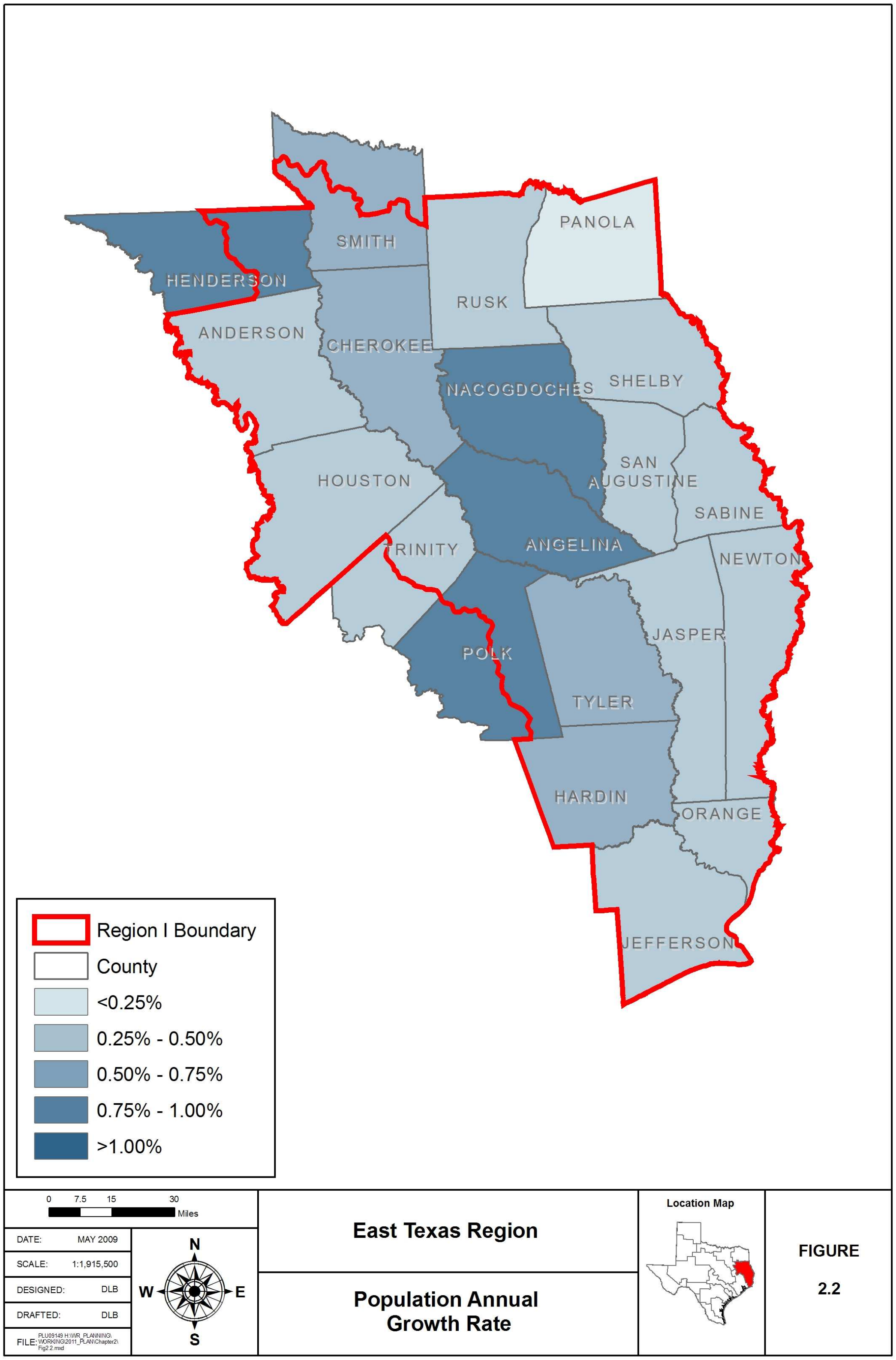


Figure 2.1
Population Projections by County (2010 - 2060)
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Population
2060 Population
2010 Population
Anderson
Angelina
Cherokee
Hardin
Henderson
Houston
Jasper
Jefferson
Nacogdoches
Newton
Orange
Panola
Polk
Rusk
Sabine
San Augustine
Shelby
Smith
Trinity
Tyler
County


PANOLA
SMITH
HENDERSON
RUSK
ANDERSON
CHEROKEE
NACOGDOCHES
SHELBY
HOUSTON
SAN AUGUSTINE
SABINE
TRINITY
ANGELINA
NEWTON
JASPER
POLK
TYLER
HARDIN
ORANGE
JEFFERSON
Region I Boundary
County
<0.25%
0.25% - 0.50%
0.50% - 0.75%
0.75% - 1.00%
>1.00%
0
7.5
15
30
Miles
DATE: MAY 2009
SCALE: 1:1,915,500
DESIGNED: DLB
DRAFTED: DLB
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N
S
E
W
East Texas Region
Population Annual Growth Rate
Location Map
FIGURE
2.2

Table 2.1 Distribution of Population by County/Entity

Original figures taken from TWDB Board Revisions dated Feb. 5, 2005

County/Entity	Historical	Projections					
Anderson County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Brushy Creek WSC	2,928	3,155	3,332	3,466	3,604	3,712	3,805
Consolidated WSC	1,447	1,560	1,647	1,713	1,781	1,834	1,881
County-Other	24,445	26,344	27,821	28,934	30,091	30,994	31,768
Elkhart	1,215	1,309	1,383	1,438	1,496	1,541	1,579
Four Pine WSC	2,727	2,939	3,104	3,228	3,357	3,458	3,544
Frankston	1,209	1,303	1,376	1,431	1,488	1,533	1,571
Palestine	17,598	18,965	20,028	20,830	21,663	22,313	22,870
Walston Springs WSC	3,540	3,815	4,029	4,190	4,358	4,488	4,601
Anderson County Total	***55,109***	***59,390***	***62,720***	***65,230***	***67,838***	***69,873***	***71,619***
Angelina County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Central WCID of Angelina County	6,302	6,564	6,886	7,283	7,783	8,470	9,380
County-Other	14,354	15,180	16,197	17,451	19,031	21,197	24,069
Angelina WSC	3,344	3,537	3,774	4,066	4,434	4,939	5,608
Redland WSC	2,264	2,394	2,555	2,752	3,001	3,343	3,796
Diboll	5,470	6,449	7,654	9,137	11,007	13,574	16,976
Four Way WSC	2,972	4,503	6,388	8,708	11,634	15,649	20,970
Hudson	3,792	5,021	6,535	8,398	10,747	13,971	18,243
Hudson WSC	6,208	7,579	9,268	11,346	13,967	17,564	22,331
Huntington	2,068	2,306	2,598	2,958	3,412	4,035	4,861
Lufkin	32,709	37,219	42,351	48,190	54,834	62,394	70,997
Zavalla	647	647	647	647	647	647	647
Angelina County Total	***80,130***	***91,399***	***104,853***	***120,936***	***140,497***	***165,783***	***197,878***
Cherokee County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Alto	1,190	1,290	1,404	1,502	1,592	1,681	1,786
Alto Rural WSC	4,500	4,806	5,156	5,456	5,732	6,006	6,329
Bullard	53	54	55	56	57	58	59
County-Other	6,836	6,288	5,555	4,406	2,811	2,110	1,690
Craft-Turney WSC	4,575	5,672	7,032	8,719	10,810	12,000	13,000
Jacksonville	13,868	14,543	15,316	15,978	16,587	17,191	17,904
New Summerfield	998	1,290	1,624	1,910	2,173	2,434	2,742
North Cherokee WSC	3,489	4,116	4,834	5,449	6,015	6,576	7,238
Rusk	5,085	5,525	6,029	6,461	6,858	7,252	7,717
Rusk Rural WSC	2,970	3,166	3,391	3,584	3,761	3,937	4,145

Table 2.1 Distribution of Population by County/Entity (Cont.)

County/Entity	Historical	Projections					
Southern Utilities Company	2,286	2,525	2,799	3,034	3,250	3,464	3,717
Troup	40	44	49	53	57	61	66
Wells	769	774	780	785	789	793	798
Cherokee County Total	***46,659***	***50,093***	***54,024***	***57,393***	***60,492***	***63,563***	***67,191***
Hardin County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County-Other	11,311	12,824	13,909	14,402	14,913	15,441	15,989
Kountze	2,115	2,398	2,601	2,693	2,788	2,887	2,990
Lake Livingston Water Supply and Sewer Service Company	88	100	108	112	116	120	124
Lumberton	8,731	9,899	10,736	11,117	11,511	11,919	12,342
Lumberton MUD	7,269	8,241	8,939	9,256	9,584	9,923	10,275
North Hardin WSC	6,500	7,370	7,993	8,276	8,570	8,874	9,188
Silsbee	6,393	7,248	7,861	8,140	8,429	8,728	9,037
Sour Lake	1,667	1,890	2,050	2,123	2,198	2,276	2,356
West Hardin WSC	3,999	4,534	4,918	5,092	5,272	5,459	5,653
Hardin County Total	***48,073***	***54,504***	***59,115***	***61,211***	***63,381***	***65,627***	***67,954***
Henderson County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Athens	236	380	536	690	848	1,040	1,283
Berryville	891	977	1,071	1,164	1,259	1,375	1,521
Bethel-Ash WSC	2,391	3,096	3,860	4,614	5,387	6,330	7,521
Brownsboro	796	949	1,115	1,279	1,447	1,652	1,910
Brushy Creek WSC	732	837	951	1,063	1,178	1,318	1,495
Chandler	2,099	2,385	2,695	3,001	3,314	3,696	4,179
County-Other	13,113	14,004	14,971	15,923	16,904	18,097	19,604
Murchison	592	642	696	749	804	871	955
RPM WSC	443	495	552	608	665	735	823
Henderson County Total	***21,293***	***23,765***	***26,447***	***29,091***	***31,806***	***35,114***	***39,291***
Houston County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Consolidated WSC	12,965	13,391	13,732	14,281	14,852	15,446	16,064
County-Other	1,020	1,053	1,080	1,123	1,169	1,216	1,264
Crockett	7,141	7,376	7,563	7,866	8,180	8,507	8,848
Grapeland	1,451	1,499	1,536	1,599	1,662	1,729	1,798
Lovelady	608	628	644	670	696	724	753
Houston County Total	***23,185***	***23,947***	***24,555***	***25,539***	***26,559***	***27,622***	***28,727***
Jasper County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County-Other	20,643	22,244	23,624	24,439	24,647	24,647	24,647
Jasper	7,657	8,315	8,883	9,218	9,303	9,303	9,303

Table 2.1 Distribution of Population by County/Entity (Cont.)

County/Entity	Historical	Projections					
Jasper County WCID No. 1	4,000	4,319	4,595	4,757	4,799	4,799	4,799
Kirbyville	2,085	2,251	2,395	2,480	2,501	2,501	2,501
Mauriceville WSC	1,219	1,316	1,400	1,450	1,462	1,462	1,462
Jasper County Total	***35,604***	***38,445***	***40,897***	***42,344***	***42,712***	***42,712***	***42,712***
Jefferson County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Beaumont	113,866	113,866	113,866	113,866	113,866	113,866	113,866
Bevil Oaks	1,346	1,346	1,346	1,346	1,346	1,346	1,346
China	1,112	1,096	1,072	1,051	1,035	1,018	987
County-Other	16,364	21,249	28,265	34,588	39,464	44,381	53,675
Groves	15,733	15,733	15,733	15,733	15,733	15,733	15,733
Jefferson County WCID No. 10	4,497	4,923	5,534	6,085	6,509	6,937	7,747
Meeker MUD	2,835	3,322	4,022	4,653	5,139	5,629	6,556
Nederland	17,422	18,052	18,958	19,775	20,404	21,039	22,238
Nome	515	549	598	643	677	712	777
Port Arthur	57,755	57,755	57,755	57,755	57,755	57,755	57,755
Port Neches	13,601	13,956	14,466	14,926	15,281	15,638	16,314
West Jefferson County MWD	7,005	7,853	9,071	10,169	11,016	11,870	13,484
Jefferson County Total	***252,051***	***259,700***	***270,686***	***280,590***	***288,225***	***295,924***	***310,478***
Nacogdoches County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Appleby WSC	3,218	4,341	5,481	6,560	7,749	9,985	12,345
County-Other	8,810	9,802	10,810	11,762	12,812	14,788	16,872
D&M WSC	5,160	5,742	6,331	6,890	7,506	8,662	9,883
Melrose WSC	3,039	3,381	3,729	4,057	4,419	5,101	5,820
Woden WSC	2,281	2,538	2,799	3,046	3,317	3,829	4,369
Cushing	637	683	730	774	823	915	1,012
Garrison	844	844	844	844	844	844	844
Lily Grove SUD	2,300	3,229	4,172	5,064	6,047	7,896	9,847
Nacogdoches	29,914	33,044	36,501	39,946	43,074	49,198	54,345
Swift WSC	3,000	3,753	4,517	5,240	6,037	7,535	9,116
Nacogdoches County Total	***59,203***	***67,357***	***75,914***	***84,183***	***92,628***	***108,753***	***124,453***
Newton County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County-Other	9,384	9,967	10,417	10,476	10,790	11,114	11,447
Mauriceville WSC	457	485	507	510	525	541	557
Newton	2,459	2,612	2,730	2,745	2,827	2,912	3,000
South Newton WSC	2,772	2,944	3,077	3,094	3,187	3,282	3,381
Newton County Total	***15,072***	***16,008***	***16,731***	***16,825***	***17,329***	***17,849***	***18,385***

Table 2.1 Distribution of Population by County/Entity (Cont.)

County/Entity	Historical	Projections					
Orange County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Bridge City	8,651	9,264	9,681	9,851	9,924	10,075	10,184
County-Other	31,924	32,563	32,998	33,177	33,252	33,411	33,527
Mauriceville WSC	5,944	9,467	11,866	12,848	13,265	14,137	14,769
Orange	18,643	18,643	18,643	18,643	18,643	18,643	18,643
Pine Forest	632	632	632	632	632	632	632
Pinehurst	2,274	2,274	2,274	2,274	2,274	2,274	2,274
Rose City	519	519	519	519	519	519	519
South Newton WSC	828	1,108	1,299	1,377	1,410	1,479	1,529
Vidor	11,440	11,922	12,251	12,386	12,443	12,562	12,648
West Orange	4,111	4,111	4,111	4,111	4,111	4,111	4,111
Orange County Total	***84,966***	***90,503***	***94,274***	***95,818***	***96,473***	***97,843***	***98,836***
Panola County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Beckville	752	790	806	820	831	840	846
Carthage	6,664	7,000	7,146	7,263	7,362	7,444	7,497
County-Other	14,432	15,159	15,476	15,728	15,944	16,121	16,235
Gill WSC	693	728	743	755	766	774	780
Tatum	215	226	231	234	238	240	242
Panola County Total	***22,756***	***23,903***	***24,402***	***24,800***	***25,141***	***25,419***	***25,600***
Polk County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Corrigan	1,721	2,232	2,720	3,132	3,409	3,580	3,759
County-Other	6,314	8,190	9,981	11,490	12,508	13,132	13,789
Polk County Total	**8,035**	***10,422***	***12,701***	***14,622***	***15,917***	***16,712***	***17,548***
Rusk County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County-Other	26,005	27,930	29,754	30,789	31,307	32,741	36,271
Easton	37	61	83	96	102	120	163
Elderville WSC	2,282	2,518	2,741	2,868	2,931	3,107	3,539
Henderson	11,273	11,358	11,438	11,484	11,506	11,570	11,726
Kilgore	2,580	2,580	2,580	2,580	2,580	2,580	2,580
Mount Enterprise	525	540	554	562	566	577	605
New London	987	1,026	1,063	1,084	1,094	1,123	1,194
Overton	2,215	2,363	2,503	2,582	2,621	2,732	3,003
Southern Utilities Company	399	426	451	465	472	492	541
Tatum	960	960	960	960	960	960	960
West Gregg WSC	109	112	114	115	116	118	123
Rusk County Total	***47,372***	***49,874***	***52,241***	***53,585***	***54,255***	***56,120***	***60,705***

Table 2.1 Distribution of Population by County/Entity (Cont.)

County/Entity	Historical	Projections					
Sabine County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County-Other	1,740	1,875	1,952	2,010	2,070	2,133	2,197
G-M WSC	6,643	7,157	7,451	7,675	7,905	8,142	8,386
Hemphill	1,106	1,192	1,241	1,278	1,316	1,356	1,396
Pineland	980	1,056	1,099	1,132	1,166	1,201	1,237
Sabine County Total	***10,469***	***11,280***	***11,743***	***12,095***	***12,457***	***12,832***	***13,216***
San Augustine County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County-Other	5,712	6,203	6,328	6,490	6,685	6,886	7,023
G-M WSC	759	824	841	862	888	915	933
San Augustine	2,475	2,688	2,742	2,812	2,897	2,984	3,043
San Augustine County Total	***8,946***	***9,715***	***9,911***	***10,164***	***10,470***	***10,785***	***10,999***
Shelby County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Center	5,678	5,974	6,363	6,668	6,896	7,092	7,306
County-Other	16,481	17,417	18,647	19,614	20,333	20,953	21,632
Joaquin	925	974	1,038	1,088	1,126	1,158	1,193
Tenaha	1,046	1,046	1,046	1,046	1,046	1,046	1,046
Timpson	1,094	1,120	1,154	1,181	1,201	1,218	1,237
Shelby County Total	***25,224***	***26,531***	***28,248***	***29,597***	***30,602***	***31,467***	***32,414***
Smith County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Arp	901	965	1,013	1,061	1,109	1,189	1,295
Bullard	1,097	1,284	1,424	1,563	1,702	1,936	2,245
Community Water Company	1,050	1,340	1,557	1,773	1,989	2,352	2,832
County-Other	4,750	4,253	3,807	3,409	3,052	2,732	2,446
Crystal Systems, Inc.	276	321	355	389	423	480	555
Dean WSC	4,310	5,111	5,710	6,307	6,903	7,904	9,229
Jackson WSC	2,449	3,832	4,650	5,535	6,420	7,000	7,550
Lindale	673	673	673	673	673	673	673
Lindale Rural WSC	2,246	2,714	3,064	3,413	3,761	4,346	5,119
New Chapel Hill	553	635	697	758	819	922	1,058
Noonday	515	550	576	602	628	672	730
Overton	57	61	64	67	70	75	81
RPM WSC	201	228	249	269	289	323	368
Southern Utilities Company	33,640	36,295	38,496	40,620	42,736	47,202	53,328
Troup	1,909	2,113	2,266	2,418	2,570	2,825	3,163
Tyler[1]	82,927	88,332	92,372	96,399	100,415	107,168	116,102
Whitehouse	5,346	6,305	7,022	7,736	8,449	9,647	11,232
Smith County Total	***142,900***	***155,012***	***163,995***	***172,992***	***182,008***	***197,446***	***218,006***

Table 2.1 Distribution of Population by County/Entity (Cont.)

County/Entity	Historical						Projections
Trinity County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County-Other	2,857	3,186	3,435	3,518	3,660	3,817	3,960
Groveton	542	604	652	668	660	633	610
Trinity County Total	***3,399***	***3,790***	***4,087***	***4,186***	***4,320***	***4,450***	***4,570***
Tyler County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Colmesneil	638	756	872	946	974	974	974
County-Other	11,271	13,363	15,398	16,707	17,209	17,209	17,209
Lake Livingston Water Supply and Sewer Service Company	88	104	120	130	134	134	134
Tyler County WSC	6,459	7,658	8,824	9,574	9,862	9,862	9,862
Woodville	2,415	2,863	3,299	3,580	3,687	3,687	3,687
Tyler County Total	***20,871***	***24,744***	***28,513***	***30,937***	***31,866***	***31,866***	***31,866***
Total for ETRWPA	***1,011,317***	***1,090,382***	***1,166,057***	***1,232,138***	***1,294,976***	***1,377,760***	***1,482,448***

[1]The Texas State Data Center (TSDC) is responsible for maintaining current population estimates for the State. The TSDC 2007 inter-census population estimates for the ETRWPA were provided to the ETRWPG by the TWDB. It should be noted that for most counties in the region, the projection error between the TWDB 2007 interpolated population (i.e., population based on the 2000 census population and the ETRWPA 2010 population projection) and that of the TSDC was relatively small. However, for Smith County, and particularly for the City of Tyler, the TWDB estimates are significantly below the TSDC estimates. This understatement of population for the City of Tyler could present a significant problem for water planning in the ETRWPA if not corrected. Other water suppliers including the City of Nacogdoches and Woodville expressed concerns regarding a possible underestimate of population. The ETRWPG's expectation is that the population of the region's constituent cities and counties will be appropriately adjusted in the next round of planning, based on the 2010 census.

2.3 Water Demands

Municipal water demands have been compiled for each WUG in the region. Likewise, demands for WWPs and for the various categories of water use have been compiled.

For the ETRWPA, the total increase in water demand is expected to increase from 730,911 ac-ft per year to 1,490,596 ac-ft per year between 2010 and 2060. Table 2.2 shows a summary of the water usage by water use category for each decade of the planning period. The percentage of total water used for each of the six WUGs for 2010 and 2060 are shown on Figures 2.3 and 2.4.

Table 2.2 Summary of Water Usage by Use Category and Decade (ac-ft per year)

Water User Category	2006	2010	2020	2030	2040	2050	2060
Municipal	178,646	189,559	196,828	202,761	208,193	218,705	233,622
Manufacturing	237,474	299,992	591,904	784,140	821,841	857,902	893,476
Irrigation	104,150	151,100	151,417	151,771	152,153	152,575	153,040
Steam-Electric	30,599	44,985	80,989	94,515	111,006	131,108	155,611
Livestock	20,571	23,613	25,114	26,899	29,020	31,546	34,533
Mining	8,357	21,662	37,297	17,331	18,385	19,432	20,314
Total for Region	**579,797**	**730,911**	**1,083,549**	**1,277,417**	**1,340,598**	**1,411,268**	**1,490,596**

Figure 2.3
2010 Distribution of Water Demand

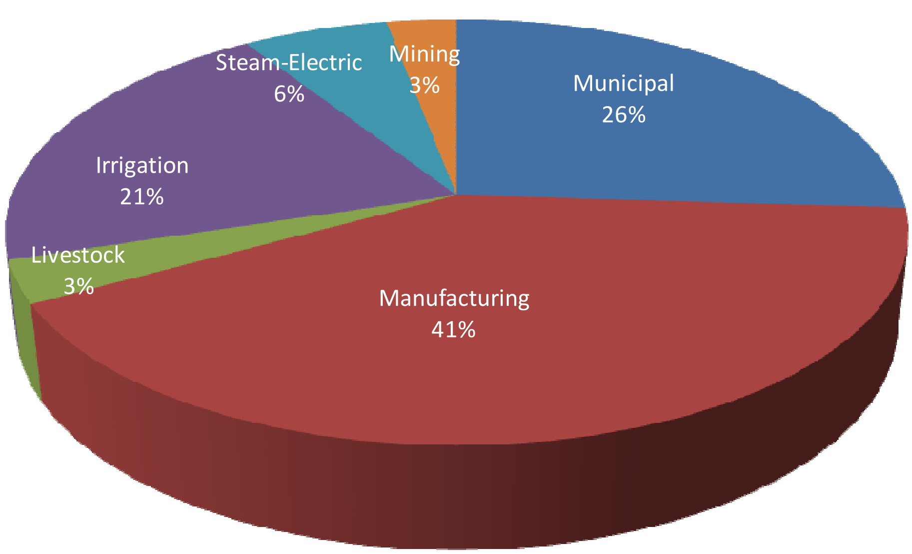
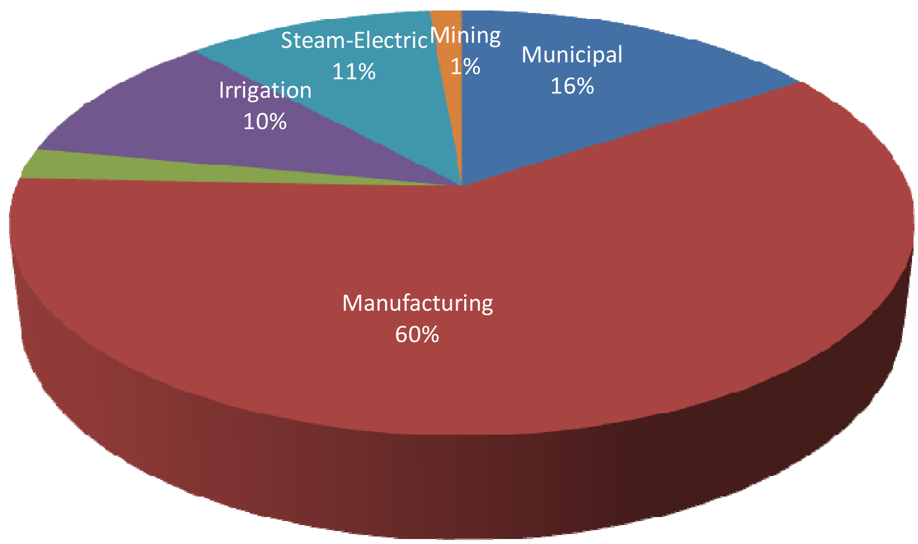


Figure 2.4
2060 Distribution of Water Demand



Details of each water use category are provided below.

2.3.1 Municipal Demands. Municipal water use includes both residential and commercial use. Residential use includes single and multi-family housing. Commercial demand 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 projected per capita water use by decade. The per capita water uses were adjusted in the 2006 Plan to account for implementation of the State Water-Efficiency Plumbing Act. The estimated water savings in the year 2060, afforded by the savings projected into the per capita consumption, is approximately 20,600 ac-ft per year. Table 2.3 provides a summary of the calculated municipal use by entities in the ETRWPA.

Table 2.3 Historical and Projected Municipal Water Demand by County(ac-ft per year)

City/County	Historical	Projected					
Anderson County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Brushy Creek WSC	266	272	276	280	278	282	289
Consolidated WSC	122	127	129	129	127	130	133
County-Other	5,147	5,459	5,672	5,801	5,932	6,075	6,227
Elkhart	170	177	183	185	188	192	196
Four Pine WSC	272	283	292	296	301	306	314
Frankston	492	524	547	564	582	598	612
Palestine	3,529	3,717	3,837	3,920	4,004	4,099	4,202
Walston Springs WSC	408	427	438	441	444	452	464
Anderson County Total	***10,406***	***10,986***	***11,374***	***11,616***	***11,856***	***12,134***	***12,437***
Angelina County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Central WCID of Angelina Co	678	676	686	702	724	778	862
County-Other	1,955	1,819	1,887	1,975	2,089	2,303	2,615
Angelina WSC	275	424	440	460	487	537	609
Redland WSC	230	287	298	311	329	363	412
Diboll	858	968	1,123	1,310	1,554	1,901	2,377
Four Way WSC	256	368	501	673	886	1,192	1,597
Hudson	459	579	732	931	1,168	1,518	1,982
Hudson WSC	563	654	768	902	1,095	1,358	1,726
Huntington	227	243	262	288	325	380	457
Lufkin	6,778	7,546	8,444	9,446	10,565	11,951	13,599
Zavalla	89	86	84	82	80	78	78
Angelina County Total	***12,368***	***13,650***	***15,224***	***17,080***	***19,302***	***22,359***	***26,315***
Cherokee County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Alto	220	233	248	261	273	286	304
Alto Rural WSC	383	393	404	409	411	424	447
Bullard	13	13	13	13	13	13	14
County-Other	995	902	790	617	378	272	218
Craft-Turney WSC	436	515	614	742	908	995	1,078
Jacksonville	3,402	3,502	3,637	3,741	3,827	3,948	4,111
New Summerfield	165	208	258	302	338	379	427
North Cherokee WSC	344	387	439	482	519	560	616
Rusk	1,122	1,194	1,283	1,353	1,421	1,495	1,591
Rusk Rural WSC	349	358	372	381	388	401	423
Southern Utilities Company	392	421	458	486	513	543	583
Troup	6	6	6	7	7	8	8
Wells	124	122	121	119	117	115	116
Cherokee County Total	***7,951***	***8,254***	***8,643***	***8,913***	***9,113***	***9,439***	***9,936***

Table 2.3 Historical and Projected Municipal Water Demand by County(ac-ft per year) (Cont.)

City/County	Historical	Projected					
Hardin County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County-Other	1,685	1,853	1,963	1,984	2,005	2,058	2,131
Kountze	282	306	323	326	328	336	348
Lake Livingston WS & SSC	6	6	7	7	7	7	7
Lumberton	1,301	1,430	1,515	1,544	1,573	1,615	1,673
Lumberton MUD	1,734	1,929	2,073	2,125	2,179	2,245	2,325
North Hardin WSC	626	685	716	714	720	736	762
Silsbee	974	1,072	1,136	1,149	1,161	1,193	1,235
Sour Lake	162	176	184	183	182	186	193
West Hardin WSC	291	315	325	325	325	330	342
Hardin County Total	***7,061***	***7,772***	***8,242***	***8,357***	***8,480***	***8,706***	***9,016***
Henderson County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Athens	44	77	107	136	163	199	246
Berryville	119	126	134	142	149	162	179
Bethel-Ash WSC	206	250	303	351	404	468	556
Brownsboro	136	158	182	206	232	263	304
Brushy Creek WSC	66	72	79	86	91	100	114
Chandler	369	409	453	494	538	596	674
County-Other	2,644	2,761	2,901	3,032	3,162	3,365	3,645
Murchison	131	139	148	157	166	179	196
RPM WSC	64	69	75	80	86	95	106
Henderson County Total	***3,779***	***4,061***	***4,382***	***4,684***	***4,991***	***5,427***	***6,020***
Houston County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Consolidated WSC	1,089	1,095	1,077	1,072	1,064	1,090	1,134
County-Other	176	178	179	182	186	192	199
Crockett	1,416	1,438	1,449	1,480	1,512	1,553	1,615
Grapeland	260	264	265	270	275	283	294
Lovelady	75	75	75	76	76	78	81
Houston County Total	***3,016***	***3,050***	***3,045***	***3,080***	***3,113***	***3,196***	***3,323***
Jasper County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County-Other	2,706	2,815	2,911	2,929	2,871	2,844	2,844
Jasper	1,510	1,602	1,682	1,714	1,699	1,688	1,688
Jasper County WCID No. 1	318	324	329	325	312	306	306
Kirbyville	446	474	494	506	501	499	499
Mauriceville WSC	98	100	104	104	103	103	103
Jasper *County Total*	***5,078***	***5,315***	***5,520***	***5,578***	***5,486***	***5,440***	***5,440***

Table 2.3 Historical and Projected Municipal Water Demand by County (ac-ft per year) (Cont.)

City/County	Historical	Projected					
Jefferson County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Beaumont	27,550	27,040	26,657	26,275	25,892	25,636	25,636
Bevil Oaks	143	137	133	128	124	121	121
China	171	165	157	151	145	140	136
County-Other	1,503	1,880	2,438	2,906	3,272	3,679	4,449
Groves	3,260	3,190	3,137	3,085	3,031	2,996	2,996
Jefferson County WCID No. 10	605	640	700	750	787	832	929
Meeker MUD	289	324	379	423	461	498	580
Nederland	4,059	4,125	4,268	4,387	4,456	4,573	4,834
Nome	121	127	136	144	150	157	172
Port Arthur	9,898	9,704	9,510	9,315	9,122	8,993	8,993
Port Neches	1,782	1,782	1,782	1,789	1,780	1,804	1,882
West Jefferson County MWD	949	1,029	1,148	1,264	1,345	1,436	1,631
Jefferson County Total	***50,330***	***50,143***	***50,445***	***50,617***	***50,565***	***50,865***	***52,359***
Nacogdoches County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Appleby WSC	580	763	945	1,117	1,311	1,678	2,074
County-Other	1,582	1,120	1,199	1,265	1,349	1,540	1,758
D&M WSC	178	656	702	741	790	902	1,030
Melrose WSC	232	386	414	436	465	531	606
Woden WSC	277	290	310	328	349	399	455
Cushing	123	129	135	140	147	162	179
Garrison	153	149	147	144	141	139	139
Lily Grove SUD	314	423	533	641	752	982	1,224
Nacogdoches	6,903	7,625	8,423	9,218	9,939	11,352	12,540
Swift WSC	403	483	567	640	730	903	1,093
Nacogdoches County Total	***10,745***	***12,024***	***13,375***	***14,670***	***15,974***	***18,589***	***21,098***
Newton County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County-Other	1,104	1,128	1,132	1,103	1,100	1,120	1,154
Mauriceville WSC	37	37	37	37	37	38	39
Newton	463	480	495	489	497	509	524
South Newton WSC	255	257	259	253	253	257	265
Newton County Total	***1,859***	***1,902***	***1,923***	***1,882***	***1,887***	***1,924***	***1,982***
Orange County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Bridge City	940	965	977	960	934	936	947
County-Other	4,577	4,559	4,473	4,385	4,284	4,267	4,282
Mauriceville WSC	479	721	877	921	936	998	1,042
Orange	3,863	3,801	3,738	3,675	3,613	3,571	3,571
Pine Forest	75	73	71	69	67	65	65

Table 2.3 Historical and Projected Municipal Water Demand by County (ac-ft per year) (Cont.)

City/County	Historical	Projected					
Pinehurst	344	336	329	321	313	308	308
Rose City	86	84	83	81	79	78	78
South Newton WSC	76	97	109	113	112	116	120
Vidor	1,601	1,629	1,619	1,595	1,561	1,562	1,572
West Orange	548	530	516	502	488	479	479
Orange County Total	***12,589***	***12,795***	***12,792***	***12,622***	***12,387***	***12,380***	***12,464***
Panola County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Beckville	129	133	133	132	131	131	132
Carthage	2,187	2,274	2,297	2,311	2,317	2,326	2,343
County-Other	1,665	1,698	1,681	1,656	1,625	1,607	1,619
Gill WSC	89	94	96	97	99	100	100
Tatum	28	29	28	28	28	27	28
Panola County Total	***4,098***	***4,228***	***4,235***	***4,224***	***4,200***	***4,191***	***4,222***
Polk County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Corrigan	216	270	320	358	378	389	408
County-Other	884	1,110	1,319	1,480	1,583	1,647	1,730
Polk County Total	***1,100***	***1,380***	***1,639***	***1,838***	***1,961***	***2,036***	***2,138***
Rusk County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County-Other	2,622	2,660	2,733	2,759	2,700	2,787	3,088
Easton	5	8	11	12	13	15	21
Elderville WSC	294	324	353	369	378	400	456
Henderson	2,450	2,417	2,396	2,367	2,333	2,320	2,351
Kilgore	543	532	520	512	503	500	500
Mount Enterprise	71	71	71	70	68	69	73
New London	220	225	228	230	228	232	248
Overton	394	413	429	434	432	447	491
Southern Utilities Company	68	71	74	74	75	77	85
Tatum	125	122	118	115	112	110	110
West Gregg WSC	15	15	15	15	15	15	16
Rusk County Total	***6,807***	***6,858***	***6,948***	***6,957***	***6,857***	***6,972***	***7,439***
Sabine County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County-Other	424	449	461	468	476	485	500
G-M WSC	640	665	668	662	655	666	686
Hemphill	349	371	382	389	397	406	418
Pineland	209	221	227	230	232	237	244
Sabine County Total	***1,622***	***1,706***	***1,738***	***1,749***	***1,760***	***1,794***	***1,848***
San Augustine County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County-Other	601	625	623	618	614	624	637
G-M WSC	73	77	75	74	74	75	76
San Augustine	851	915	925	939	957	979	999
San Augustine County Total	***1,525***	***1,617***	***1,623***	***1,631***	***1,645***	***1,678***	***1,712***

Table 2.3 Historical and Projected Municipal Water Demand by County (ac-ft per year) (Cont.)

City/County	Historical	Projected					
Shelby County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Center	1,577	1,633	1,718	1,785	1,823	1,867	1,923
County-Other	2,049	2,087	2,172	2,241	2,255	2,300	2,375
Joaquin	145	148	155	158	160	163	168
Tenaha	194	191	187	184	180	178	178
Timpson	180	179	181	181	180	181	184
Shelby County Total	***4,145***	***4,238***	***4,413***	***4,549***	***4,598***	***4,689***	***4,828***
Smith County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Arp	166	173	178	183	188	200	218
Bullard	269	309	338	366	395	447	518
Community Water Company	89	137	188	211	232	271	327
County-Other	1,059	929	823	726	643	572	512
Crystal Systems, Inc.	58	65	71	77	82	93	108
Dean WSC	473	538	582	629	673	761	889
Jackson WSC	234	288	333	384	431	463	499
Lindale	154	150	148	146	145	144	144
Lindale Rural WSC	375	438	484	531	577	662	780
New Chapel Hill	105	118	127	137	146	163	187
Noonday	98	102	105	107	110	117	127
Overton	10	11	11	11	12	12	13
RPM WSC	29	32	34	36	38	42	47
Southern Utilities Company	5,680	6,058	6,296	6,507	6,750	7,402	8,363
Troup	267	286	297	311	322	351	393
Tyler	24,244	25,528	26,385	27,211	28,007	29,771	32,253
Whitehouse	862	982	1,070	1,153	1,240	1,405	1,636
Smith County Total	***34,172***	***36,144***	***37,470***	***38,726***	***39,991***	***42,876***	***47,014***
Trinity County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County-Other	538	585	619	623	640	663	688
Groveton	105	114	121	122	118	113	109
Trinity County Total	***643***	***699***	***740***	***745***	***758***	***776***	***797***
Tyler County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Colmesneil	64	72	80	84	84	83	83
County-Other	1250	1,422	1,587	1,684	1,696	1,677	1,677
Lake LivingstonWater Supply & Sewer Service Company	6	7	7	8	8	8	8
Tyler County WSC	514	575	633	665	663	652	652
Woodville	571	661	750	802	818	814	814
Tyler County Total	***2,405***	***2,737***	***3,057***	***3,243***	***3,269***	***3,234***	***3,234***
Total for ETRWPA	***46,521***	***189,559***	***196,828***	***202,761***	***208,193***	***218,705***	***233,622***

Municipal water use is expected to grow from 189,559 ac-ft per year to 233,622 ac-ft per year during the planning period. This represents an approximate 23% increase in municipal water demand. The projected increase for each county is illustrated on Figure 2.5. Most of the increased demand will occur in Angelina, Nacogdoches, and Smith Counties. The average annual percent increase in each county for municipal demand over the planning period is represented on Figure 2.6.

2.3.2 Manufacturing Demands. Manufacturing demands are expected to increase from 299,992 ac-ft per year to 893,476 ac-ft per year during the planning period. Table 2.4, Figure 2.7, and Figure 2.8 summarize the manufacturing usage by the counties. 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 and Orange Counties. These two counties account for almost 70% of all manufacturing water use in 2010, and over 86% in 2060. Use is mainly in the petrochemical industry.

Angelina and Jasper Counties will comprise an additional 26% of use in 2010. Although manufacturing water demand will increase in these two counties over the planning period, their percentage of use in the region will decrease to approximately 12% by 2060.

2.3.3 Irrigation Demands. Irrigation in Jefferson County accounts for over 91% of all water used for irrigation in the ETRWPA. Water use for irrigation is presented in Table 2.5. Other major irrigation counties in the ETRWPA, after Jefferson County, are Hardin, Houston, and Orange Counties. The projection of irrigation use for these counties is presented on Figure 2.10. The usage for the remaining counties is shown on Figure 2.11.

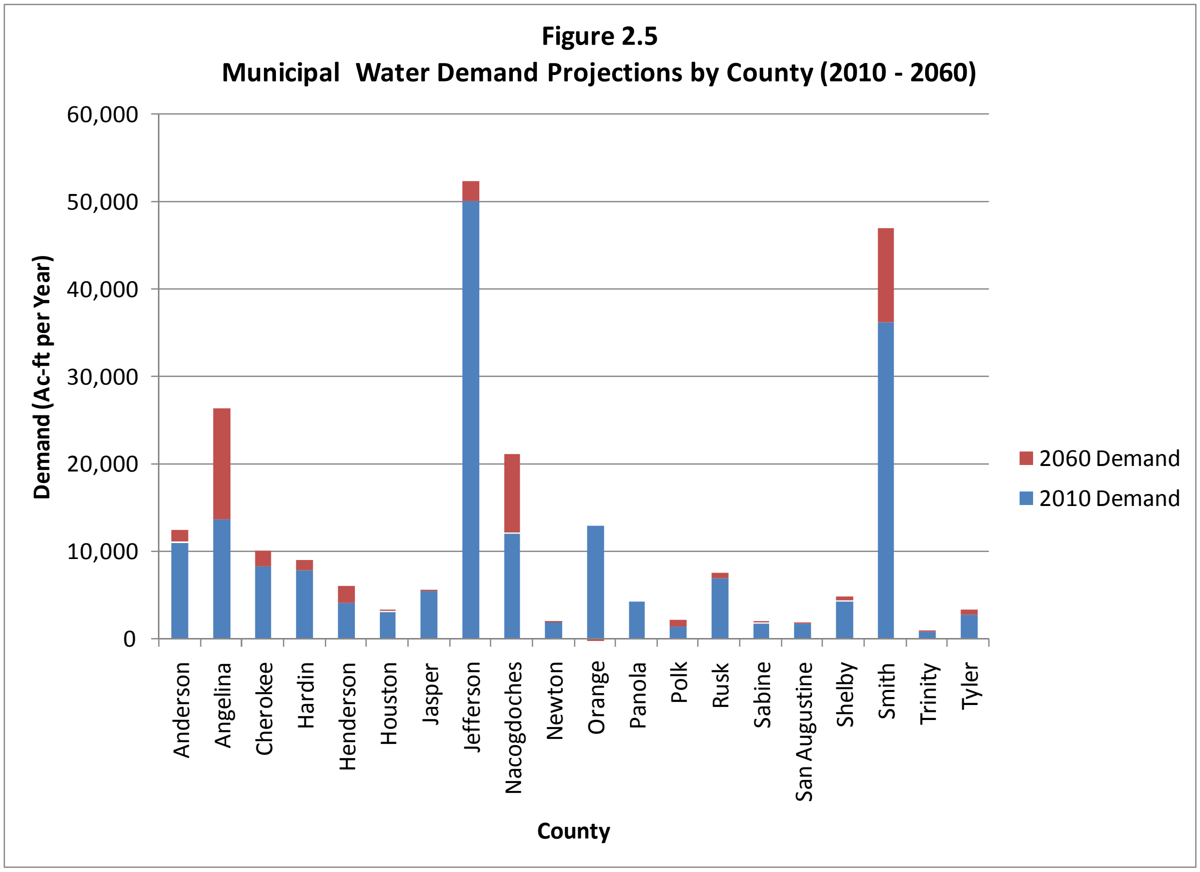


Figure 2.5
Municipal Water Demand Projections by County (2010 - 2060)
60,000
50,000
40,000
30,000
20,000
10,000
0
Demand (Ac-ft per Year)
Anderson
Angelina
Cherokee
Hardin
Henderson
Houston
Jasper
Jefferson
Nacogdoches
Newton
Orange
Panola
Polk
Rusk
Sabine
San Augustine
Shelby
Smith
Trinity
Tyler
County
2060 Demand
2010 Demand

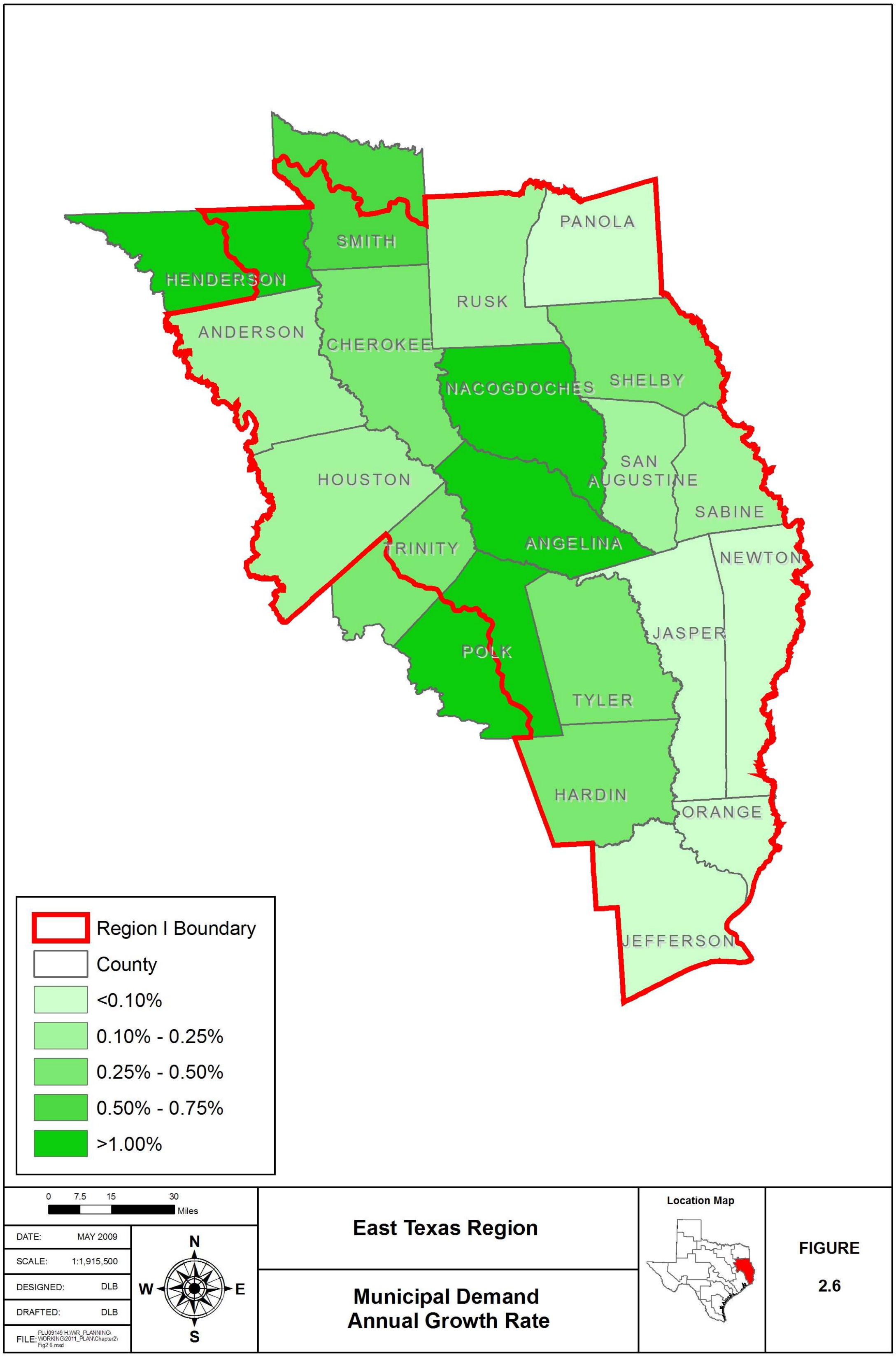

PANOLA
SMITH
HENDERSON
RUSK
ANDERSON
CHEROKEE
NACOGDOCHES
SHELBY
HOUSTON
SAN AUGUSTINE
SABINE
TRINITY
ANGELINA
NEWTON
JASPER
POLK
TYLER
HARDIN
ORANGE
JEFFERSON
Region I Boundary
County
<0.10%
0.10% - 0.25%
0.25% - 0.50%
0.50% - 0.75%
>1.00%
0 7.5 15 30 Miles
DATE: MAY 2009
SCALE: 1:1,915,500
DESIGNED: DLB
DRAFTED: DLB
N
W
E
S
East Texas Region
Municipal Demand
Annual Growth Rate
Location Map
FIGURE
2.6

Table 2.4 Historical and Projected Manufacturing Water Demand by County (ac-ft per year)

County	Historical 2006	Projections					
		2010	2020	2030	2040	2050	2060
Anderson	46	0	0	0	0	0	0
Angelina	7,282	14,750	23,500	25,980	28,490	30,720	33,100
Cherokee	136	718	784	839	891	934	1,007
Hardin	137	146	165	182	200	216	233
Henderson	0	12	14	16	18	20	22
Houston	99	169	190	209	227	243	263
Jasper	55,565	64,267	67,649	70,162	72,359	74,006	74,069
Jefferson	121,798	151,672	423,258	603,321	629,171	655,034	680,914
Nacogdoches	2,369	2,288	2,553	2,786	3,016	3,214	3,468
Newton	32	678	793	899	1,006	1,103	1,196
Orange	43,710	57,624	64,461	70,439	76,399	81,690	87,641
Panola	764	1,357	1,437	1,500	1,561	1,614	1,720
Polk	529	619	725	825	930	1,026	1,110
Rusk	31	82	90	97	103	108	116
Sabine	157	359	427	490	554	611	662
San Augustine	7	6	7	8	9	10	11
Shelby	1,469	1,360	1,508	1,637	1,766	1,880	2,019
Smith	3,342	3,846	4,297	4,697	5,081	5,407	5,854
Trinity	0	0	0	0	0	0	0
Tyler	1	39	46	53	60	66	71
Total for ETRWPA	**237,474**	**299,992**	**591,904**	**784,140**	**821,841**	**857,902**	**893,476**

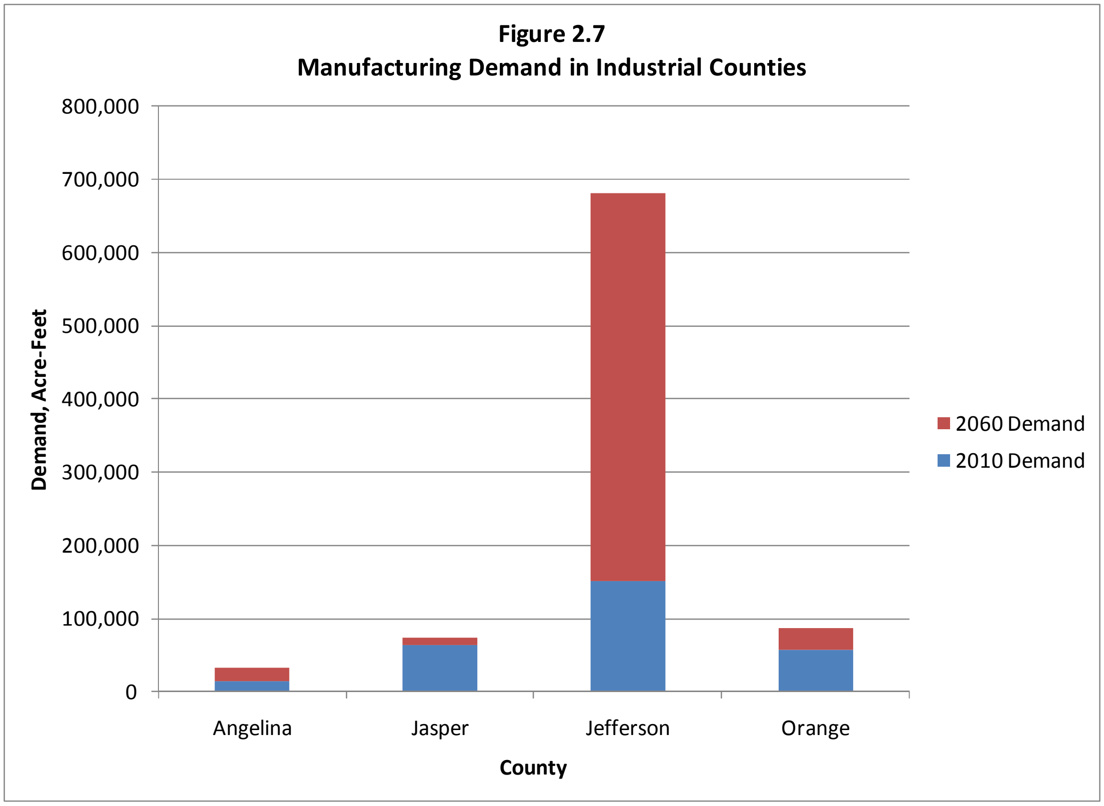


Figure 2.7
Manufacturing Demand in Industrial Counties
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
Demand, Acre-Feet
Angelina
Jasper
Jefferson
Orange
County
2060 Demand
2010 Demand

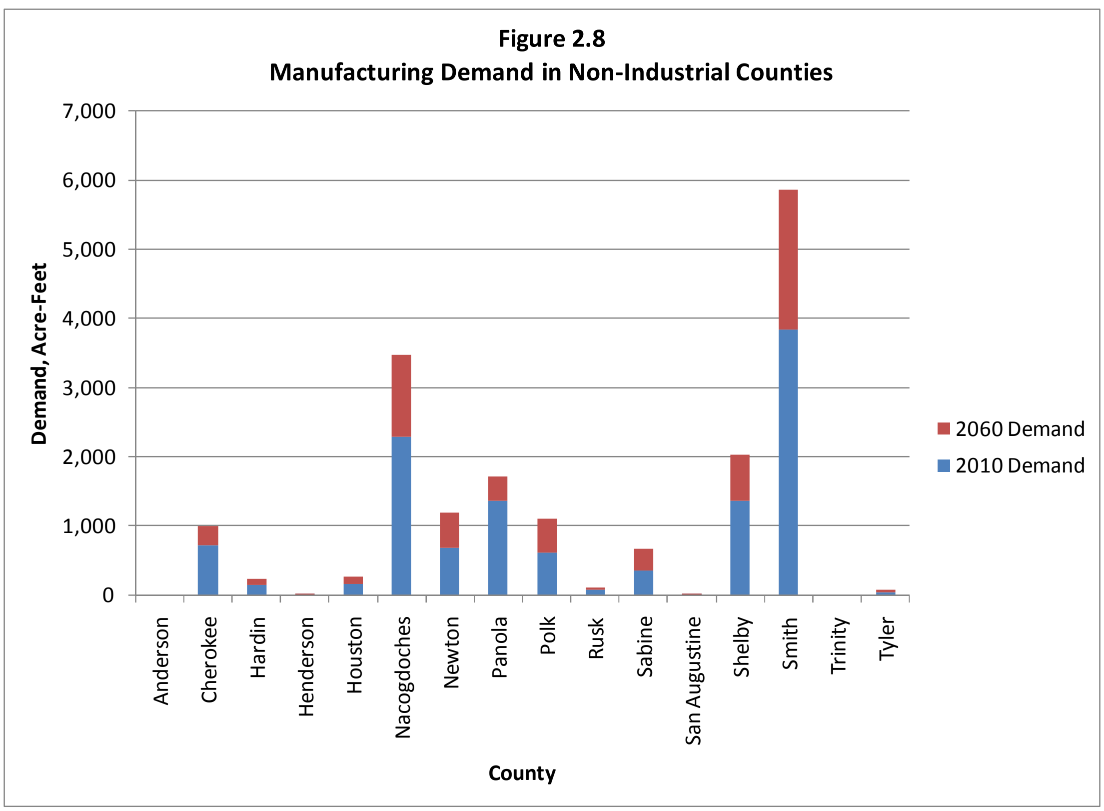


Figure 2.8
Manufacturing Demand in Non-Industrial Counties
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Demand, Acre-Feet
Anderson
Cherokee
Hardin
Henderson
Houston
Nacogdoches
Newton
Panola
Polk
Rusk
Sabine
San Augustine
Shelby
Smith
Trinity
Tyler
County
2060 Demand
2010 Demand

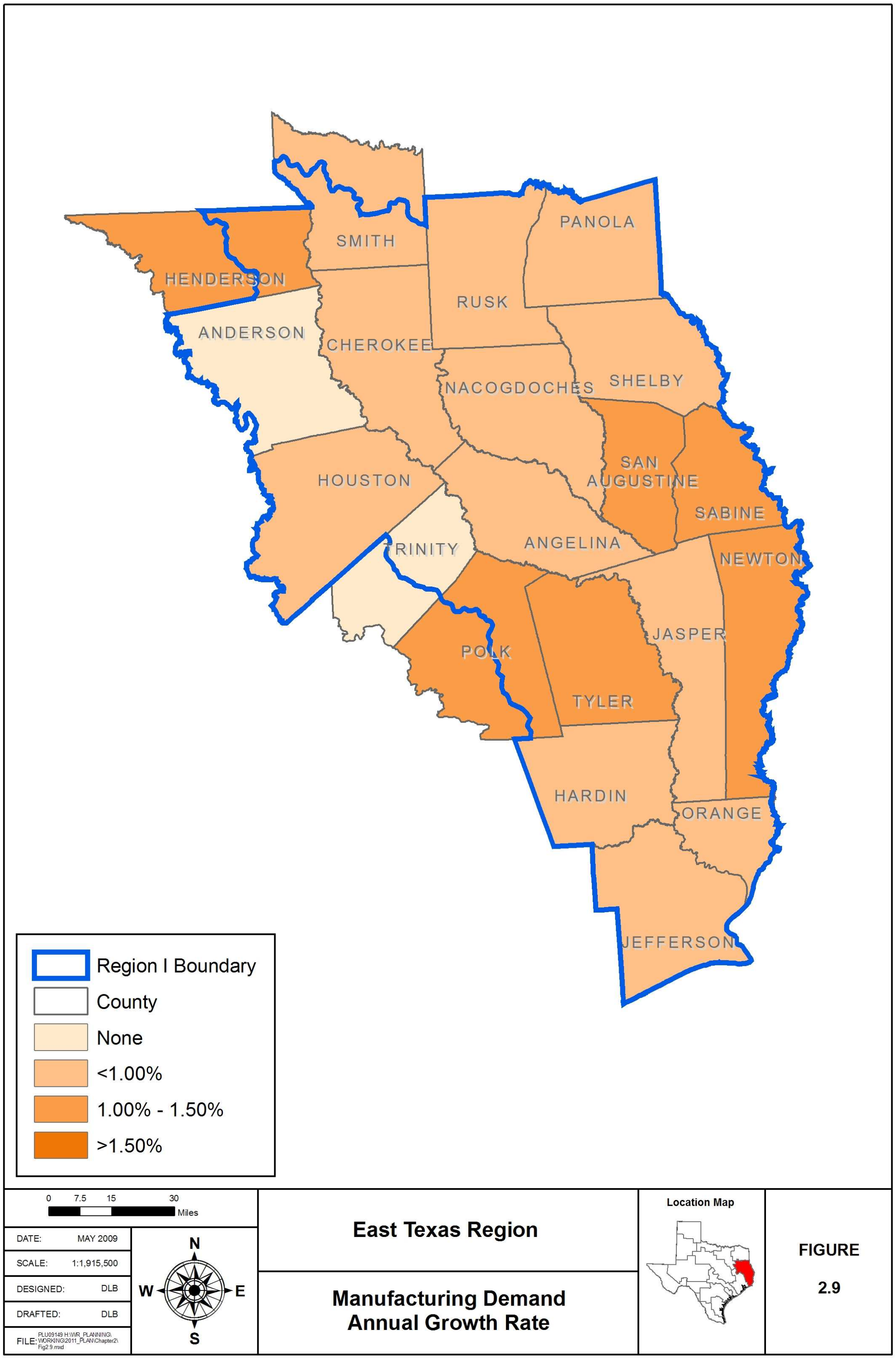

SMITH
PANOLA
HENDERSON
RUSK
ANDERSON
CHEROKEE
NACOGDOCHES
SHELBY
HOUSTON
SAN AUGUSTINE
SABINE
TRINITY
ANGELINA
NEWTON
JASPER
POLK
TYLER
HARDIN
ORANGE
JEFFERSON
Region I Boundary
County
None
<1.00%
1.00% - 1.50%
>1.50%
0 7.5 15 30
Miles
DATE: MAY 2009
SCALE: 1:1,915,500
DESIGNED: DLB
DRAFTED: DLB
N
W
E
S
East Texas Region
Manufacturing Demand
Annual Growth Rate
Location Map
FIGURE
2.9

Table 2.5 Historical and Projected Irrigation Water Demand by County (ac-ft per year)

County	Historical 2006	Projections					
		2010	2020	2030	2040	2050	2060
Anderson	305	212	212	212	212	212	212
Angelina	234	30	30	30	30	30	30
Cherokee	254	321	321	321	321	321	321
Hardin	978	3,502	3,502	3,502	3,502	3,502	3,502
Henderson	384	10	10	10	10	10	10
Houston	2,990	2,739	3,024	3,343	3,691	4,077	4,503
Jasper	36	0	0	0	0	0	0
Jefferson	90,244	140,000	140,000	140,000	140,000	140,000	140,000
Nacogdoches	400	302	302	302	302	302	302
Newton	375	367	367	367	367	367	367
Orange	6,250	2,509	2,509	2,509	2,509	2,509	2,509
Panola	18	0	0	0	0	0	0
Polk	100	135	135	135	135	135	135
Rusk	100	126	126	126	126	126	126
Sabine	0	0	0	0	0	0	0
San Augustine	63	225	225	225	225	225	225
Shelby	27	27	30	34	37	41	46
Smith	892	566	595	626	657	689	723
Trinity	0	0	0	0	0	0	0
Tyler	500	29	29	29	29	29	29
Total for ETRWPA	**104,150**	**151,100**	**151,417**	**151,771**	**152,153**	**152,575**	**153,040**

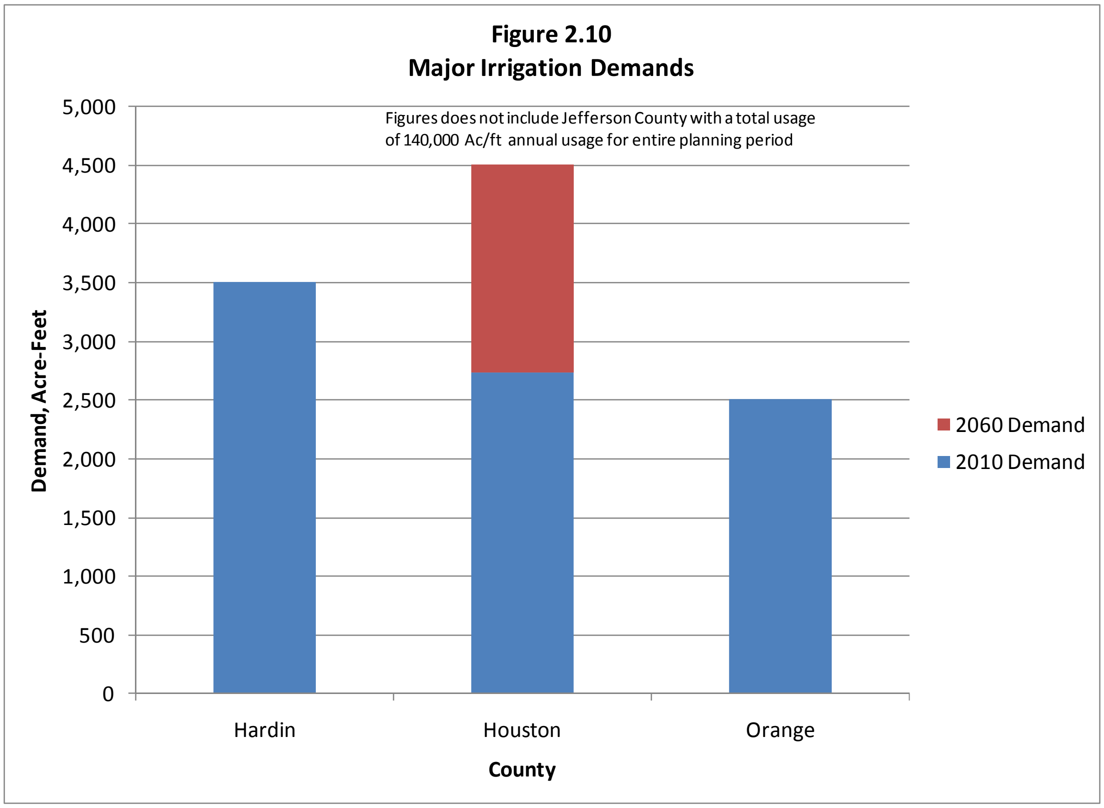


Figure 2.10
Major Irrigation Demands
Figures does not include Jefferson County with a total usage of 140,000 Ac/ft annual usage for entire planning period
Demand, Acre-Feet
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Hardin
Houston
Orange
County
2060 Demand
2010 Demand

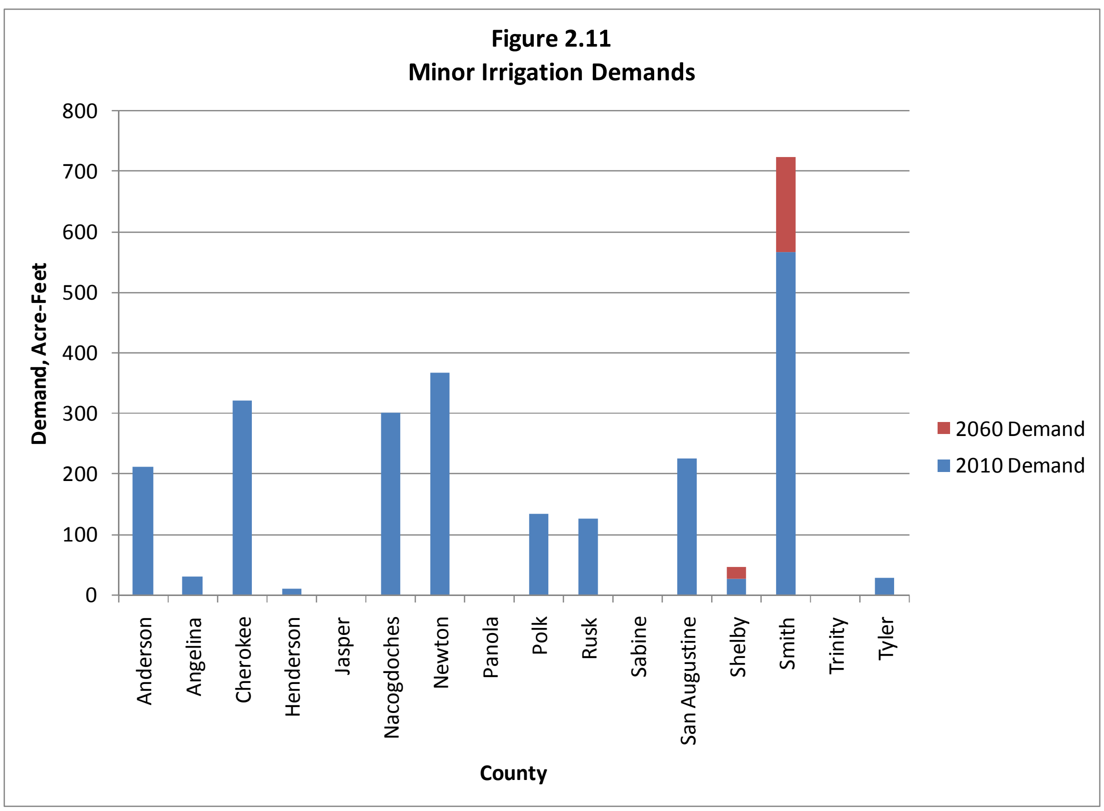


Figure 2.11
Minor Irrigation Demands
Demand, Acre-Feet
800
700
600
500
400
300
200
100
0
Anderson
Angelina
Cherokee
Henderson
Jasper
Nacogdoches
Newton
Panola
Polk
Rusk
Sabine
San Augustine
Shelby
Smith
Trinity
Tyler
County
2060 Demand
2010 Demand

2.3.4 Steam-Electric Demands. Counties in the ETRWPA with existing steam-electric power facilities are Cherokee, Newton, Orange, and Rusk Counties. The demands for this user group were taken from a report, "Power Generation Water Use in Texas for the Years 2000 through 2060," prepared by representatives of Investor-Owned Utility Companies of Texas.[1] Subsequent to the 2003 report, several proposed facilities or expansions have been delayed or cancelled, and new power facilities in Angelina and Nacogdoches Counties are being developed. Cancelled facilities include power plants in Nacogdoches, Jefferson, Newton, Anderson, and Rusk Counties. While these facilities are not moving forward at this time, the ETRWPG anticipates that the region is a prime location for new facilities to provide additional power that is needed for Texas. No changes to the steam-electric power demands for these counties were made.

There are two new power facilities currently being developed in the ETRWPA. The Aspen Power Facility is a 50-megawatts (MW) biomass electric plant planned to be located in Lufkin. Nacogdoches Power is developing a 100-MW biomass electric generating facility, which is expected to be online by 2011. New water demands for the Aspen Power Facility were developed and are included in this update for Angelina County. The projected demands in the 2006 Regional Water Plan for Nacogdoches County included cancelled facilities sufficient for the new Nacogdoches Power Facility; therefore, no changes were made to steam-electric demands for Nacogdoches County.

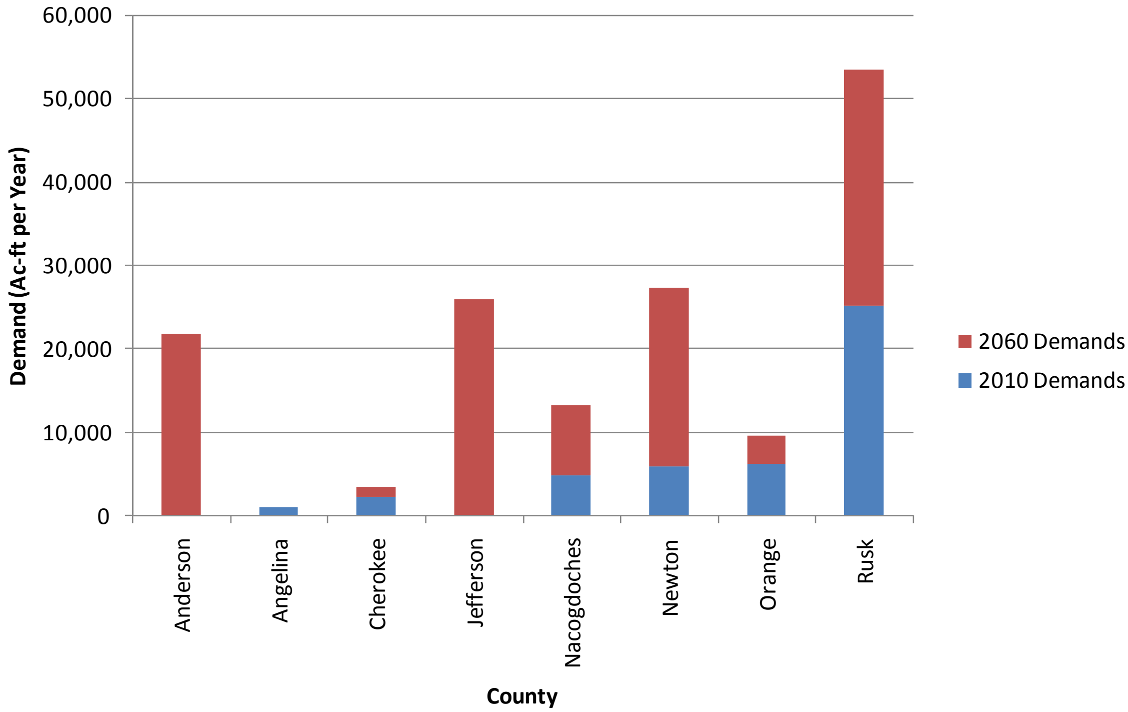
The usage in the ETRWPA is expected to increase from 44,985 ac-ft per year to 155,611 ac-ft per year during the planning period. Rusk County accounts for approximately 55 percent of the usage in the region. The report indicates the demand for Rusk County to be associated with two existing power plants. The only county adding new demands since the 2006 Regional Water Plan is Angelina County. The projected demands for steam-electric usage are included in Table 2.6. Figure 2.12 shows the projected demand by county for 2010 and 2060. Figure 2.13 shows the counties with steam-electric demands.

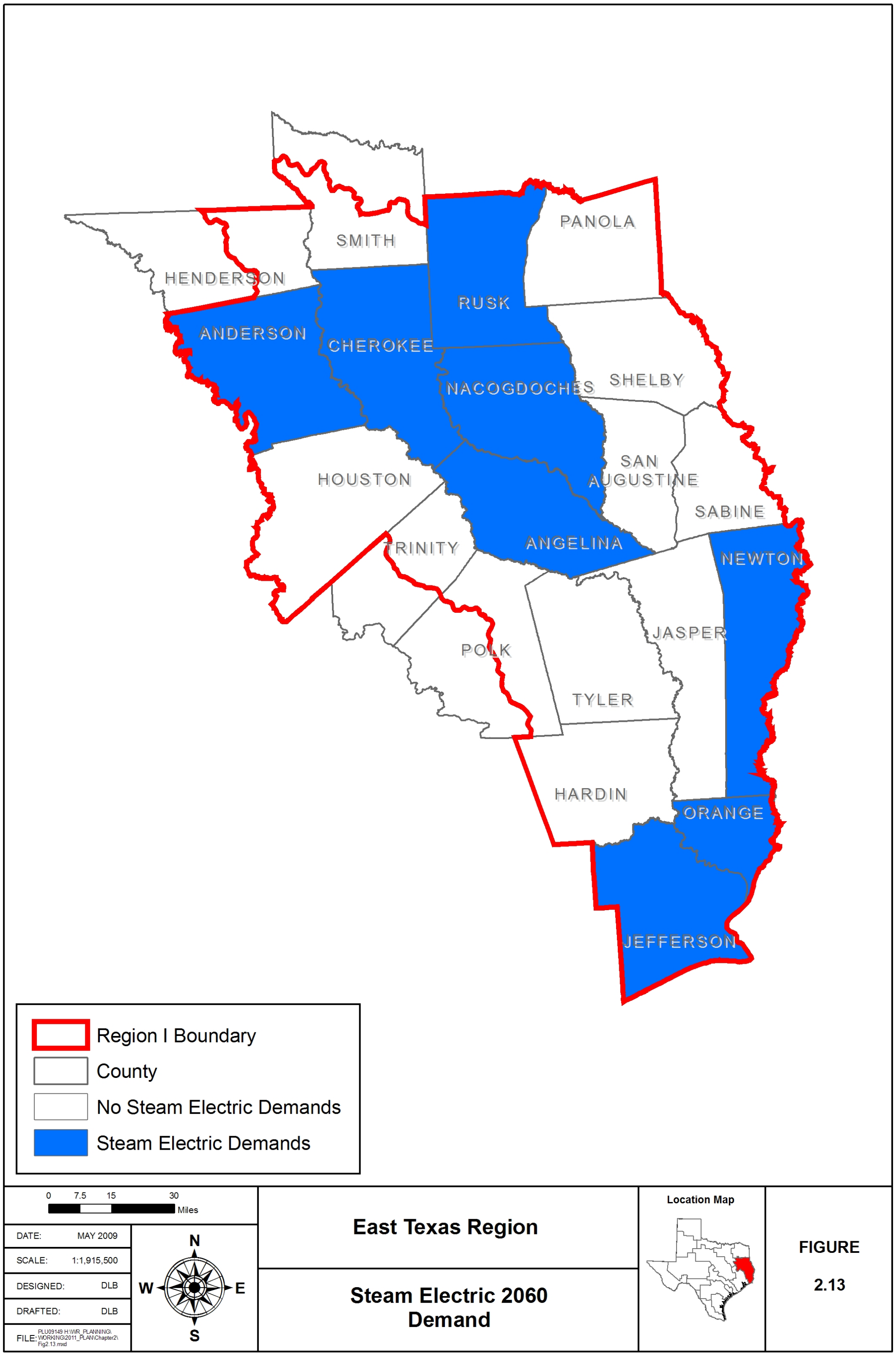
Table 2.6 Historical and Projected Steam-Electric Power Water Demand by County (ac-ft per year)

County	Historical	Projections					
	2006	2010	2020	2030	2040	2050	2060
Anderson	0	0	11,306	13,218	15,549	18,390	21,853
Angelina	0	1,000	1,000	1,000	1,000	1,000	1,000
Cherokee	743	2,245	1,790	2,093	2,462	2,912	3,460
Hardin	0	0	0	0	0	0	0
Henderson	0	0	0	0	0	0	0
Houston	0	0	0	0	0	0	0
Jasper	0	0	0	0	0	0	0
Jefferson	0	0	13,426	15,696	18,464	21,838	25,951
Nacogdoches	0	4,828	6,911	8,079	9,504	11,241	13,358
Newton	0	5,924	14,132	16,522	19,436	22,987	27,317
Orange	4,698	6,228	4,966	5,805	6,829	8,077	9,598
Panola	0	0	0	0	0	0	0
Polk	0	0	0	0	0	0	0
Rusk	25,158	24,760	27,458	32,102	37,762	44,663	53,074
Sabine	0	0	0	0	0	0	0
San Augustine	0	0	0	0	0	0	0
Shelby	0	0	0	0	0	0	0
Smith	0	0	0	0	0	0	0
Trinity	0	0	0	0	0	0	0
Tyler	0	0	0	0	0	0	0
Total for ETRWPA	**30,599**	**44,985**	**80,989**	**94,515**	**111,006**	**131,108**	**155,611**

Note: Historical use estimates were obtained from the Texas Water Development Board.

Figure 2.12
Steam-Electric Water Demand Projections by County
(2010 - 2060)




SMITH
PANOLA
HENDERSON
RUSK
ANDERSON
CHEROKEE
NACOGDOCHES
SHELBY
HOUSTON
SAN AUGUSTINE
SABINE
TRINITY
ANGELINA
NEWTON
JASPER
POLK
TYLER
HARDIN
ORANGE
JEFFERSON
Region I Boundary
County
No Steam Electric Demands
Steam Electric Demands
0 7.5 15 30
Miles
DATE: MAY 2009
SCALE: 1:1,915,500
DESIGNED: DLB
DRAFTED: DLB
N
W
E
S
East Texas Region
Steam Electric 2060 Demand
Location Map
FIGURE
2.13

2.3.5 Livestock Demands. Shelby County presently accounts for 18% of the livestock usage and is expected to account for 33% of the livestock usage by the end of the planning period. Other major livestock counties include Anderson, Cherokee, Henderson, Houston, Nacogdoches, Panola, Rusk and San Augustine, and account for approximately 60% of usage during the planning period. The total usage is expected to increase from 23,613 ac-ft per year to 34,533 ac-ft per year. The projected usage by county during the planning period is presented in Table 2.7. Figures 2.14 and 2.15 show the livestock demand by major and minor counties. The largest percentage change in growth, as well as total demand, is expected to occur in Nacogdoches, San Augustine, and Shelby Counties. Figure 2.16 illustrates the average annual projected growth by county in the ETRWPA during the planning period.

2.3.6 Mining Demands. Historically, most of the demand for mining water for the ETRWPA has been concentrated in Hardin, Panola, and Rusk Counties. This water has been used in aggregate mining operations, for the most part.

Beginning in the 2010 decade, however, a projected demand for mining water use has developed to support the growing natural gas production industry in Angelina, Cherokee, Nacogdoches, Shelby and San Augustine Counties. This demand is projected through 2020, but not beyond that decade. Therefore, mining water demand shows a spike at the outset of the planning period, but drops off to levels projected in the previous plan.

Table 2.8 provides mining water projections for each county in the ETRWPA. Demands for counties with major projections (greater than 2,000 ac-ft per year) are depicted on Figure 2.17. Those counties with lower projected demands are shown on Figure 2.18. Figure 2.19 illustrates the annual percent change for mining water in each county in the ETRWPA.

Table 2.7 Historical and Projected Livestock Water Demand by County (ac-ft per year)

County	Historical 2006	Projections					
		2010	2020	2030	2040	2050	2060
Anderson	1,537	1,708	1,708	1,708	1,708	1,708	1,708
Angelina	398	598	620	647	677	712	749
Cherokee	1,439	1,765	1,765	1,765	1,765	1,765	1,765
Hardin	161	156	156	156	156	156	156
Henderson	516	2,594	2,594	2,594	2,594	2,594	2,594
Houston	1,616	2,115	2,291	2,483	2,690	2,915	3,158
Jasper	473	317	317	317	317	317	317
Jefferson	1,047	807	807	807	807	807	807
Nacogdoches	1,338	1,719	1,954	2,227	2,544	2,911	3,332
Newton	139	110	110	110	110	110	110
Orange	205	210	210	210	210	210	210
Panola	3,329	3,096	3,096	3,096	3,096	3,096	3,096
Polk	197	202	202	202	202	202	202
Rusk	1,008	1,171	1,188	1,207	1,231	1,257	1,283
Sabine	829	667	710	759	816	882	954
San Augustine	1,025	1,004	1,082	1,173	1,278	1,400	1,534
Shelby	3,920	4,246	5,176	6,310	7,691	9,376	11,430
Smith	839	660	660	660	660	660	660
Trinity	273	194	194	194	194	194	194
Tyler	282	274	274	274	274	274	274
Total for ETRWPA	**20,571**	**23,613**	**25,114**	**26,899**	**29,020**	**31,546**	**34,533**

Figure 2.14
Major Livestock Water Demand Projections (2010 - 2060)

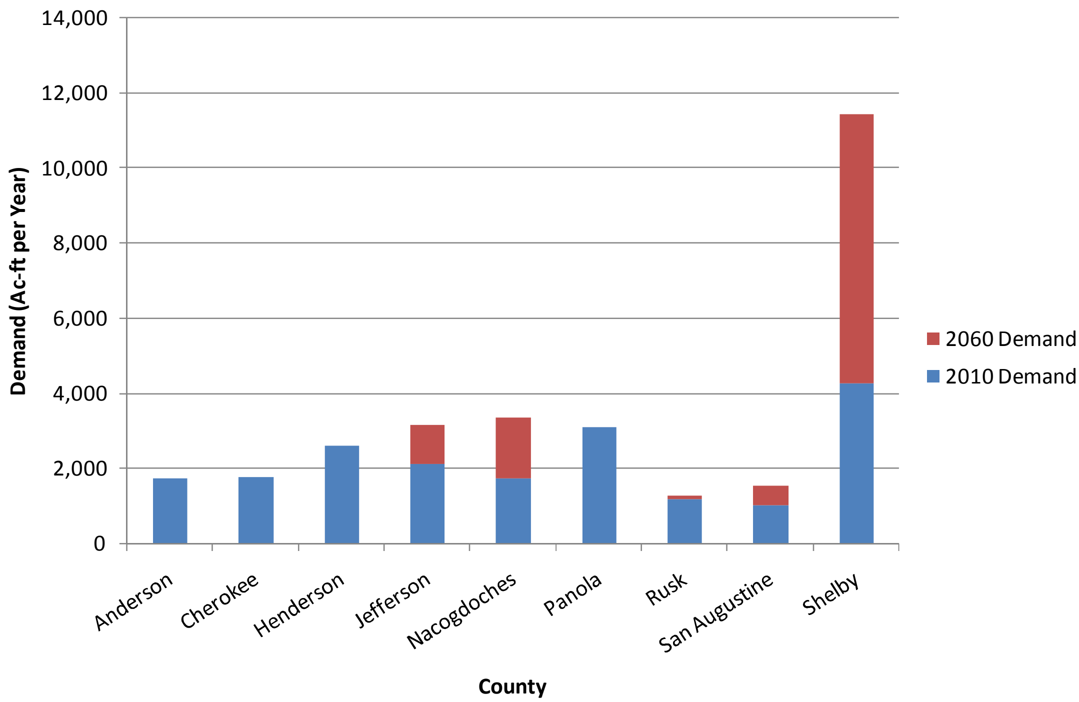
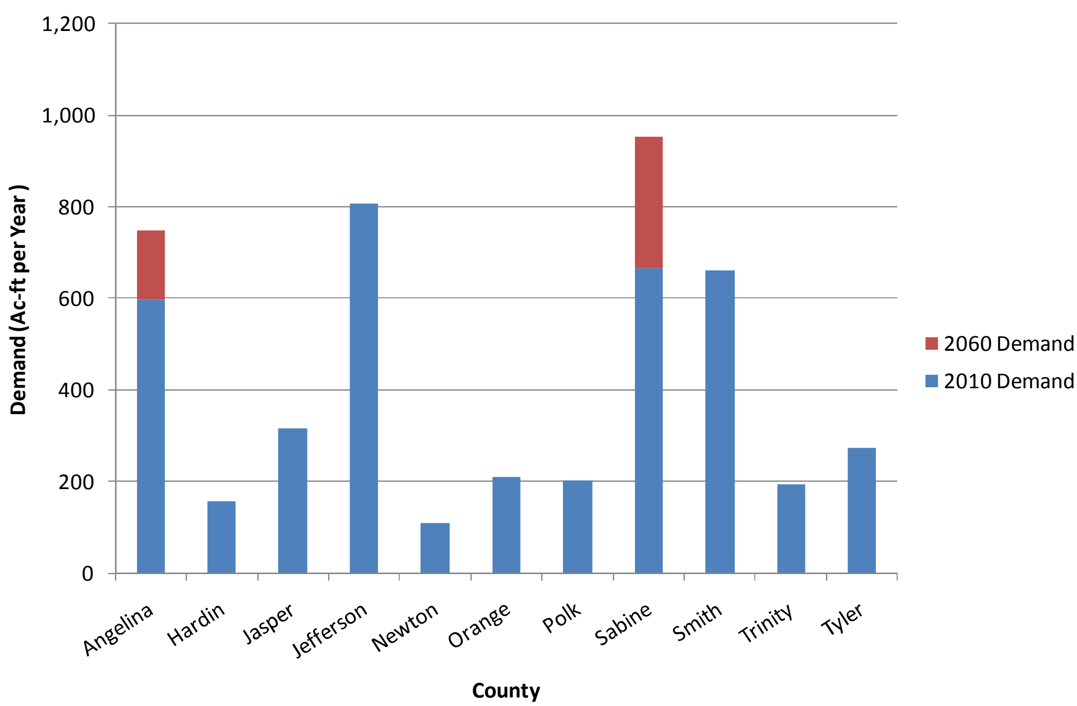
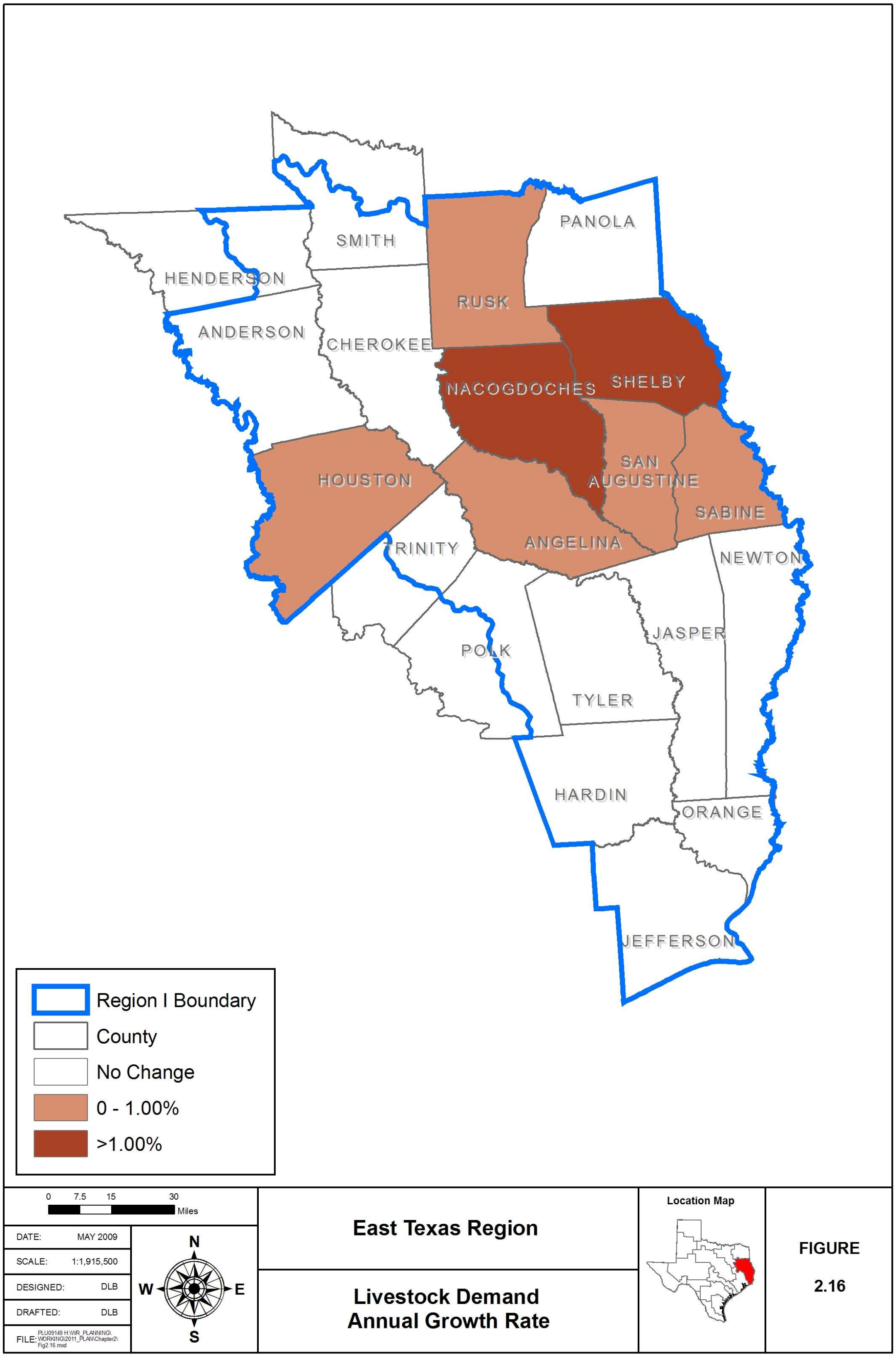


Figure 2.15
Minor Livestock Water Demand Projections (2010 - 2060)




SMITH
PANOLA
HENDERSON
RUSK
ANDERSON
CHEROKEE
NACOGDOCHES
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HOUSTON
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ANGELINA
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POLK
TYLER
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JEFFERSON
Region I Boundary
County
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DATE: MAY 2009
SCALE: 1:1,915,500
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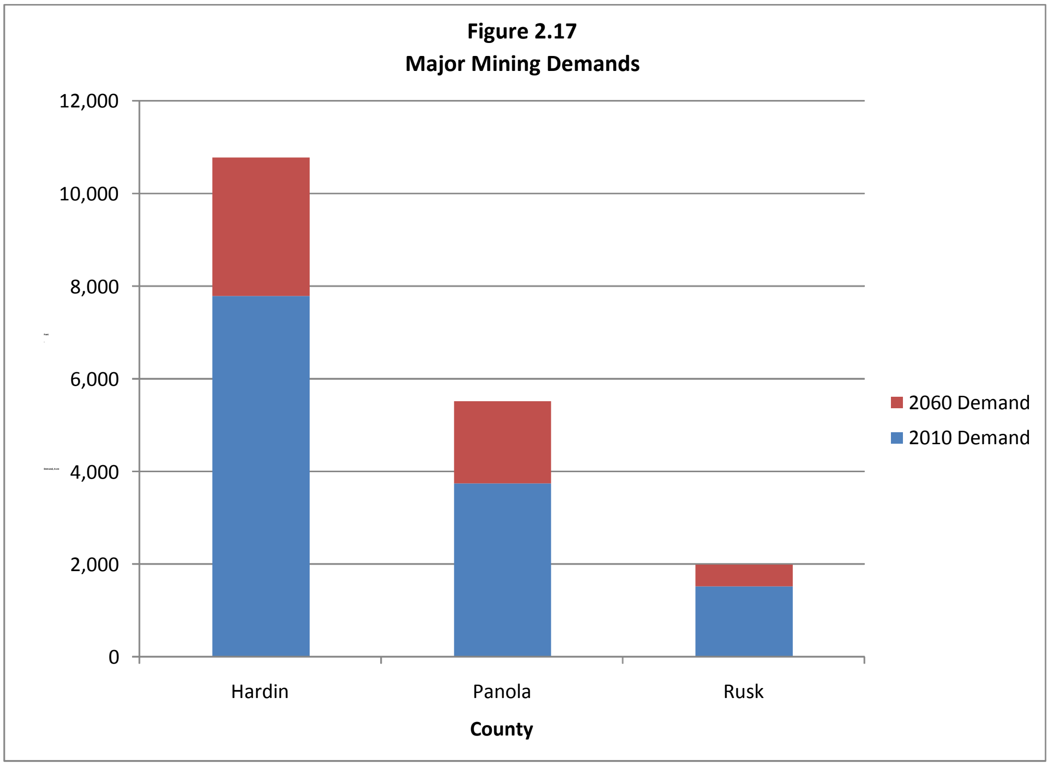
East Texas Region
Livestock Demand
Annual Growth Rate
Location Map
FIGURE
2.16

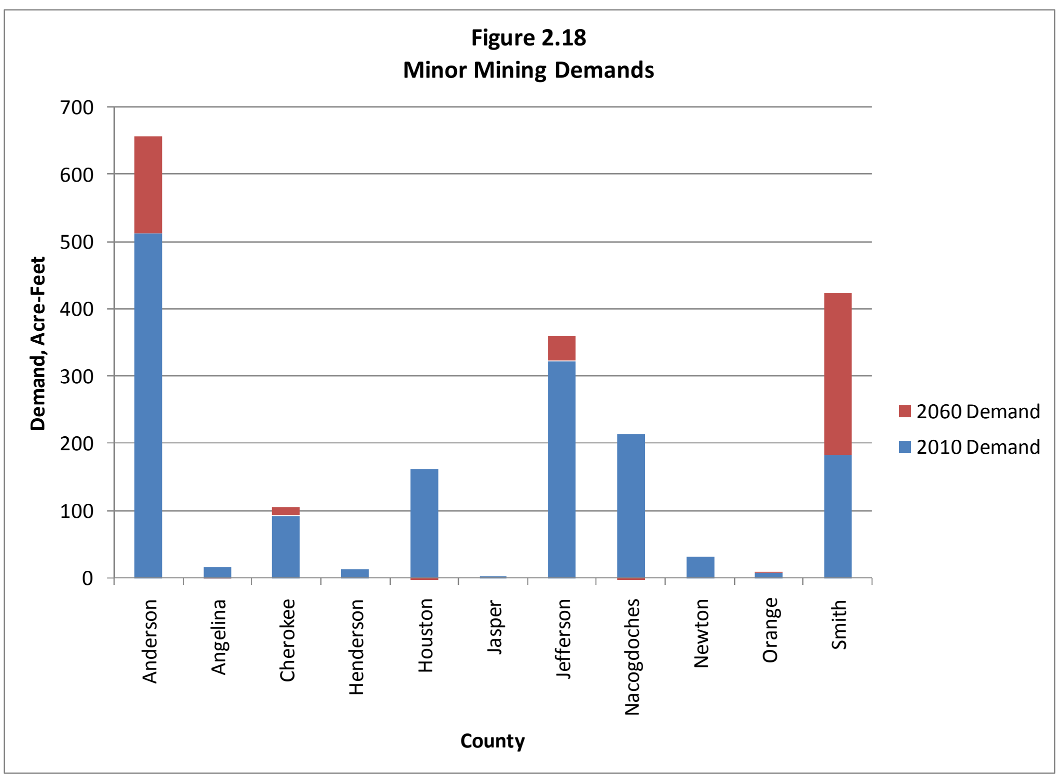
Table 2.8 Historical and Projected Mining Water Demand by County (ac-ft per year)

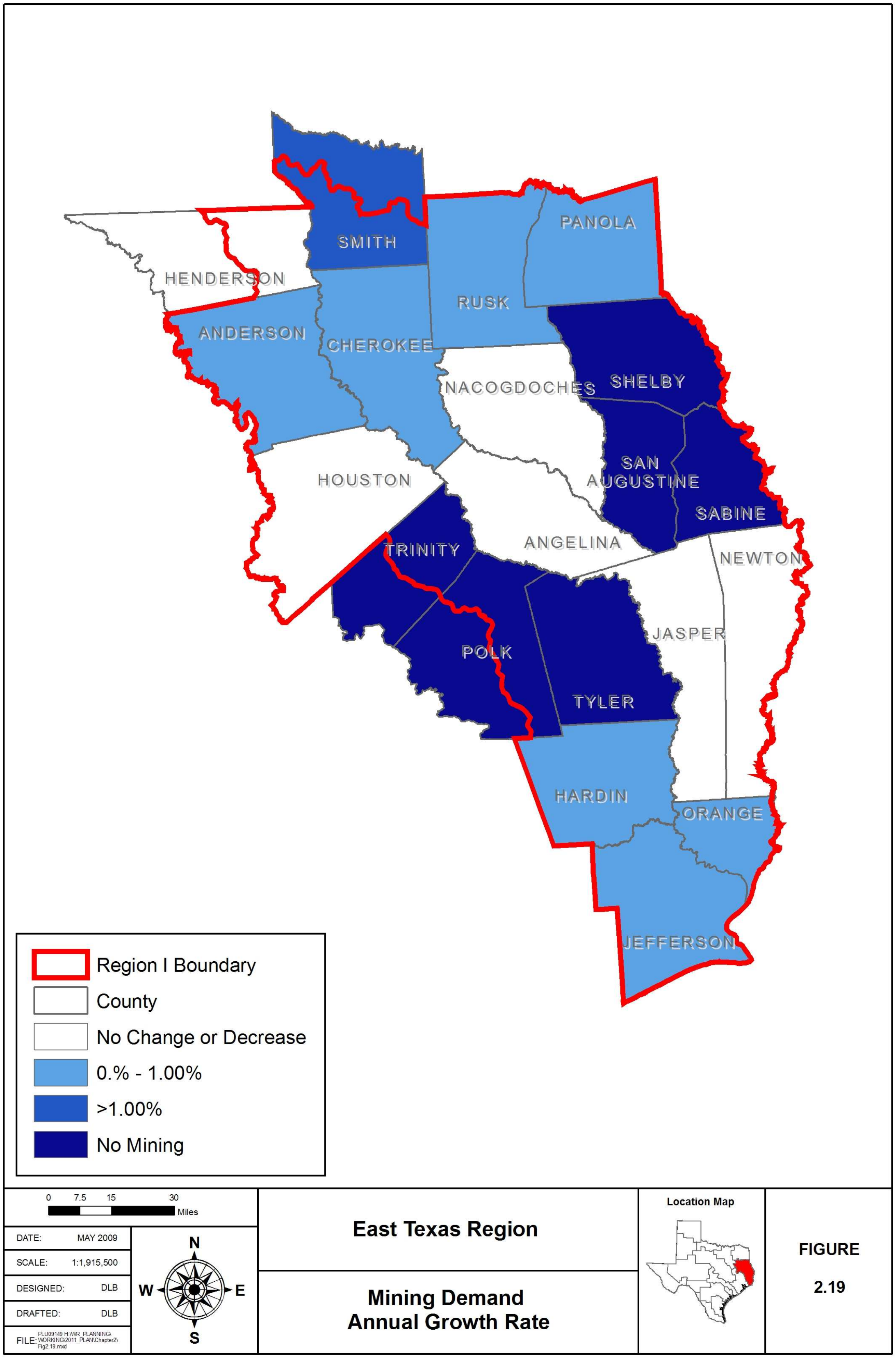
	Historical	Projections					
	2006	2010	2020	2030	2040	2050	2060
Anderson	424	513	557	583	608	633	657
Angelina	22	2,018	4,017	17	17	17	17
Cherokee	83	593	1,597	99	101	103	105
Hardin*	5,236	7,800	8,648	9,219	9,788	10,361	10,798
Henderson	21	14	14	14	14	14	14
Houston	177	163	160	158	156	154	153
Jasper	4	4	4	4	4	4	4
Jefferson	434	323	334	341	348	355	360
Nacogdoches	220	2,715	7,213	212	211	210	209
Newton	34	32	32	32	32	32	32
Orange	0	8	9	9	9	9	9
Panola	953	3,756	4,271	4,587	4,905	5,228	5,536
Polk	0	0	0	0	0	0	0
Rusk	633	1,540	1,679	1,761	1,841	1,921	1,996
Sabine	0	0	0	0	0	0	0
San Augustine	0	1,500	7,000	0	0	0	0
Shelby	0	500	1,500	0	0	0	0
Smith	116	183	262	295	351	391	424
Trinity	0	0	0	0	0	0	0
Tyler	0	0	0	0	0	0	0
Total for ETRWPA	***8,357**	**21,660**	**37,297**	**17,331**	**18,385**	**19,432**	**20,314**

*Historical data for mining are reported for 2005. In 2006, the TWDB changed the methodology of reporting mining use to include only data provided to the TWDB through the annual survey and other mining use that can be confirmed. This resulted in significantly lower estimates of mining water use across the state.



* Footnote: Angelina, San Augustine, Cherokee, Nacogdoches, Shelby




SMITH
HENDERSON
PANOLA
RUSK
ANDERSON
CHEROKEE
NACOGDOCHES
SHELBY
HOUSTON
SAN AUGUSTINE
SABINE
TRINITY
ANGELINA
NEWTON
JASPER
POLK
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Region I Boundary
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DATE: MAY 2009
SCALE: 1:1,915,500
DESIGNED: DLB
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East Texas Region
Mining Demand Annual Growth Rate
Location Map
FIGURE
2.19

2.4 Demands for Wholesale Water Providers

As part of the development of the regional water plan, current water demands were identified for the WWPs in the ETRWPA. The WWPs 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, and
- Upper Neches River Municipal Water Authority.

Chapter 1 provides a description of each WWP in the ETRWPA.

2.4.1 Angelina and Neches River Authority. ANRA is currently pursuing developing Lake Columbia, a new lake on Mud Creek, and has 17 participants that have committed to taking water on a wholesale basis from the project. In addition, ANRA currently provides retail water service to Holmwood Utility located in Jasper County. The demands shown in Table 2.9 represent the contract amounts for the Lake Columbia participants and the expected demands from Holmwood Utility.

Table 2.9 Expected Demands for the Angelina and Neches River Authority (ac-ft per year)

Customer	2010	2020	2030	2040	2050	2060
Angelina County Manufacturing (Temple Inland)	8,551	8,551	8,551	8,551	8,551	8,551
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
Nacogdoches County-Other	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
City of Alto	428	428	428	428	428	428
Smith County-Other	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
Total Demand – Lake Columbia	*53,870*	*53,870*	*53,870*	*53,870*	*53,870*	*53,870*
Holmwood Utility	60	65	70	70	70	70
Total Demand	**53,930**	**53,935**	**53,940**	**53,940**	**53,940**	**53,940**

2.4.2. Angelina-Nacogdoches Water Control and Improvement District No. 1. The A-NWCID No. 1 provides water for cooling for Luminant Energy's natural gas fired electrical plant located on the shoreline of Lake Striker. Luminant has a contract for 5,000 ac-ft per year of raw water. Luminant's current contract expires on April 30, 2031, with an option of 10 year extensions beyond the 2031 date.

The District has a wholesale contract with Nacogdoches Power LLC, to provide cooling water for their biomass fired electrical power plant that is soon to be under construction near Sacul. Nacogdoches Power has a contract for 2,240 ac-ft per year and an option for an additional 4,481 ac-ft per year. This water will be re-circulated through a cooling tower. Their contract began January 1, 2008, and is scheduled for a primary term of 25 years with an option of a 15-year extension.

The Cities of Henderson and Whitehouse have options for water from Lake Striker for their potential future needs. Each of these options expires on September 30, 2016. Table 2.10 depicts expected demands for the A-NWCID No. 1.

Table 2.10 Expected Demands for the Angelina-Nacogdoches Water Control and Improvement District No. 1(ac-ft per year)

WUGs	2010	2020	2030	2040	2050	2060
Luminant Energy	2,245	1,790	2,093	2,462	2,912	3,460
Nacogdoches Power	2,240	6,721	6,721	6,721	0	0
City of Whitehouse	2,186	0	0	0	0	0
Henderson	2,242	0	0	0	0	0
Total Demand	**8,913**	**8,511**	**8,814**	**9,183**	**2,912**	**3,460**

2.4.3. Athens Municipal Water Authority. The Athens MWA provides wholesale water to the City of Athens, which is located in Regions C and I. The City of Athens also provides water to manufacturing in Henderson County in Region C. In addition, Athens MWA supplies a small amount of water for local irrigation around the lake and has a contract with the Athens Fish Hatchery for 3,023 ac-ft per year of raw water. Table 2.11 depicts expected demands on Athens MWA.

Table 2.11 Expected Demands for the Athens Municipal Water Authority and Lake Athens (ac-ft per year)

Customer	2010	2020	2030	2040	2050	2060
City of Athens (less groundwater supplies)	2,085	2,591	3,190	3,870	4,762	5,867
Henderson Co. Irrigation	159	164	169	174	179	185
Athens Fish Hatchery	3,023	3,023	3,023	3,023	3,023	3,023
Henderson County Manufacturing	100	106	120	136	155	176
Total Demand	**5,367**	**5,884**	**6,502**	**7,203**	**8,119**	**9,251**

2.4.4 City of Beaumont. In addition to retail municipal water for its own customers, the City of Beaumont provides wholesale water to numerous industries in Jefferson County. The City also provides treated water to most of the County-Other demands in Jefferson County, including Jefferson County Water Improvement District No. 1, Northwest Forest Municipal Utility District, and prison complexes. The City also provides retail municipal water to its residents. Table 2.12 depicts expected demands for the City of Beaumont.

Table 2.12 Expected Demands for the City of Beaumont (ac-ft per year)

Customer	2010	2020	2030	2040	2050	2060
City of Beaumont*	27,040	26,657	26,275	25,892	25,636	25,636
Jefferson County-Other	1,692	2,194	2,615	2,945	3,311	4,004
Jefferson County Manufacturing	1,000	1,105	1,221	1,349	1,490	1,646
Meeker MUD	3	4	4	5	5	8
Total Demand	**29,735**	**29,960**	**30,116**	**30,190**	**30,442**	**31,294**

*Municipal (not wholesale) demand

2.4.5 City of Carthage. In addition to providing municipal water on a retail basis to its own customers, the City of Carthage provides wholesale water to County-Other and manufacturing customers in Panola County. Expected demands on the City are expected to increase from 4,779 ac-ft per year in 2010 to 5,120 ac-ft per year in 2060. Table 2.13 depicts expected demands for the City of Carthage.

Table 2.13 Expected Demands for the City of Carthage (ac-ft per year)

Customer	2010	2020	2030	2040	2050	2060
City of Carthage*	2,274	2,297	2,311	2,317	2,326	2,343
Panola County-Other	1,487	1,487	1,487	1,487	1,487	1,487
Panola County Manufacturing	1,018	1,078	1,125	1,171	1,211	1,290
Total Demand	**4,779**	**4,862**	**4,923**	**4,975**	**5,024**	**5,120**

*Municipal (not wholesale) demand.

2.4.6 City of Center. The City of Center provides municipal water on a retail basis for its own customers, and wholesale water to Shelby County Manufacturing and Shelby County-Other. The City's municipal customers include Sand Hills WSC and Shelbyville WSC. The primary customer for manufacturing water is Tyson Foods, Inc. Table 2.14 depicts expected demands for the City of Center.

Table 2.14 Expected Demands for the City of Center (ac-ft per year)

Customer	2010	2020	2030	2040	2050	2060
Sand Hills WSC	167	174	179	180	184	190
Shelbyville WSC	21	22	22	23	23	24
Manufacturing	1,156	1,282	1,391	1,501	1,598	1,716
City of Center*	1,633	1,718	1,785	1,823	1,867	1,923
Total Demand	**2,977**	**3,195**	**3,378**	**3,527**	**3,672**	**3,853**

*Municipal (not wholesale) demand.

2.4.7 City of Jacksonville. The City of Jacksonville currently provides treated water to several water supply corporations in Cherokee County as well as nearly all of the manufacturing needs in the county. The expected demand on Jacksonville is over 5,300 ac-ft per year in 2010, increasing to nearly 6,900 ac-ft per year by 2060. Table 2.15 depicts expected demands for the City of Jacksonville.

Table 2.15 Expected Demands for the City of Jacksonville (ac-ft per year)

Customer	2010	2020	2030	2040	2050	2060
City of Jacksonville*	3,502	3,637	3,741	3,827	3,948	4,111
Cherokee County Manufacturing	718	784	839	891	934	1,007
Cherokee County-Other	226	198	154	95	68	55
North Cherokee WSC	387	439	482	519	560	616
Bullard	10	10	10	10	10	10
Craft-Turney WSC	515	614	742	908	995	1,078
Total Demand	**5,358**	**5,682**	**5,968**	**6,250**	**6,515**	**6,877**

*Municipal (not wholesale) demand.

2.4.8 City of Lufkin. The City of Lufkin provides municipal water on a retail basis to its own customers, as well as wholesale water to several industries in Angelina County and municipal water to the Angelina Fresh Water Authority, Redland WSC and the City of Huntington. The City has recently contracted with the City of Diboll for 632 MGY and has a contract with Abitibi for 5 MGD, if needed. Neither of these customers is currently receiving water. The City's largest industrial customer is Pilgrim's Pride. With the recent acquisition of the Abitibi well field and Lake Kurth water rights, there is the potential for the City to provide wholesale water to other entities in Angelina and Nacogdoches Counties. Table 2.16 depicts expected demands for the City of Lufkin.

Table 2.16 Expected Demands for the City of Lufkin (ac-ft per year)

Customer	2010	2020	2030	2040	2050	2060
City of Lufkin*	7,546	8,444	9,446	10,565	11,951	13,599
Angelina County-Other	91	94	99	104	115	131
Angelina County Manufacturing	9,550	17,255	18,981	20,879	22,966	25,263
Redland WSC	107	104	101	98	97	97
Angelina Fresh Water Authority	40	54	66	72	80	88
Huntington	20	27	33	36	40	44
City of Diboll	1,940	1,940	1,940	1,940	1,940	1,940
Total Demand	**19,294**	**27,918**	**30,664**	**33,694**	**37,189**	**41,162**

*Municipal (not wholesale) demand.

2.4.9 City of Nacogdoches. The City currently provides retail municipal water to its own customers and wholesale water to County-Other in Nacogdoches County, including Central Heights WSC, Lilly Grove WSC, Nacogdoches County MUD No. 1, and Timber Ridge East. The city also supplies water to Appleby WSC, D&M Water Supply, and nearly all of the manufacturing demands in Nacogdoches County. For this plan it is assumed that Nacogdoches will continue to meet the projected manufacturing demands for Nacogdoches County. Table 2.17 depicts expected demands for the City of Nacogdoches.

Table 2.17 Expected Demands for the City of Nacogdoches (ac-ft per year)

Customer	2010	2020	2030	2040	2050	2060
City of Nacogdoches*	7,625	8,423	9,218	9,939	11,352	12,540
Manufacturing	2,288	2,553	2,786	3,016	3,214	3,468
Appleby WSC	25	145	317	511	878	1,274
D&M Water Supply	406	452	491	540	652	780
Total Demand	**10,344**	**11,573**	**12,812**	**14,006**	**16,096**	**18,062**

*Municipal (not wholesale) demand.

2.4.10 City of Port Arthur. The City of Port Arthur provides retail municipal water to its customers as well as treated wholesale water to industrial users in Jefferson County. The City of Port Arthur receives raw water supply from the LNVA. The City also provides a small amount of reuse water to one industrial customer. Table 2.18 depicts expected demands for the City of Port Arthur.

Table 2.18 Expected Demands for the City of Port Arthur (ac-ft per year)

Customer	2010	2020	2030	2040	2050	2060
City of Port Arthur*	9,704	9,510	9,315	9,122	8,993	8,993
Jefferson County-Other	5	5	5	5	5	5
Jefferson County Manufacturing	6,140	6,862	7,584	8,306	9,028	9,752
Total Demand	**15,849**	**16,377**	**16,904**	**17,433**	**18,026**	**18,750**

*Municipal (not wholesale) demand.

2.4.11 City of Tyler. The City of Tyler provides municipal water on a retail basis to its own customers and wholesale water to local industries, Walnut Grove Water System, Southern Utilities Company, and the City of Whitehouse. It also provides a small amount of water for golf course irrigation. It is assumed that Tyler will continue to provide about 75 percent of the manufacturing demand in Smith County and 70 percent of the demands for Whitehouse. Table 2.19 depicts expected demands for the City of Tyler.

Table 2.19 Expected Demands for the City of Tyler (ac-ft per year)

Customer	2010	2020	2030	2040	2050	2060
City of Tyler	25,886	26,849	27,778	28,675	30,615	33,334
Smith County Irrigation	300	300	300	300	300	300
Smith County Manufacturing	2,885	3,223	3,523	3,811	4,055	4,391
City of Whitehouse	687	749	807	868	984	1,145
Walnut Grove Water System	445	467	491	515	541	568
Southern Utilities Company	303	315	325	338	370	918
Total Demand	**30,506**	**31,903**	**33,224**	**34,506**	**36,865**	**40,656**

2.4.12 Houston County Water Control and Improvement District No. 1. HCWCID No. 1 provides wholesale raw water to municipal and manufacturing customers. HCWCID No. 1 presently serves Houston County-Other, Consolidated WSC, City of Crockett, City of Grapeland, City of Lovelady, and manufacturing water to AMPACET. Table 2.20 depicts expected demands for the HCWCID No. 1.

Table 2.20 Expected Demands for the Houston County Water Control and Improvement District No. 1 (ac-ft per year)

Customer	2010	2020	2030	2040	2050	2060
City of Grapeland	405	405	405	405	405	405
Houston County-Other	89	90	91	93	96	100
Houston County Manufacturing	169	190	209	227	243	263
City of Crockett	1,841	1,841	1,841	1,841	1,841	1,841
City of Lovelady	77	77	77	77	77	77
Consolidated WSC	1,031	1,031	1,031	1,031	1,031	1,031
Total Demand	**3,612**	**3,634**	**3,654**	**3,674**	**3,693**	**3,717**

2.4.13 Lower Neches Valley Authority. The LNVA provides wholesale raw water for municipal, industrial, and irrigation uses. The LNVA currently serves municipal customers in Jefferson County in the ETRWPA, and Chambers and Galveston Counties in Region H. LNVA provides a significant portion of water for industrial use in Jefferson County (directly and indirectly through the City of Port Arthur) and Jasper County. It is expected that LNVA will provide water to Liquid Natural Gas (LNG) facilities that are currently planned within the ETRWPA. The LNVA also provides irrigation water through its canal system to farmers in Jefferson County in the ETRWPA and Chambers and Liberty Counties in Region H.

The LNVA has recently entered into contracts with the City of Beaumont, West Vaco and the City of Woodville for future water supplies. The total expected demand on LNVA, including these contractual obligations, is 530,800 ac-ft per year in 2010 and increasing to over 1 million ac-ft per year by 2060. Table 2.21 depicts expected demands for the LNVA.

Table 2.21 Expected Demands for the Lower Neches Valley Authority (ac-ft per year)

Customer	2010	2020	2030	2040	2050	2060
Jasper County Manufacturing	20,189	23,571	26,084	28,281	29,928	29,991
Groves	3,190	3,137	3,085	3,031	2,996	2,996
Nederland	4,125	4,268	4,387	4,456	4,573	4,834
Port Arthur	15,849	16,377	16,904	17,433	18,026	18,750
Port Neches	1,782	1,782	1,789	1,780	1,804	1,882
Jefferson County - Other	188	244	291	327	368	445
Jefferson County Manufacturing	144,032	235,566	235,566	260,566	285,566	310,566
Jefferson County LNG	0	179,225	358,450	358,450	358,450	358,450
Jefferson County - Irrigation	140,000	140,000	140,000	140,000	140,000	140,000
West Jefferson County MWD	1,029	1,148	1,264	1,345	1,436	1,631
Jefferson County WCID #10	640	700	750	787	832	929
Nome	127	136	144	150	157	172
Region H						
Trinity Bay Conservation District	2,688	2,688	2,688	2,688	2,688	2,688
Bolivar Peninsula SUD	6,000	6,000	6,000	6,000	6,000	6,000
Chambers County - Irrigation	37,000	37,000	37,000	37,000	37,000	37,000
Liberty County - Irrigation	23,000	23,000	23,000	23,000	23,000	23,000
Delivery Losses	43,982	67,484	77,166	70,824	63,898	56,360
Total Demand	**443,822**	**742,326**	**934,568**	**956,117**	**976,721**	**995,694**
Other Obligations						
City of Beaumont - Reserve	31,360	31,360	31,360	31,360	31,360	31,360
West Vaco - Contract	50,000	50,000	50,000	50,000	50,000	50,000
City of Woodville - Contract	5,600	5,600	5,600	5,600	5,600	5,600
Obligation sub-total	**86,960**	**86,960**	**86,960**	**86,960**	**86,960**	**86,960**
Total Demands & Obligations	**530,782**	**829,286**	**1,021,528**	**1,043,077**	**1,063,681**	**1,082,654**

2.4.14 Panola County Freshwater Supply District No. 1. PCFWSD No. 1 provides raw water to the City of Carthage from its water right of 21,400 acre-feet in Lake Murvaul. Water is also provided for mining operations, Panola County manufacturing, and Panola County-Other. Table 2.22 depicts expected demands for the PCFWSD No.1.

Table 2.22 Expected Demands for the Panola County Freshwater Supply District No. 1 (ac-ft per year)

Customer	2010	2020	2030	2040	2050	2060
City of Carthage	2,274	2,297	2,311	2,317	2,326	2,343
Panola County-Other	1,487	1,487	1,487	1,487	1,487	1,487
Panola County Manufacturing	1,018	1,078	1,125	1,171	1,211	1,290
Panola County Mining	2,254	2,563	2,752	2,943	3,137	3,322
Total Demand	**7,032**	**7,424**	**7,675**	**7,918**	**8,160**	**8,442**

2.4.15 Sabine River Authority. SRA owns and operates several reservoirs and run-of-the-river water rights. The SRA system consists of an Upper Basin System (Lake Fork and Lake Tawakoni) and Lower Basin System (Toledo Bend Reservoir and Canal System). The SRA provides wholesale water to municipal and industrial customers in Regions C and D from the Upper Basin System, located outside of the ETRWPA.

The SRA provides wholesale water to customers in the ETRWPA from its Toledo Bend Reservoir and Canal System. Municipal customers include the Cities of Hemphill, Huxley, and Rose City; Beechwood WSC, El Camino Bay Property Owners Association, and Pendleton Utility Corporation. The largest manufacturing demands are for E.I. Dupont de Nemours Company, Inc., and Temple-Inland Paperboard and Packaging. Water from SRA's Canal System also provides irrigation water in Orange County. Table 2.23 depicts expected demands for SRA.

Table 2.23 Expected Demands for the Sabine River Authority (ac-ft per year)

Lower Basin Customer	2010	2020	2030	2040	2050	2060
Toledo Bend:						
Hemphill	1,841	1,841	1,841	1,841	1,841	1,841
Huxley	280	280	280	280	280	280
Tenaska	17,922	17,922	17,922	17,922	17,922	17,922
Beechwood WSC	190	190	190	190	190	190
El Camino WS	18	18	18	18	18	18
Pendleton Utility Corp	28	28	28	28	28	28
Canal (Gulf Coast Division)						
Honeywell	1,120	1,120	1,120	1,120	1,120	1,120
Bayer	1,120	1,120	1,120	1,120	1,120	1,120
Chevron Phillips	2,240	2,240	2,240	2,240	2,240	2,240
E.I. 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	737	737	737	737	737	737
Temple-Inland Paper	22,403	22,403	22,403	22,403	22,403	22,403
Gerdau Ameristeel US Inc.	1,120	1,120	1,120	1,120	1,120	1,120
North Star Steel/Lanxess	1,120	1,120	1,120	1,120	1,120	1,120
A. Schulman, Inc.	224	224	224	224	224	224
Cottonwood Energy	13,442	13,442	13,442	13,442	13,442	13,442
Rose City	478	478	478	478	478	478
Orange County Irrigation	2,500	2,500	2,500	2,500	2,500	2,500
Total Demands - Lower Basin	**95,907**	**95,907**	**95,907**	**95,907**	**95,907**	**95,907**

2.4.16 Upper Neches River Municipal Water Authority. The UNRMWA owns and operates Lake Palestine and water rights on the Neches River. It has existing wholesale water supply contracts with the cities of Dallas, Tyler, and Palestine, and provides a small amount to other local water users.

Presently, the City of Dallas has a contract for 114,337 ac-ft per year, but there are no transmission facilities to transport water from Lake Palestine. Dallas is expected to begin using water from Lake Palestine by 2015. The City of Tyler has a contract for 67,200 ac-ft per year, from Lake Palestine. Tyler has completed a 30 MGD treatment and transmission facility from the lake that can provide half of the contract amount. The City of Palestine has a contract for 28,000 ac-ft per year and takes this water from a diversion point on the Neches River. UNRMWA also provides water to Super Tree Farm, the Emerald Bay golf course, and TECON. It expects to provide a small amount of water to local County-Other in Smith County. Table 2.24 depicts the expected demands for the UNRMWA.

Table 2.24 Expected Demands for the Upper Neches River Municipal Water Authority (ac-ft per year)

Customer	2010	2020	2030	2040	2050	2060
City of Dallas (not connected)	114,337	114,337	114,337	114,337	114,337	114,337
City of Tyler	67,200	67,200	67,200	67,200	67,200	67,200
City of Palestine	28,000	28,000	28,000	28,000	28,000	28,000
Smith County-Other (1%)	93	82	73	64	57	51
Super Tree Farm for International Paper (Cherokee County Irrigation)	300	300	300	300	300	300
TECON (Henderson County-Other)	100	100	100	100	100	100
Emerald Bay Golf Course (Smith County Irrigation)	105	105	105	105	105	105
Total Demand	**210,135**	**210,124**	**210,115**	**210,106**	**210,099**	**210,093**

Chapter 3

Evaluation of Current Water Supplies in the Region

Under SB1 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 sources of water supply, although, there are other potentially significant types of sources as well.

Surface water includes reservoirs and run-of-river supplies. For surface water reservoirs, this 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 record.

Texas is currently in the process of a groundwater joint planning initiative. Joint planning is conducted by the GCDs in the GMAs and is sometimes referred to as GMA planning. The counties in the ETRWPA fall in GMA-11 or GMA-14. The Texas Water Code now requires that RWPGs rely on the MAG estimates that are determined from the DFCs in each GMA. Neither of the GMAs in the ETRWPA had DFCs or MAGs prior to the deadline set by TWDB for inclusion in the 2011 Plan, therefore, groundwater supplies have not been modified.

Other water supplies considered for planning purposes include reuse of treated wastewater, saline sources, and local supplies. Local supplies generally include stock ponds that do not require water rights permits, and local mining supplies. These supplies are assessed based on historical and current use.

Currently, water supplies available to each user are those that have been permitted or contracted with infrastructure in place to transport and treat (if necessary) water. Some water supplies are permitted or are contracted for use, but the infrastructure is not yet in place. Connecting such supplies is considered a water management strategy for future use. 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.

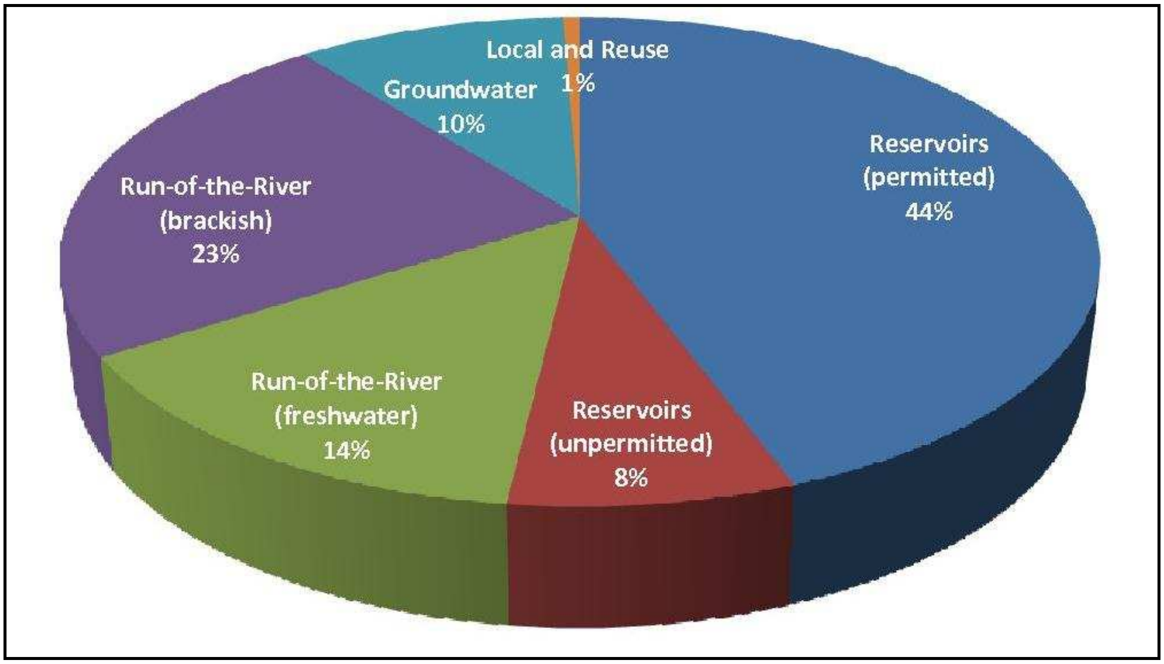
3.1 Regional Water Supply Availability

Table 3.1 and Figure 3.1 summarize overall water supply availability in the ETRWPA. Approximately 4.4 million ac-ft per year of permitted supplies are available in the region. Of this amount, about 3.4 million ac-ft per year are freshwater supplies. Most of the available water in the ETRWPA is associated with surface water sources. Approximately 15 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.

Table 3.1 Summary of Currently Available Water Supplies in the ETRWPA (ac-ft per year)

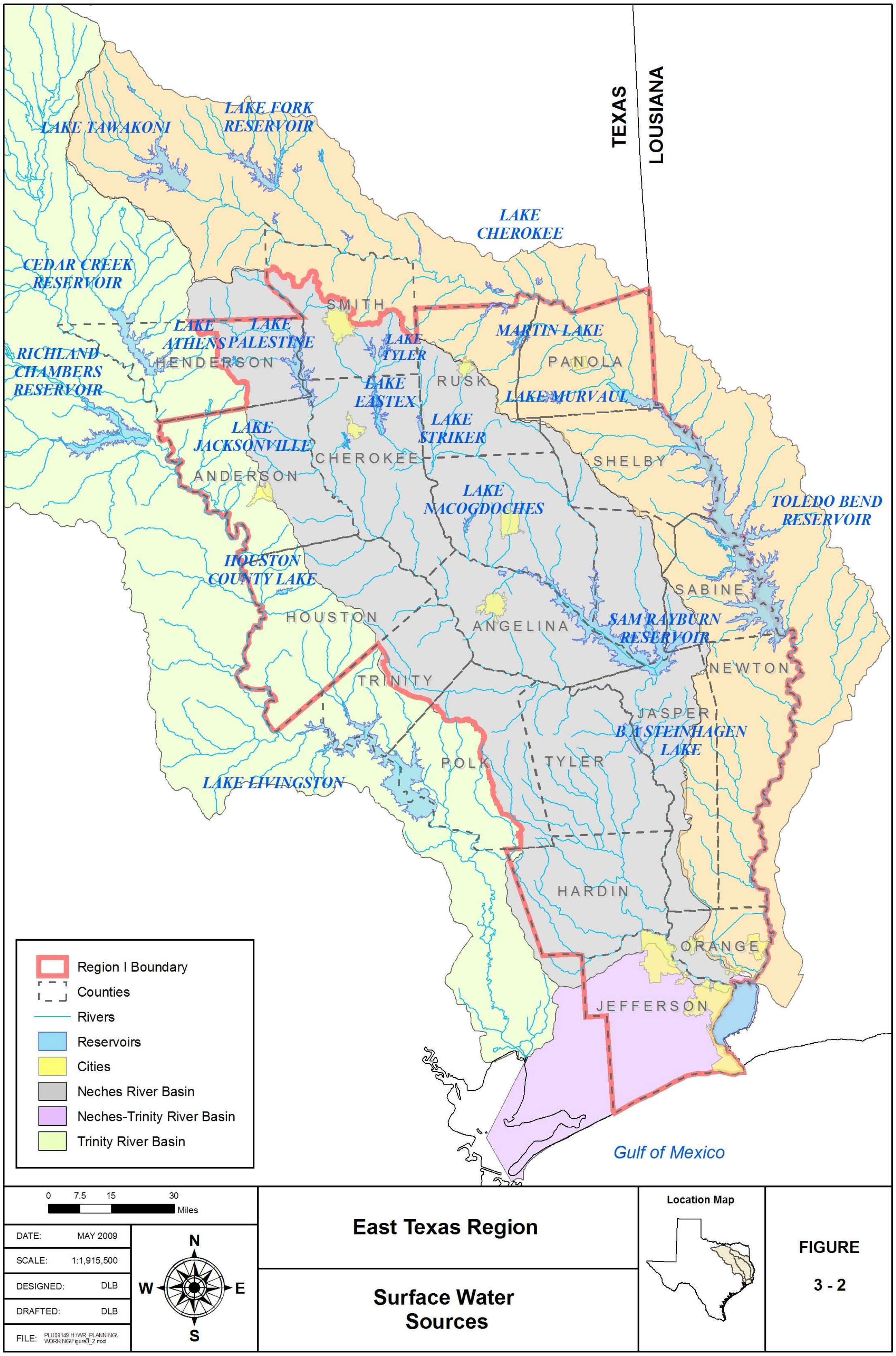
Source of Supply	2000	2010	2020	2030	2040	2050	2060
Reservoirs (permitted)	1,966,474	1,962,698	1,958,512	1,954,328	1,950,141	1,945,955	1,941,769
Reservoirs (unpermitted)	340,300	330,874	321,857	312,841	303,825	294,808	285,790
Run-of-the-River (freshwater)	623,004	623,004	623,004	623,004	623,004	623,004	623,004
Run-of-the-River (brackish)	1,035,982	1,035,982	1,035,982	1,035,982	1,035,982	1,035,982	1,035,982
Groundwater	446,043	446,043	446,043	446,043	446,043	446,043	446,043
Local Supplies	13,094	13,094	13,094	13,094	13,094	13,094	13,094
Direct Reuse	1,518	1,518	1,518	1,518	1,518	1,518	1,518
Indirect Reuse	16,559	16,559	13,687	13,687	13,687	13,687	13,687
Total	**4,442,974**	**4,429,772**	**4,413,697**	**4,400,497**	**4,387,294**	**4,374,091**	**4,360,887**

Figure 3.1 Year 2010 Available Supplies by Source Type



3.1.1 Surface Water Availability. In accordance with established procedures of the TWDB, the surface water supplies for the regional water plans were determined using the TCEQ-approved Water Availability Models (WAM). In the ETRWPA, four basins were evaluated: Neches, Neches-Trinity, Trinity, and Sabine. Figure 3.2 shows the river basins and major reservoirs.

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-


TEXAS
LOUSIANA
LAKE TAWAKONI
LAKE FORK RESERVOIR
LAKE CHEROKEE
CEDAR CREEK RESERVOIR
RICHLAND CHAMBERS RESERVOIR
LAKE ATHENS
LAKE PALESTINE
LAKE TYLER
MARTIN LAKE
LAKE EASTEX
LAKE MURVAUL
LAKE JACKSONVILLE
LAKE STRIKER
LAKE NACOGDOCHES
TOLEDO BEND RESERVOIR
HOUSTON COUNTY LAKE
SAM RAYBURN RESERVOIR
B A STEINHAGEN LAKE
LAKE LIVINGSTON
SMITH
HENDERSON
RUSK
PANOLA
CHEROKEE
ANDERSON
SHELBY
SABINE
HOUSTON
ANGELINA
NEWTON
TRINITY
JASPER
POLK
TYLER
HARDIN
ORANGE
JEFFERSON
Gulf of Mexico
Region I Boundary
Counties
Rivers
Reservoirs
Cities
Neches River Basin
Neches-Trinity River Basin
Trinity River Basin
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N
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East Texas Region
Surface Water Sources
Location Map
FIGURE
3 - 2

approved 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 water supplies in the ETRWPA. Generally, changes to the WAMs include the following:

- Assessment of reservoir sedimentation rates, and the calculation of area-capacity conditions for current (2000) and future (2060) conditions. Since the 2006 regional water plan there have been three new volumetric surveys completed: Lake Jacksonville, Lake Palestine, and Sam Rayburn Reservoir. New sedimentation rates were calculated and estimates of the current storage volumes were updated.
- Inclusion of subordination agreements that are currently in place
- Inclusion of system operations where appropriate
- Basin-specific modifications

The specific changes to each river basin are described below. The modified Trinity WAM for Region C was used to assess the supplies in the ETRWPA from the Trinity Basin. There were no changes specific to the region's sources. Also, no changes were made to the Neches-Trinity WAM.

Neches River Basin WAM. Changes made to the Neches WAM include the following:

- Modeled the UNRMWA's water rights as a system (Lake Palestine and Rocky Point dam).
- Sam Rayburn/Steinhagen water right was modeled subordinate to flow upstream above the Ponta Dam site (which is now Lake Columbia) and

Weches Dam site (special condition (d) of Certificate of Adjudication 4411)[1.

- Sam Rayburn/Steinhagen industrial and irrigation water use was modeled subordinate to municipal rights located below the Ponta and Weches dam sites and above the reservoirs. This included Lake Nacogdoches, Pinkston Reservoir and the water rights for San Augustine Lake that are junior to 1963.
- The TCEQ input file did not consider hydropower use in Sam Rayburn. Hydropower was included in the model.
- The operation of LNVA's water rights was modeled as a system by including backup of LNVA's Pine Island water rights with storage from Sam Rayburn.
- The firm yield of Sam Rayburn/Steinhagen included a minimum elevation in Sam Rayburn of 149 ft. msl., and all storage available in Sam Rayburn up to elevation 164.4 ft. msl.

Sabine River Basin WAM. The Sabine WAM that was developed for the 2006 Plan was used to assess surface water supplies for the 2011 Plan update. The changes made to TCEQ-approved Sabine WAM include the following:

- Adjusted the sedimentation rate for Lake Fork to equal the rate determined for Lake Tawakoni. Based on soil types and watershed characteristics of the two lakes, sedimentation for Lake Fork should be less than Lake Tawakoni. This rate will be re-assessed after a new volumetric survey is completed for Lake Fork.
- The SRA's water rights in the lower basin were modeled as a system by backing up the Authority's canal water rights with releases from Toledo Bend Reservoir.

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[1]Lake Columbia and the Weches Dam have not been constructed to date. Lake Columbia has a water right permit for 85,507 ac-ft per year.

- The remainder of the yield of Toledo Bend was evaluated assuming all diversions were taken lakeside.
- The TCEQ Sabine WAM models Toledo Bend with hydropower. For purposes of finding total available supply for Toledo Bend, hydropower was excluded. Hydropower was included in the evaluation of supplies for all other reservoirs and run-of-the-river supplies.

Reservoirs. 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 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. For this plan, 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 3.2.

Unpermitted Reservoir Yields. Table 3.3 includes information on "unpermitted reservoir yields". This provides an estimate of available supply that could be permitted for future use. The largest unpermitted reservoir yield in the ETRWPA is Texas' share of the yield of Toledo Bend Reservoir, which is nearly 225,000 ac-ft per year. Other unpermitted yields are located in the Lake Sam Rayburn/B.A. Steinhagen System, Houston County Lake, San Augustine City Lake, and Lake Jacksonville.

Table 3.2 Currently Available Supplies from Permitted Reservoirs Serving the ETRWPA (ac-ft per year)

Reservoir	Basin	County	Permitted Diversion	Currently Available Supply[1]						
				2000	2010	2020	2030	2040	2050	2060
Lake Athens	Neches	Henderson	8,500	6,145	6,064	5,983	5,903	5,822	5,741	5,660
Bellwood Lake	Neches	Smith	2,200	950	950	950	950	950	950	950
Lake Kurth	Neches	Angelina	19,100	18,425	18,421	18,417	18,413	18,408	18,404	18,400
Lake Columbia	Neches	Cherokee	85,507	0	0	0	0	0	0	0
Lake Jacksonville	Neches	Cherokee	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200
Lake Nacogdoches	Neches	Nacogdoches	22,000	17,450	17,067	16,683	16,300	15,917	15,533	15,150
Lake Palestine system	Neches	Anderson	238,110	209,500	207,458	205,417	203,375	201,333	199,292	197,250
Lake Tyler/Tyler East	Neches	Smith	40,325	30,950	30,925	30,900	30,875	30,850	30,825	30,800
Pinkston Reservoir	Neches	Shelby	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800
Rusk City Lake	Neches	Cherokee	160	65	64	63	63	62	61	60
San Augustine City Lake	Neches	San Augustine	1,285	1,285	1,285	1,285	1,285	1,285	1,285	1,285
Sam Rayburn & Steinhagen System	Neches	Jasper	820,000	820,000	820,000	820,000	820,000	820,000	820,000	820,000
Striker Lake	Neches	Rusk	20,600	20,600	20,183	19,357	18,530	17,703	16,877	16,050
Lake Timpson	Neches	Shelby	350	350	350	350	350	350	350	350
Lake Cherokee[2]	Sabine	Cherokee/ Gregg	62,400	29,120	28,885	28,650	28,415	28,180	27,945	27,710
Lake Center	Sabine	Shelby	1,460	754	754	754	754	754	754	754
Lake Murvaul	Sabine	Panola	22,400	22,380	21,792	21,203	20,615	20,027	19,438	18,850
Martin Lake	Sabine	Rusk	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Toledo Bend	Sabine	Sabine	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000
Houston County Lake	Trinity	Houston	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Total – Permitted Reservoirs				**1,966,474**	**1,962,698**	**1,958,512**	**1,954,328**	**1,950,141**	**1,945,955**	**1,941,769**

1. Supplies are determined by modified WAM Run 3. Supply for Lake Columbia is shown as “0” because the lake has not been constructed to date.
2. Lake Cherokee is located in both ETRWPA and Northeast Texas region. Most of the water from this source is used in Northeast Texas region.

Table 3.3 Unpermitted Supply from Existing Reservoirs (ac-ft per year)

Reservoir	Basin	County	2000	2010	2020	2030	2040	2050	2060
Houston County Lake	Trinity	Houston	3,100	2,967	2,834	2,701	2,568	2,435	2,300
Lake Jacksonville	Neches	Cherokee	3,000	2,768	2,537	2,305	2,073	1,842	1,610
Sam Rayburn & B.A. Steinhagen System	Neches	Jasper	108,290	104,222	100,153	96,085	92,017	87,948	83,880
San Augustine City Lake	Neches	San Augustine	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Striker Lake	Neches	Rusk	410	0	0	0	0	0	0
Toledo Bend	Sabine	Sabine, Shelby	224,500	219,917	215,333	210,750	206,167	201,583	197,000
Total - Unpermitted Supply			**340,300**	**330,874**	**321,857**	**312,841**	**303,825**	**294,808**	**285,790**

Run-of-the-River Diversion. Table 3.4 presents the run-of-the-river supplies by county and basin. Some of the projected demands include industries that currently use these brackish supplies. 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 3.4.

Table 3.4 Summary of the Available Supply from Run-of-the-River Diversions (ac-ft per year)

County	Basin	Use	Owner	2000	2010	2020	2030	2040	2050	2060
Anderson	Neches	Irrigation		197	197	197	197	197	197	197
Anderson	Trinity	Irrigation		1,060	1,060	1,060	1,060	1,060	1,060	1,060
Angelina	Neches	Industrial	Temple Inland	57	57	57	57	57	57	57
Angelina	Neches	Irrigation		17	17	17	17	17	17	17
Cherokee	Neches	Irrigation		182	182	182	182	182	182	182
Hardin	Neches	Irrigation		57	57	57	57	57	57	57
Henderson	Neches	Irrigation		0	0	0	0	0	0	0
Houston	Neches	Irrigation		287	287	287	287	287	287	287
Houston	Trinity	Irrigation		1,783	1,783	1,783	1,783	1,783	1,783	1,783
Jasper	Neches	Industrial	TPWD (hatchery)	604	604	604	604	604	604	604
Jasper	Neches	Industrial	Louisiana Pacific	12	12	12	12	12	12	12
Jasper	Neches	Irrigation		127	127	127	127	127	127	127
Jefferson	Neches	Multi-use	LNVA	381,876	381,876	381,876	381,876	381,876	381,876	381,876
Jefferson	Neches	Industrial	Huntsman Corp.	434,400	434,400	434,400	434,400	434,400	434,400	434,400
Jefferson	Neches	Industrial	Independent Refining	2,700	2,700	2,700	2,700	2,700	2,700	2,700
Jefferson	Neches	Industrial	Union Oil	4,300	4,300	4,300	4,300	4,300	4,300	4,300
Jefferson	Neches	Industrial	Mobil Oil	17,922	17,922	17,922	17,922	17,922	17,922	17,922
Jefferson	Neches	Industrial		319	319	319	319	319	319	319
Jefferson	Neches	Industrial	Beaumont	2,806	2,806	2,806	2,806	2,806	2,806	2,806
Jefferson	Neches	Industrial	Motiva	12,900	12,900	12,900	12,900	12,900	12,900	12,900
Jefferson	Neches	Industrial	Gulf States Utilities	279,131	279,131	279,131	279,131	279,131	279,131	279,131
Jefferson	Neches-Trinity	Industrial	Premcor Refining	480	480	480	480	480	480	480
Jefferson	Neches-Trinity	Irrigation		54,746	54,746	54,746	54,746	54,746	54,746	54,746
Jefferson	Neches-Trinity	Industrial		680	680	680	680	680	680	680
Jefferson	Neches-Trinity	Mining		34	34	34	34	34	34	34
Jefferson	Neches	Municipal	Beaumont	25,160	25,160	25,160	25,160	25,160	25,160	25,160

Table 3.4 Summary of the Available Supply from Run-of-the-River Diversions (Cont.)

County	Basin	Use	Owner	2000	2010	2020	2030	2040	2050	2060
Jefferson	Neches	Municipal	Beaumont	4,145	4,145	4,145	4,145	4,145	4,145	4,145
Nacogdoches	Neches	Industrial		2	2	2	2	2	2	2
Nacogdoches	Neches	Irrigation		136	136	136	136	136	136	136
Orange	Neches	Industrial	TE Products	*100*	*100*	*100*	*100*	*100*	*100*	*100*
Orange	Neches	Industrial	Gulf States Utilities	*17,210*	*17,210*	*17,210*	*17,210*	*17,210*	*17,210*	*17,210*
Rusk	Neches	Irrigation		86	86	86	86	86	86	86
Rusk	Neches	Industrial		2	2	2	2	2	2	2
Sabine	Neches	Industrial	Temple Inland	182	182	182	182	182	182	182
Smith	Neches	Irrigation		50	50	50	50	50	50	50
Smith	Neches	Mining		0	0	0	0	0	0	0
Trinity	Neches	Irrigation	Temple Inland	62	62	62	62	62	62	62
Tyler	Neches	Irrigation		123	123	123	123	123	123	123
Newton	Sabine	Industrial	Weirgate Lumber	135	135	135	135	135	135	135
Newton	Sabine	Irrigation	SRA	46,700	46,700	46,700	46,700	46,700	46,700	46,700
Newton	Sabine	Irrigation		50	50	50	50	50	50	50
Newton	Sabine	Industrial	SRA	100,400	100,400	100,400	100,400	100,400	100,400	100,400
Orange	Sabine	Industrial	E.I. Dupont Nemours	*267,000*	*267,000*	*267,000*	*267,000*	*267,000*	*267,000*	*267,000*
Orange	Sabine	Irrigation		28	28	28	28	28	28	28
Panola	Sabine	Industrial	Hills Lake Fishing Club	114	114	114	114	114	114	114
Panola	Sabine	Industrial	TXU	129	129	129	129	129	129	129
Panola	Sabine	Irrigation		191	191	191	191	191	191	191
Panola	Sabine	Mining	TXU	167	167	167	167	167	167	167
Rusk	Sabine	Irrigation		127	127	127	127	127	127	127
Rusk	Sabine	Municipal	Henderson	10	10	10	10	10	10	10
TOTAL				**1,658,986**	**1,658,986**	**1,658,986**	**1,658,986**	**1,658,986**	**1,658,986**	**1,658,986**
Subtotal Freshwater				**623,004**	**623,004**	**623,004**	**623,004**	**623,004**	**623,004**	**623,004**
Subtotal Brackish water				***1,035,982***	***1,035,982***	***1,035,982***	***1,035,982***	***1,035,982***	***1,035,982***	***1,035,982***

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

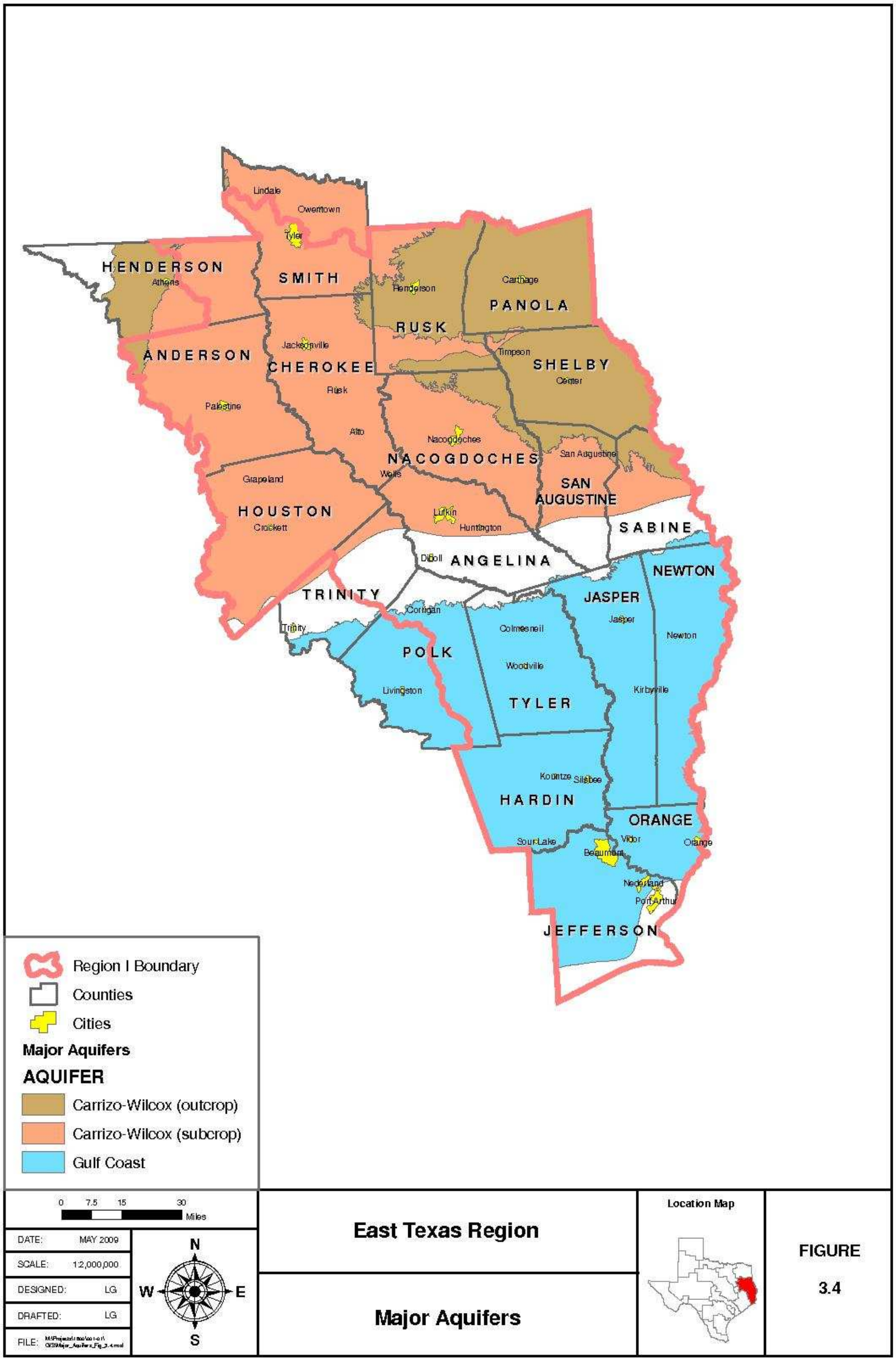
3.1.2 Groundwater Availability. As indicated in the introduction to this chapter, neither GMS-11 nor GMS-14 determined DFCs or MAGs before the TWDB deadline for inclusion in the 2011 Plan. However, on April 13, 2010, GMA-11 adopted initial DFCs intended to protect and conserve groundwater resources within the GMA, while allowing for anticipated growth in the area. The Yegua-Jackson, Sparta, Weches, Queen City, Reklaw, and Carrizo-Wilcox aquifers within GMA-11 now have a defined DFC of 17 feet of drawdown. The Trinity, Nacatoch, and Gulf Coast aquifers are not included in GMA-11 DFCs. As of September 1, 2010, GMA-14 has not adopted DFCs for aquifers within its designated area.

The Southeast Texas GCD had expressed interest in providing the ETRWPA with preliminary estimates of groundwater availability based on a GAM run completed by TWDB, but these numbers were not available when groundwater supplies were evaluated. The rest of the groundwater supplies were based on the previous ETRWPA plan. Those supply estimates were based on region-approved acceptable levels of drawdown.

The TWDB planning guidelines require that regional planning groups “Calculate the largest annual amount of water that can be pumped from a given aquifer without violating the most restrictive physical or regulatory or policy conditions limiting withdrawals, under drought-of-record conditions. Regulatory conditions refer specifically to any limitations on pumping withdrawals imposed by GCDs through their rules and permitting programs.” This guideline requires that planning groups make a policy decision as to the interpretation of the term “most restrictive” as it relates to long-term groundwater availability. In addition, TWDB guidelines further require that, “Once GAM (Groundwater Availability Model) information is accessible for an area within a region, the planning group shall incorporate this information in its next planning cycle unless better site-specific information is developed.”

Groundwater supplies in the ETRWPA can 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.

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. Figures 3.4 and 3.5 provide an overview of the location of the aquifers. Five GCDs are located in the northern region: Anderson County Underground Water Conservation District (UWCD), which is part of Anderson County, Neches and Trinity Valleys GCD (Anderson, Henderson and Cherokee Counties), Pineywoods GCD (Angelina and Nacogdoches Counties), Rusk County GCD (Rusk County), and Panola County GCD. All the districts have management plans, and some are beginning to register new and existing wells and monitor water levels. In the absence of specific production restrictions during the last round of planning, the ETRWPG selected a reasonably sustainable planning goal for the groundwater during the 50-year planning window as well as for future generations beyond the 50-year window. With that goal in mind, groundwater availability for the planning period was defined as the amount of groundwater that could be withdrawn from aquifers over the next 50 years that will not cause more than 50 feet of water level decline or 10% decrease in saturated thickness (in unconfined portions of the aquifer) whichever is less in the aquifers of the Northern Region.


HENDERSON
Athens
SMITH
Lindale
Owentown
Tyler
RUSK
Henderson
PANOLA
Carthage
ANDERSON
Palestine
CHEROKEE
Jacksonville
Rusk
Alto
SHELBY
Timpson
Center
NACOGDOCHES
Nacogdoches
Wells
SAN AUGUSTINE
San Augustine
HOUSTON
Grapeland
Crockett
Lufkin
Huntington
SABINE
ANGELINA
Diboll
NEWTON
Newton
TRINITY
Trinity
Corrigan
JASPER
Jasper
Kirbyville
POLK
Livingston
Colmesneil
Woodville
TYLER
HARDIN
Kountze
Silsbee
Sour Lake
ORANGE
Vidor
Orange
Beaumont
Nederland
Port Arthur
JEFFERSON
Region I Boundary
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Cities
Major Aquifers
AQUIFER
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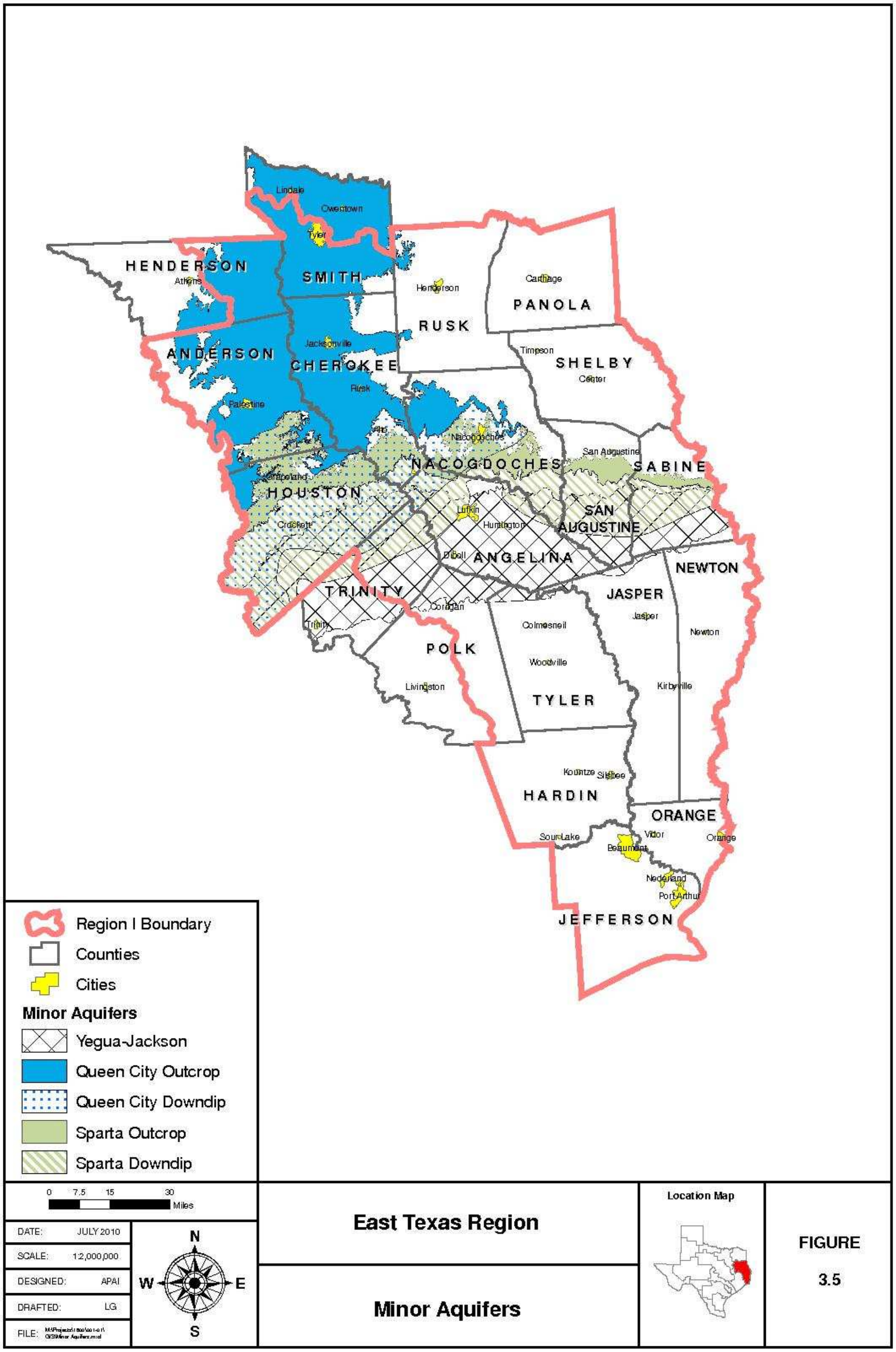
East Texas Region
Major Aquifers
Location Map
FIGURE
3.4


HENDERSON
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NEWTON
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Henderson
Carthage
Jacksonville
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Center
Rusk
Palestine
Nacogdoches
San Augustine
Crockett
Lufkin
Huntington
Diboll
Corrigan
Trinity
Colmesneil
Jasper
Newton
Woodville
Livingston
Kirbyville
Kountze
Silsbee
Sour Lake
Vidor
Orange
Beaumont
Nederland
Port Arthur
Region I Boundary
Counties
Cities
Minor Aquifers
Yegua-Jackson
Queen City Outcrop
Queen City Downdip
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East Texas Region
Minor Aquifers
Location Map
FIGURE
3.5

The Queen City/Sparta/Carrizo Wilcox GAM was available to analyze the availability of groundwater in each county based on the above criteria. The only county not meeting the criteria was Smith County. In Smith County, the GAM indicated that current demands could not be met with available supplies based on the above criteria. Average water-level decline was over 80 feet during the 50-year period. In this case, the groundwater supply was set equal to the demand because there is currently no GCD to limit pumping in that county. The ETRWPG acknowledges that additional water does occur in storage within the aquifers and that a portion of that water (above than the estimated supply) could be pumped if there is not a GCD in place to prevent such withdrawals. The groundwater availability for the counties in the Northern Region are provided in Table 3.5.

Southern Region. The Gulf Coast Aquifer provides most of the groundwater supply in the southern region. One GCD, the Southeast Texas GCD (Jasper, Newton, Tyler, and Hardin Counties), is located in the Southern Region. In the last round of planning, a predictive Gulf Coast GAM was not available to assess supplies for the Gulf Coast Aquifer, but since then, a predictive GAM has been developed and approved by the TWDB. The Southeast Texas GCD has worked with TWDB to complete several GAM runs to assess supplies, but these numbers were not available when groundwater supplies were estimated for this round of planning. Therefore, the supplies for the Southern Region were not modified, and were based on published information such as Baker (1986),[2] available well and water level records, and the knowledge base of the consultant team. Table 3.5 contains a summary of groundwater availability in the Southern Region.

Table 3.5 Total Available Groundwater by Aquifer (ac-ft per year)

County	Yegua Jackson	Queen City	Sparta	Carrizo Wilcox	Gulf Coast	Other
Northern Region						
Anderson		18,320	600	9,830		280
Angelina	6,472	1,060	670	28,330		1,450
Cherokee		21,850	350	10,870		
Henderson (P)		14,870		4,200		
Houston	1,380	400	870	5,220		1,380
Nacogdoches	60	4,860	400	31,140		80
Panola				10,370		
Rusk		4,250		20,290		
Sabine	1,100		290	6,710	1,100	200
San Augustine	540		200	1,690		60
Shelby				12,750		
Smith (P)		17,280		18,400		80
Trinity (P)	740		600	2,161	100	280
Northern Region Subtotal	**10,292**	**82,890**	**3,980**	**161,961**	**1,200**	**3,810**
Southern Region						
Hardin					23,500	
Jasper					52,000	6,000
Jefferson					2,500	
Newton					29,000	1,500
Orange					20,000	
Polk (P)	360				13,500	1,450
Tyler	180				30,300	1,620
Southern Region Subtotal	**540**	**–**	**–**	**–**	**170,800**	**10,570**
Aquifer Totals	**10,832**	**82,890**	**3,980**	**161,961**	**172,000**	**14,380**
Grand Total						**446,043**

Note: The above values are total supply available to meet both existing and projected demands and are available for each decade of the 50-year planning cycle.
(P) denotes Partial County

3.1.3 Local Supply. 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. This generally represents 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 supplies are listed on Table 3.6.

Table 3.6 Summary of Available Local Supply (ac-ft per year)

County	Basin	Use	Supply (ac-ft per year)
Local Supplies			
Anderson	Neches	Livestock	599
Anderson	Trinity	Livestock	684
Angelina	Neches	Livestock	347
Cherokee	Neches	Livestock	1,059
Cherokee	Neches	Mining	2
Hardin	Neches	Livestock	139
Hardin	Trinity	Livestock	2
Henderson	Neches	Livestock	279
Houston	Neches	Livestock	388
Houston	Trinity	Livestock	783
Jasper	Neches	Livestock	115
Jasper	Sabine	Livestock	75
Jefferson	Neches	Livestock	43
Jefferson	Neches-Trinity	Livestock	280
Jefferson	Neches	Mining	242
Nacogdoches	Neches	Livestock	910
Nacogdoches	Neches	Mining	220
Newton	Sabine	Livestock	66
Newton	Sabine	Mining	28
Orange	Neches	Livestock	56
Orange	Sabine	Livestock	70
Orange	Sabine	Mining	1
Panola	Cypress	Livestock	30
Panola	Sabine	Livestock	1,828
Polk	Neches	Livestock	122
Rusk	Neches	Livestock	386
Rusk	Sabine	Livestock	308
Rusk	Sabine	Mining	287
Sabine	Neches	Livestock	59
Sabine	Sabine	Livestock	320
San Augustine	Neches	Livestock	490
San Augustine	Sabine	Livestock	71
Shelby	Neches	Livestock	334
Shelby	Sabine	Livestock	1,755
Smith	Neches	Livestock	416
Trinity	Neches	Livestock	135
Tyler	Neches	Livestock	165
Total Local Supply			**13,094**

3.1.4 Reuse. The reuse listed as available to the region is for existing projects based on current permits and authorizations. Categories of reuse include (1) currently permitted and operating indirect reuse projects for non-industrial purposes, in which water is reused after being returned to the stream; (2) existing indirect reuse for industrial purposes; and (3) authorized direct reuse projects for which facilities are already developed. The specific reuse projects are listed in Table 3.7.

Table 3.7 Summary of Available Reuse Supply (ac-ft per year)

County	Basin	Use	Supply
Direct Reuse Supplies			
Angelina	Neches	Manufacturing	1,265
Sabine	Neches	Manufacturing	20
Orange	Sabine	Irrigation	15
Shelby	Sabine	Irrigation	82
Shelby	Sabine	Manufacturing	136
Indirect Reuse Supplies			
Henderson	Neches	Livestock	2,872
Jefferson	Neches-Trinity	Irrigation	13,687
Total Reuse Supply			**18,077**

3.1.5 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 Groveton and surface water for the City of Joaquin 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 Northeast Region is provided to Crystal Water System, Kilgore, Elderville WSC, and West Gregg WSC. Groundwater in the Region C portion of Henderson County is provided to the small portion of the City of Athens that lies in the ETRWPA.

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. Water from Lake Cherokee is provided to customers in both the Northeast Region and ETRWPA through the Cherokee Water Company and the City of Longview. There is also an existing contract to supply water to Dallas from Lake Palestine. The infrastructure for this supply has not been constructed. A summary of exports and imports is provided in Table 3.8.

Table 3.8 Summary of Exports and Imports in ETRWPA (ac-ft per year)

Source	2010	2020	2030	2040	2050	2060
Exports						
Lake Athens	1,581	1,706	1,826	1,935	2,046	2,147
Sam Rayburn/B.A. Steinhagen	63,863	63,863	63,863	63,863	63,863	63,863
Lake Cherokee	25,675	25,675	25,675	25,675	25,675	25,675
Lake Tyler	358	464	567	668	844	1,081
Total	**91,477**	**91,743**	**92,014**	**92,285**	**92,648**	**93,080**
Imports						
Carrizo-Wilcox Aquifer (Henderson, Smith and Gregg Counties)	659	649	638	624	613	602
Lake Fork	3,413	3,413	3,413	3,413	3,413	3,413
Lake Livingston	114	121	122	118	113	109
Toledo Bend - Louisiana	235	235	235	235	235	235
Sabine River	303	290	278	266	251	233
Total	**4,724**	**4,708**	**4,686**	**4,656**	**4,625**	**4,592**

3.2 Impacts of Water Quality on Supplies

The quality of a surface water body or groundwater aquifer can be a significant factor in the determination of water supply availability. Water quality can dictate 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. The ETRWPA is fortunate in that water quality impacts 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 5. 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
- Dissolved Oxygen
- Nutrients
- Metals
- Turbidity

In general, these parameters 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 are discussed as they relate to availability, and treatment requirements are discussed in the following subsections.

3.2.1 Water Quality Impacts on Surface Water Availability. Surface water quality in the ETRWPA is addressed in Chapter 1, Appendix 1-B, where it is noted that a total of 69 water quality impairments have been identified in the Draft 2008 303(d) List. These impairments are found on 48 classified segments within the ETRWPA. The specific impairments include the following:

- Bacteria (28 impairments)
- Dissolved Oxygen (18)
- Toxicity in water or sediment (4)
- Metals in water (4)
- Mercury in fish/shellfish (9)
- pH (3)
- Biological (3)

In comparing surface quality impairments with the key water quality parameters identified in Chapter 5, it is seen that metals and dissolved solids are common to both lists. The metals identified include mercury in fish tissue in nine segments, lead in two segments, aluminum in one segment, and zinc in one segment.

Mercury in fish tissue is a human health concern (through ingestion), but is not considered a limiting factor to either water supply availability or the treatability of the water. Mercury has not been demonstrated to be a concern in the water in any segment in the ETRWPA.

Lead in water can be either a human health protection concern or an aquatic life protection concern. Lead levels in the two segments identified as impaired in the ETRWPA are not identified in the Draft 2008 303(d) List. However, the water quality inventory on which the list is based indicates that the data for lead are inadequate or limited. It is unlikely that levels exceed the Primary Drinking Water Standard action level of 0.015 mg/L. Furthermore, lead can be readily removed in the water treatment process. Therefore, lead is not anticipated to be a limiting factor in water supply availability or treatment for the ETRWPA.

Excessive aluminum in water is an aquatic life protection concern for surface water bodies, but is generally not considered to affect water supply availability or treatability. Aluminum is a secondary drinking water contaminant. Conventional water treatment processes readily remove aluminum. Therefore, aluminum is not considered to be a limiting factor in water supply availability or treatment for the ETRWPA.

Excessive zinc in water is also an aquatic life protection concern for surface water bodies. Zinc is a secondary drinking water contaminant. It is not generally considered to affect water supply availability or treatability. Conventional water treatment processes also readily remove zinc. In the case of zinc found in the one segment in the ETRWPA (Segment 0606, Neches River above Lake Palestine), the average concentrations observed in the water are only slightly above the surface water quality standard and well below the secondary drinking water standard. Therefore, zinc is not considered to be a concern for water supply availability or treatment in the ETRWPA.

Of the remaining listed impairments, none are considered to limit the availability of water supply or treatability of the water.

3.2.2 Water Quality Impacts on Groundwater Availability. Appendix 1-C provides a detailed discussion of water quality in four water supply aquifers in the ETRWPA. The four aquifers evaluated were the Carrizo-Wilcox, the Gulf Coast, the Queen City-Sparta, and the Yegua-Jackson. In the evaluation, a range of primary and secondary drinking water contaminants was evaluated. Water quality data for wells within the TWDB database were reviewed and summarized. Based on this evaluation, it may be stated that limitations on water supply availability or treatability are rare for groundwater supplies in the ETRWPA.

Primary drinking water contaminants evaluated included alpha particles, arsenic, barium, cadmium, chromium, lead, nitrate (as nitrogen), and selenium. Although individual wells sometimes detect concentrations of contaminants, none are considered to be widespread in any of the aquifers at levels of concern. The most prevalent of the primary drinking water contaminants was found to be nitrate (as nitrogen), which exceeded the primary standard of 10 mg/L in about 4% of samples from all aquifers. However, the median concentration of nitrate (as nitrogen) was less than 0.25 mg/L and the average less than 3 mg/L. Nitrate can be removed from water using advanced treatment processes such as reverse osmosis or ion exchange. This would result in a reduced availability as a significant portion of the supply becomes the reject or waste stream. Given the low incidence of nitrate 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, iron, manganese, and pH were commonly found in excess of secondary standards in all aquifers. TDS was found to exceed the Texas secondary standard of 1,000 mg/L in only the Yegua-Jackson Aquifer.

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. A common means of managing iron and manganese concentrations in drinking water is through aeration of the groundwater as it is pumped from the ground and to a storage tank. The aeration causes the iron and manganese to precipitate and settle to the bottom of the storage tank. The drinking water then distributed to customers, therefore, contains lower concentrations of the constituents. Industrial users of water with excessive levels of iron or manganese may require significant removal prior to using the water in industrial processes.

In the ETRWPA, approximately 26% of all wells evaluated exceeded the secondary standard for iron (i.e., 0.3 mg/L). Median values for iron were within the secondary standard, but averages exceeded the standard by over four times in some cases. Approximately 16% of all wells exceeded the secondary standard for manganese (i.e., 0.05 mg/L). Median values for manganese were well within the standard. The average manganese level exceeded the standard in only Gulf Coast Aquifer wells, at a concentration of 0.065 mg/L.

Although it is not known whether any existing public water supply system or industrial user is currently contending with excessive iron or manganese in its groundwater source, these results indicate that iron and manganese could be a significant issue in groundwater in some parts of the ETRWPA. As indicated above, treatment may be relatively simple and would not generally result in a reduction of water supply availability or treatability. In extreme cases of excessive iron or where the water is desired for industrial uses, it is possible that more comprehensive treatment could be necessary to remove a sufficient amount of the constituent to enable its use.

It was found to be 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. The pH was outside the range in approximately 33% of the groundwater samples. However, neither the median nor the average values were found outside the range for any of the aquifers. This indicates that the pH concerns for groundwater in the ETRWPA may be a minimal issue.

Control of pH, if necessary, could be accomplished by the addition of pH adjusting chemicals, such as soda ash (to raise pH), or sulfuric acid (to lower pH). Treatment would not result in a significant reduction of the source availability. Therefore, pH is not considered to be a significant limiting factor in availability or treatability.

The concentration of TDS in the Yegua-Jackson Aquifer was found to exceed the Texas secondary standard in approximately 18% of the groundwater samples evaluated. However, the average concentration for all wells in the aquifer was only approximately 672 mg/L. This indicates that TDS concerns for the Yegua-Jackson Aquifer are probably minimal.

Treatment for TDS, if necessary, could include processes such as reverse osmosis or ion exchange. This would result in reduced availability as a significant portion of the supply becomes the reject or waste stream. Given the low incidence of TDS contamination in most of the region, it is unlikely that it would become a significant issue for groundwater availability for the ETRWPA.

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

The objective of this section of the 2011 Plan is to provide an evaluation of the effect of environmental flow policies on water rights, water availability, and water planning in the ETRWPA. Much has occurred in the area of environmental flow recommendations since the 2006 Plan was adopted, including the development of new recommendations for the Sabine and Neches watersheds. However, it is not clear how much effect these recommendations will have in the short-term.

The Legislature passed Senate Bill 3 (SB3) in the 2007 80th Regular Session. SB3 is the third in a series of three omnibus water bills related to the State of Texas' meeting the future needs for water. SB3 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. Such standards will be 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.

Prior to SB3, Texas law recognized the importance of balancing the biological soundness of the state's rivers, lakes, bays, and estuaries with the public's economic health and general well-being. The Texas Water Code (TWC) requires the TCEQ, while balancing all other interests, to consider and provide for the freshwater inflows necessary to maintain the viability of Texas' bay and estuary systems in TCEQ's regular granting of permits for the use of state water. Balancing the effect of authorizing a new use of water with the need for that water to maintain a sound ecological system was done on a case-by-case basis as part of the water rights permitting process.

SB3 called for the appointment of stakeholder committees for the various watersheds feeding bays and estuaries for the Texas coast. For that portion of the Texas coast within the ETRWPA, the primary basins of interest were the Sabine and Neches Rivers, and part of the Neches-Trinity Coastal basin. These basins feed fresh water to Sabine Lake and the upper Texas coast. Since a portion of the Trinity River basin is in the region and the Trinity River forms a portion of the western boundary of the region, another stakeholder group for the Trinity-San Jacinto-Galveston Bay area is also of potential interest. Stakeholder committees for both areas were appointed in 2008. Each stakeholder committee then appointed a "bay and basin expert science team" (BBEST) in the fall of 2008 to address the development of environmental flow recommendations in accordance with SB3. The BBESTs met individually over the course of 12 months to develop environmental flow recommendations for their respective areas. Appendix 3-A contains the Sabine and Neches Executive Summary (ES), which is the primary area of interest to the ETRWPA. The ES describes, generally, the process undertaken and the recommendations made by the BBEST.

The Sabine and Neches Rivers and Sabine Lake Bay Basin and Bay Area Stakeholder's Committee (Sabine-Neches Bay and Basin Area Stakeholder Committee [BBASC]) evaluated the recommendations of the BBEST and prepared its own report. The report, dated May 4, 2010, has been presented to the TCEQ for its review. A copy of the report is provided in Appendix 3-A.

Environmental flow recommendations will impact the procurement of water rights in the future by creating a comprehensive process of evaluating environmental flow needs whenever a new water right application is processed. The process of approving water rights is likely to become more complex under the new environmental flow policies that will be implemented by the TCEQ. However, it should result in more clarity in how diversions can be made, and better ensure that sufficient water is available in the streams of the Sabine and Neches basins.

As a result of the implementation of new environmental flow recommendations, the operation of reservoirs will become more dependent on the development of an "accounting plan," which is a feature that the TCEQ is already implementing within the State. Whether such accounting plans will have a significant impact on the availability of water is not known at this time.

The implementation of environmental flow recommendations will result in a need to more carefully consider environmental flow needs during the process of water planning in the ETRWPA. In future planning cycles, the ETRWPG will need to analyze new water rights in light of these recommendations to determine how the new environmental flow requirements are consistent with the long-term protection of the region's water resources.

3.4 Water Availability 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 3-B presents the current water available for each WUG by county. (WUGs are cities, water supply corporations, county-other municipal users and countywide manufacturing, irrigation, mining, livestock, and steam electric uses.) For county-wide user groups, historical use was considered in the determination of currently available supplies.

The table in Appendix 3-B shows the amount of supply available to each user group from each source by decade based on existing facilities. The total supply to water users by use type is shown on Figure 3.6. These developed supplies represent about one third of the currently available supply to the region. The supplies by county are shown in Table 3.9.

Figure 3.6 Currently Available Supply to Water User Groups

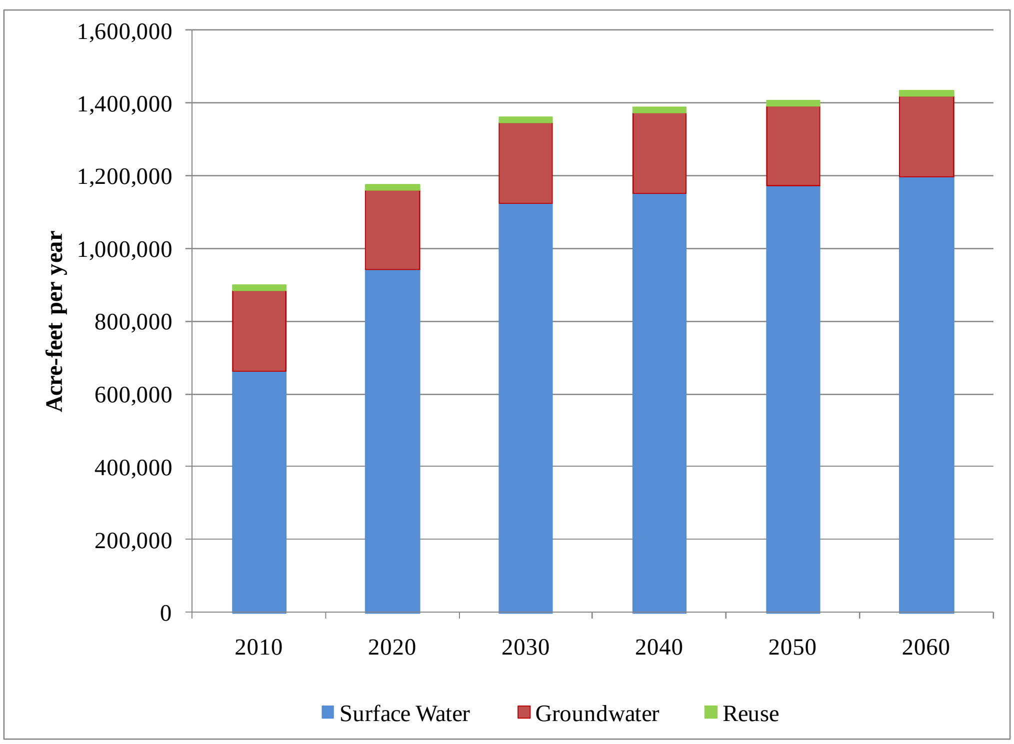

Table 3.9 Summary of Available Supply to Water Users by County (ac-ft per year)

County	Available Supply					
	2010	2020	2030	2040	2050	2060
Anderson	17,649	17,649	17,649	17,649	17,649	17,649
Angelina	25,957	26,321	26,392	26,458	26,521	26,579
Cherokee	18,684	18,273	18,625	19,046	19,539	20,126
Hardin	14,296	14,296	14,296	14,296	14,296	14,271
Henderson (P)	9,509	7,890	7,705	7,538	7,365	7,205
Houston	10,248	10,246	10,246	10,247	10,246	10,246
Jasper	72,835	76,218	78,731	80,928	82,575	82,638
Jefferson	414,903	686,525	866,571	892,088	918,150	944,597
Nacogdoches	33,596	37,693	37,289	36,856	29,640	29,129
Newton	19,908	19,908	19,908	19,908	19,908	19,908
Orange	98,484	98,484	98,484	98,484	98,484	98,484
Panola	16,758	17,067	17,256	17,448	17,641	17,826
Polk (P)	2,626	2,626	2,626	2,626	2,626	2,626
Rusk	60,725	60,732	60,732	60,722	60,719	60,729
Sabine	4,101	4,101	4,101	4,101	4,101	4,101
San Augustine	2,933	2,933	2,933	2,933	2,933	2,933
Shelby	11,430	11,445	11,458	11,471	11,482	11,496
Smith (P)	59,273	58,953	58,711	58,484	58,186	57,842
Trinity (P)	1,021	1,028	1,029	1,025	1,020	1,016
Tyler	5,328	5,328	5,328	5,328	5,328	5,328
TOTAL	**900,264**	**1,177,716**	**1,360,070**	**1,387,636**	**1,408,409**	**1,434,729**

Note: (P) denotes Partial County

3.5 Water Availability by Wholesale Water Provider

There are 16 designated WWPs in the ETRWP area. A WWP is a provider 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 the planning period. Similar to the available supply to WUGs, the water availability for each WWP 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. A summary of supplies of each WWP is included in Appendix 3-B. Total available supply by decade for each wholesale provider is shown in Table 3.10.

Table 3.10 Summary of Currently Available Supplies for Wholesale Water Provider (ac-ft per year)

Water Provider	Currently Available Supply					
	2010	2020	2030	2040	2050	2060
ANRA	60	65	70	70	70	70
A-N WCID 1	20,183	19,357	18,530	17,703	16,877	16,050
Athens MWA	5,772	2,900	2,900	2,900	2,900	2,900
Beaumont	31,420	31,420	31,420	31,420	31,420	31,420
Carthage	6,461	6,461	6,461	6,461	6,461	6,461
Center	4,554	4,554	4,554	4,554	4,554	4,554
Houston Co. WCID 1	3,500	3,500	3,500	3,500	3,500	3,500
Jacksonville	7,391	7,391	7,391	7,391	7,391	7,391
LNVA	1,173,876	1,173,876	1,173,876	1,173,876	1,173,876	1,173,876
Lufkin	11,000	11,000	11,000	11,000	11,000	11,000
Nacogdoches	20,167	19,783	19,400	19,017	18,633	18,250
Panola Co. FWSD 1	21,792	21,203	20,615	20,027	19,438	18,850
Port Arthur	15,852	16,380	16,907	17,436	18,029	18,753
SRA	1,300,726	1,297,888	1,295,045	1,292,194	1,289,323	1,286,456
Tyler	44,996	44,996	44,996	44,996	44,996	44,996
UNRMWA	207,458	205,417	203,375	201,333	199,292	197,250
Wholesale Water Provider Totals	**2,875,208**	**2,866,191**	**2,860,040**	**2,853,878**	**2,847,760**	**2,841,777**

A brief description of the supply sources is presented below. As previously discussed, the analyses of the available supplies by source were determined using the assumptions outlined in Sections 3.2.1 and 3.2.2. 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.

3.5.1 Angelina and Neches River Authority. ANRA 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. ANRA estimates that development of the lake could be complete by the year 2015. No currently available supply is shown since the reservoir is not constructed. The estimated firm yield using the modified Neches WAM Run 3 is 75,700 ac-ft per year.

3.5.2 Angelina-Nacogdoches Water Control Improvement District No 1. The A-N WCID No. 1 owns and operates Lake Striker in Rusk and Cherokee Counties. The firm yield from Lake Striker in 2010 is estimated at 20,183 ac-ft per year, which is expected to decrease to 16,050 ac-ft per year by 2060.

3.5.3 Athens Municipal Water Authority. Athens MWA 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 6,145 ac-ft per year in 2000. However, the intake structure for the fish hatchery does not allow the water level to drop below 431 feet msl and maintain inflow to hatchery. Using this operational constraint, the yield of Lake Athens is 2,900 ac-ft per year. The Athens MWA 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 Athens MWA continue to study indirect reuse as a supplement to the yield of Lake Athens.

3.5.4 City of Beaumont. The City of Beaumont obtains water from the Neches River and groundwater wells from the Gulf Coast Aquifer in Hardin County. The reliable surface water supplies are estimated at 32,111 ac-ft per year (ac-ft per year) based on the firm yield of the City's run-of-the-river water rights. The City's current water treatment system is rated for 40 MGD, limiting the available treated surface water to 22,420 ac-ft per year. The City currently uses about 10,000 ac-ft per year of groundwater with a current well capacity of about 23 MGD. However, due to limited aquifer availability, the estimated reliable groundwater supply for Beaumont is limited to 9,000 ac-ft per year. Considering both its groundwater and surface water sources the City's currently available treated water supplies total 31,420 ac-ft per year.

3.5.5 City of Carthage. The City of Carthage obtains its water from groundwater from the Carrizo-Wilcox Aquifer and surface water from Panola County FWSD. The City has a contract with Panola County FWSD for 12 MGD of water from Lake Murvaul. Considering its current water system capacities, the city of Carthage has approximately 6,400 ac-ft per year of reliable supply.

3.5.6 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 754 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 of water in Lake Pinkston. The total available supply for the City of Center is 4,554 ac-ft per year.

3.5.7 Houston County 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 gpm. Supplies to Houston County WCID No. 1 are limited to its permitted diversions.

3.5.8 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 firm yield of the lake exceeds the permitted diversions. 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 based on current well field production. The total supply available to Jacksonville is estimated at 7,391 ac-ft per year.

3.5.9 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's water rights total 1,173,876 ac-ft per year. The firm yield analyses using the modified Neches WAM Run 3 show that the full permitted amount is available, and there are also unpermitted supplies associated with the Sam Rayburn/ B.A. Steinhagen system. The LNVA currently possesses the infrastructure to divert these water rights to its municipal, manufacturing, mining and irrigation users.

3.5.10 City of Lufkin. The City of Lufkin presently obtains groundwater from the Carrizo-Aquifer in Angelina County. Supplies for the City of Lufkin are based on its present well field pumping capacity.

The City has recently purchased additional groundwater rights in the Carrizo-Wilcox Aquifer and the surface water rights in Lake Kurth that were held by Abitibi Bowater. The City is currently evaluating the infrastructure improvements needed to utilize these sources. 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 to use this water.

3.5.11 City of Nacogdoches. The City of Nacogdoches obtains groundwater from the Carrizo-Wilcox aquifer and Lake Nacogdoches. The groundwater supply 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 17,450 ac-ft per year, and reducing to 15,150 ac-ft per year by 2060.

3.5.12 Panola County Freshwater Supply District No. 1. The Panola County FWSD 1 owns and operates Lake Murvaul in the ETRWPA. The estimated firm yield of Lake Murvaul using the modified Sabine WAM Run 3 is 22,380 ac-ft per year in year 2000, decreasing to 18,850 ac-ft per year by 2060.

3.5.13 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 15,846 ac-ft per year in 2010, increasing to 18,747 ac-ft per year by 2060.

3.5.14 Sabine River Authority. 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. Water in the ETRWPA 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, 750,000 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 Canal System) is approximately 1.3 million ac-ft per year.

3.5.15 City of Tyler. The City of Tyler receives raw water supply from Lake Tyler and Tyler East with a firm yield of 30,950 ac-ft per year. Supply from these reservoirs is limited to 23,541 ac-ft per year by the water treatment plant capacity. The City also has a contract with the Upper Neches River Municipal Water Authority 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 directly by industry or 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 4,340 ac-ft per year, which was reduced from its production capacity due to limited aquifer availability. Collectively, the City has a total of 44,696 ac-ft per year of treated water and an additional 950 ac-ft per year of raw water from Lake Bellwood.

3.5.16 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 209,500 ac-ft per year in year 2000, decreasing to 197,250 ac-ft per year by 2060.

3.6 Summary of Current Water Supply in East Texas Regional Water Planning Area

The projected overall reliable fresh water supply to the ETRWPA from current sources will be about 3 million ac-ft per year in 2060. (This figure does not consider supply limitations due to the capacities of current raw water transmission facilities and wells nor does it include brackish water sources). Approximately 85% of the supply is associated with in-region reservoirs and run-of-the river diversions. Nearly 15% of the supply is from groundwater. Very little supply is currently obtained from reuse.

There are some sources of supply that will not be utilized fully during the period covered by this plan. Others are fully utilized today, including groundwater from the Carrizo-Wilcox aquifer in Smith County and several smaller reservoirs.

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Chapter 4A

Comparison of Water Demands with Water Supplies to Determine Needs

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This report 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 shortages or surpluses under drought of record conditions have been estimated.

As discussed in Chapter 3, allocations of existing 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 may impact the desirability or continued use of some water sources.

The comparison of current water supply and projected water demand in the ETRWPA is evaluated on a regional basis, by county, by WUG and by WWP. Section 4A.1 presents a regional comparison of current supply and projected demand. Section 4A.2 presents a county-by-county comparison of current supply and projected demand. Section 4A.3 presents the comparison of current supply and projected demand for each WUG. Section 4A.4 discusses shortages for the WWPs in the region. Analysis of demands related to future potential users or to demands on supplies located in the ETRWPA, to meet water management strategies outside the region are not discussed in this section of the report. The discussion of these items is included in Chapter 4C, specifically for the LNVA, UNRMWA, and SRA.

4A.1 Regional Comparison of Supply and Demand

Table 4A.1 and Figure 4A.1 summarize the comparison of total currently available water supply and total projected water demand for the ETRWPA. The region as a whole has a currently available surplus of 169,352 acre-feet per year (ac-ft per year) in 2010, changing to a shortage of nearly 3,000 ac-ft per year by 2050, and increasing to a shortage of 55,867 by 2060. The actual total shortages of individual WUGs are greater, totaling 182,145 ac-ft per year by 2060. The individual shortages by water user are discussed in Section 4A.3.

As shown on Figure 4A.1, the region has supplies available to meet these needs. Unconnected water supplies are identified by comparing the supplies available to each city and category to the current regional water supply sources. Excluding unpermitted reservoir yields and brackish water, the difference between the total supply reported in Chapter 3 and the supply available to WUGs is between 2.1 and 1.5 million ac-ft per year in each decade of the planning period (Figure 4A.1). Additional infrastructure and/or contracts are needed to utilize these sources.

Table 4A.1 Summary of Supply and Demand for the ETRWPA (ac-ft per year)

	2010	2020	2030	2040	2050	2060
Demands	730,912	1,083,549	1,277,416	1,340,598	1,411,268	1,490,596
Developed Supplies	900,264	1,177,716	1,360,070	1,387,636	1,408,409	1,434,729
Difference	169,352	94,167	82,654	47,038	-2,859	-55,867

Figure 4A.1 Comparison of Regional Water Supplies to Demands

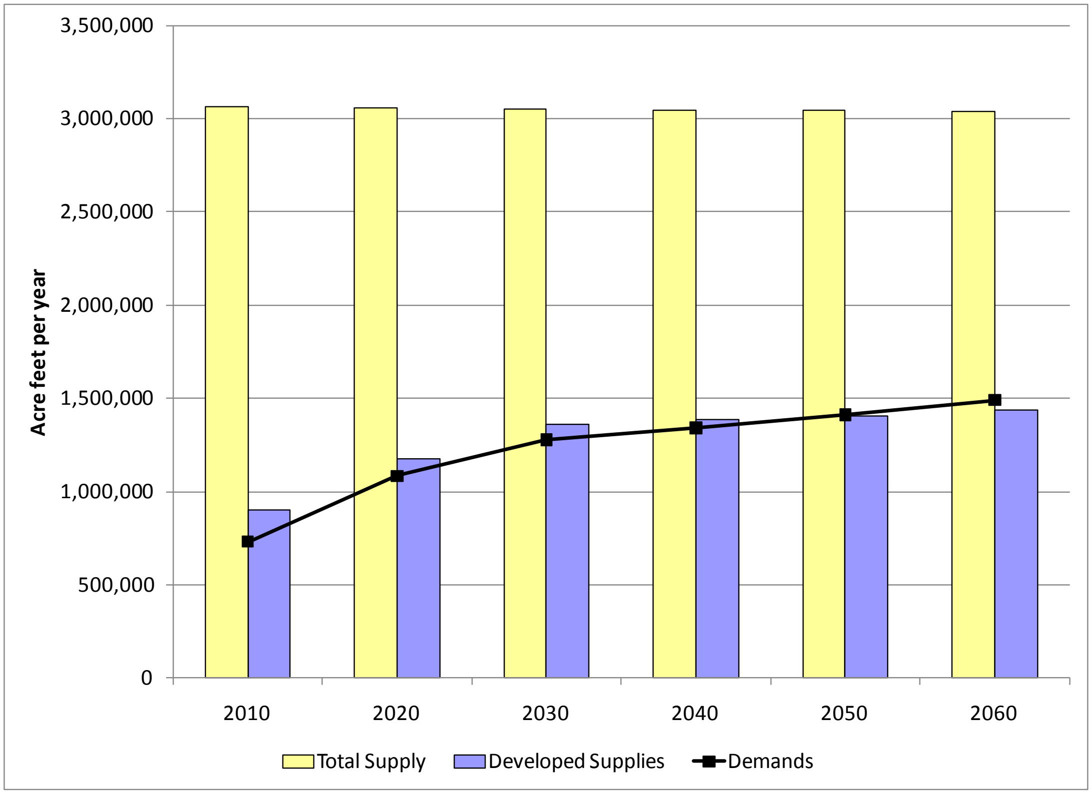
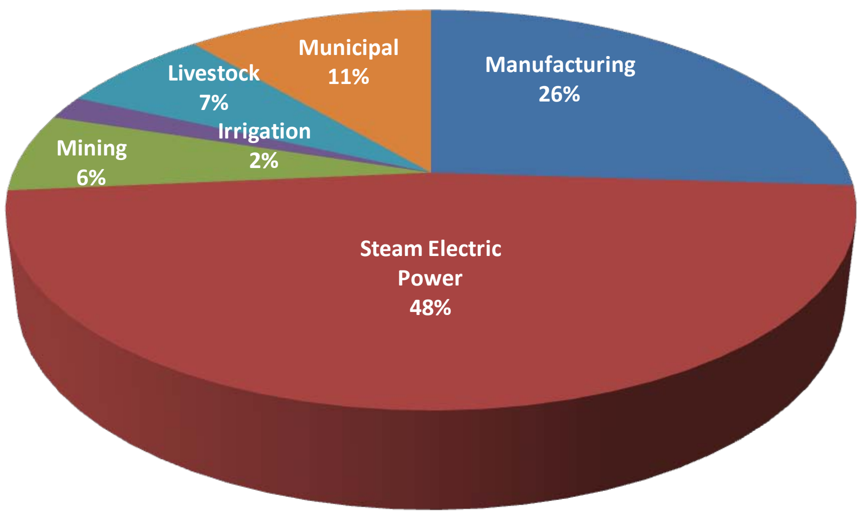


Table 4A.2 summarizes regional surpluses and shortages by category of water use. Figure 4A.2 summarizes regional surpluses and shortages by categoy of water use in 2060. On a regional basis, sufficient supplies exist for municipal and irrigation water uses. Regional shortages are identified for manufacturing, steam-electric power, mining and livestock. Most of the manufacturing shortages are the result of considerable growth in demands and supplies that are limited to existing contract amounts. The steam-electric power shortages are for projected growth that currently does not have an identified source or infrastructure. Mining shortages are largely associated with new mining demands associated with natural gas development and mining demands in Hardin County that are no longer substantiated based on current use. Livestock water use is also expected to grow in some counties, which will require the development of additional resources and/or infrastructure. Even though the municipal water use shows a net surplus in every decade of the planning period, there are individual cities that are projected to have shortages during the planning period.

Table 4A.2 Summary of Projected Surpluses or Shortages by Water Use Type (ac-ft per year)

Water Use Type	2010	2020	2030	2040	2050	2060
Municipal	68,710	58,979	51,784	44,944	33,189	17,291
Manufacturing	3,721	-11,014	-19,925	-29,031	-36,815	-45,647
Steam- Electric Power	35,136	3,158	-10,065	-26,187	-52,560	-76,515
Mining	-13,351	-28,677	-8,522	-9,385	-10,238	-10,935
Irrigation	72,533	72,135	71,769	71,376	70,943	70,467
Livestock	2,604	-414	-2,388	-4,679	-7,378	-10,528

Figure 4A.2 Distribution of Regional Shortages by Water Use in 2060



4A.2 Comparison of Supply and Demand by County

Table 4A.3 shows the projected surpluses and shortages by county for each decade of the planning period. In general, some shortages exist throughout the region. Twelve counties are identified with shortages over the planning horizon, with Anderson, Jefferson, Orange and Rusk Counties having the largest projected shortages by 2060. Table 4A.4 shows the projected surpluses or shortages as a percentage of demand. Anderson and Angelina Counties are expected to have the largest percent shortages (52 and 56 percent) in 2060, and Tyler County is expected to have the largest percentage surplus (48 percent) in 2060.

Table 4A.3 Comparison of Supply and Demand by County (ac-ft per year)

County	2010	2020	2030	2040	2050	2060
Anderson	4,230	-7,508	-9,688	-12,284	-15,428	-19,218
Angelina	-6,089	-18,070	-18,362	-23,058	-28,317	-34,632
Cherokee	4,788	3,373	4,595	4,393	4,065	3,532
Hardin	-5,080	-6,417	-7,120	-7,830	-8,645	-9,434
Henderson (P)	2,818	876	387	-89	-700	-1,455
Houston	2,012	1,536	973	370	-339	-1,154
Jasper	2,932	2,728	2,670	2,762	2,808	2,808
Jefferson	71,958	58,255	55,789	52,733	49,251	44,206
Nacogdoches	9,720	5,385	9,013	5,305	-6,827	-12,638
Newton	10,895	2,551	96	-2,930	-6,615	-11,096
Orange	19,110	13,537	6,890	141	-6,391	-13,947
Panola	4,321	4,028	3,849	3,686	3,512	3,252
Polk (P)	290	-75	-374	-602	-773	-959
Rusk	26,188	23,243	18,482	12,802	5,672	-3,305
Sabine	1,369	1,226	1,103	971	814	637
San Augustine	-1,419	-7,004	-104	-224	-380	-549
Shelby	1,059	-1,182	-1,072	-2,621	-4,504	-6,827
Smith (P)	17,874	15,669	13,707	11,744	8,163	3,167
Trinity (P)	128	94	90	73	50	25
Tyler	2,249	1,922	1,729	1,696	1,725	1,720

Note: The sum of needs by county shown in Table 4A.3 is based on total supplies to the county less the total county demands. The sum of the individual needs of water user groups within a county will differ. These needs are shown in Table 4A.5.

Table 4A.4 Surplus or Shortage as Percent of Demand by County (ac-ft per year)

County	2010	2020	2030	2040	2050	2060
Anderson	32%	-30%	-35%	-41%	-47%	-52%
Angelina	-19%	-41%	-41%	-47%	-52%	-57%
Cherokee	34%	23%	33%	30%	26%	21%
Hardin	-26%	-31%	-33%	-35%	-38%	-40%
Henderson (P)	42%	12%	5%	-1%	-9%	-17%
Houston	24%	18%	11%	4%	-3%	-10%
Jasper	4%	4%	4%	4%	4%	4%
Jefferson	21%	9%	7%	6%	6%	5%
Nacogdoches	41%	17%	32%	17%	-19%	-30%
Newton	121%	15%	0%	-13%	-25%	-36%
Orange	24%	16%	8%	0%	-6%	-12%
Panola	35%	31%	29%	27%	25%	22%
Polk (P)	12%	-3%	-12%	-19%	-23%	-27%
Rusk	76%	62%	44%	27%	10%	-5%
Sabine	50%	43%	37%	31%	25%	18%
San Augustine	-33%	-70%	-3%	-7%	-11%	-16%
Shelby	10%	-9%	-9%	-19%	-28%	-37%
Smith (P)	43%	36%	30%	25%	16%	6%
Trinity (P)	14%	10%	10%	8%	5%	3%
Tyler	73%	56%	48%	47%	48%	48%

4A.3 Comparison of Supply and Demand by Water User Group

The comparison of supply versus demands by user group for entities with shortages is presented in Table 4A.5. There are 68 WUGs with identified shortages that cannot be met by existing infrastructure and supply. These shortages total nearly 179,300 acre-feet per year by 2060.

Of the entities with shortages greater than 5,000 ac-ft per year, five are steam-electric power uses (Anderson, Jefferson, Nacogdoches, Newton and Rusk), one municipal user (Lufkin), manufacturing in Angelina and Orange County, mining in Hardin County and livestock in Shelby County.

Table 4A.5 Water User Groups with Projected Shortage (ac-ft per year)

Water User Group	2010	2020	2030	2040	2050	2060
Anderson County	**-18**	**-11,328**	**-13,269**	**-15,653**	**-18,556**	**-22,158**
County-Other	0	0	0	-10	-31	-132
Frankston	0	0	-6	-24	-40	-54
Mining	-18	-22	-45	-70	-95	-119
Steam Electric	0	-11,306	-13,218	-15,549	-18,390	-21,853
Angelina	**-9,383**	**-20,806**	**-20,557**	**-24,836**	**-29,598**	**-35,451**
County-Other	0	0	-20	-135	-349	-661
Diboll	-32	-187	-374	-618	-965	-1,441
Four Way WSC	0	0	0	0	0	-225
Hudson	0	0	-123	-360	-710	-1,174
Hudson WSC	0	0	0	-104	-367	-735
Livestock	0	0	0	-17	-52	-89
Lufkin	-3,244	-5,117	-6,057	-7,116	-8,416	-9,965
Manufacturing	-3,117	-10,513	-12,983	-15,486	-17,739	-20,161
Mining	-1,990	-3,989	0	0	0	0
Steam Electric	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000
Cherokee	**-490**	**-1,494**	**-40**	**-118**	**-233**	**-379**
Mining	-490	-1,494	0	0	0	-2
New Summerfield	0	0	-40	-76	-117	-165
Rusk	0	0	0	-42	-116	-212
Hardin	**-8,955**	**-9,931**	**-10,540**	**-11,148**	**-11,790**	**-12,317**
County-Other	-154	-263	-284	-305	-358	-431
Irrigation	-1,002	-1,002	-1,002	-1,002	-1,002	-1,002
Manufacturing	-27	-46	-63	-81	-97	-114
Mining	-7,772	-8,620	-9,191	-9,760	-10,333	-10,770
Henderson	**-75**	**-297**	**-636**	**-955**	**-1,361**	**-1,847**
Athens	0	-52	-70	-88	-117	-155
Brownsboro	0	0	0	0	0	-4
County-Other	-75	-216	-348	-479	-683	-964
Livestock	0	-29	-218	-388	-561	-724
Houston	**-642**	**-883**	**-1,396**	**-1,953**	**-2,567**	**-3,239**
Irrigation	-567	-667	-986	-1,334	-1,720	-2,146
Livestock	-72	-211	-403	-610	-835	-1,078
Manufacturing	-3	-5	-7	-9	-12	-15
Jasper	**-374**	**-470**	**-488**	**-430**	**-403**	**-403**
County-Other	-374	-470	-488	-430	-403	-403

Table 4A.5 Water User Groups with Projected Shortage (ac-ft per year)(cont'd)

Water User Group	2010	2020	2030	2040	2050	2060
Jefferson	**0**	**-13,426**	**-15,696**	**-18,464**	**-21,843**	**-25,960**
Mining	0	0	0	0	-5	-9
Steam Electric Power	0	-13,426	-15,696	-18,464	-21,838	-25,951
Nacogdoches	**-5,083**	**-7,183**	**-1,621**	**-3,476**	**-12,807**	**-15,905**
D&M WSC	0	0	-21	-70	-182	-310
Lilly Grove SUD	0	0	0	0	-221	-463
Livestock	0	0	-242	-559	-926	-1,347
Mining	-2,495	-6,993	0	0	0	0
Steam Electric Power	-2,588	-190	-1,358	-2,783	-11,241	-13,358
Swift WSC	0	0	0	-64	-237	-427
Newton	**-149**	**-264**	**-2,713**	**-5,734**	**-9,382**	**-13,805**
Manufacturing	-149	-264	-370	-477	-574	-667
Steam Electric Power	0	0	-2,343	-5,257	-8,808	-13,138
Orange	**-132**	**-5,136**	**-10,989**	**-16,789**	**-22,021**	**-27,894**
County-Other	-132	-93	-53	-7	0	-6
Manufacturing	0	-5,006	-10,855	-16,686	-21,863	-27,686
Mauriceville SUD	0	-37	-81	-96	-158	-202
Panola	**-96**	**-116**	**-132**	**-147**	**-161**	**-187**
Manufacturing	-96	-116	-132	-147	-161	-187
Polk	**-208**	**-481**	**-742**	**-950**	**-1,110**	**-1,277**
County-Other	-208	-417	-578	-681	-745	-828
Manufacturing	0	-64	-164	-269	-365	-449
Rusk	**0**	**0**	**0**	**-30**	**-1,561**	**-10,000**
Mining	0	0	0	-30	-60	-88
Steam Electric Power	0	0	0	0	-1,501	-9,912
Sabine	**-40**	**-92**	**-147**	**-210**	**-283**	**-367**
County-Other	-3	-12	-18	-24	-31	-43
Livestock	-37	-80	-129	-186	-252	-324
San Augustine	**-1,691**	**-7,269**	**-360**	**-465**	**-588**	**-723**
Irrigation	-100	-100	-100	-100	-100	-100
Livestock	-91	-169	-260	-365	-487	-621
Manufacturing	0	0	0	0	-1	-2
Mining	-1,500	-7,000	0	0	0	0

Table 4A.5 Water User Groups with Projected Shortage (ac-ft per year) (cont'd)

Water User Group	2010	2020	2030	2040	2050	2060
Shelby	**-1,403**	**-3,397**	**-3,085**	**-4,475**	**-6,200**	**-8,317**
County-Other	-126	-190	-244	-253	-288	-344
Livestock	-777	-1,707	-2,841	-4,222	-5,907	-7,961
Manufacturing	0	0	0	0	-5	-12
Mining	-500	-1,500	0	0	0	0
Smith	**-117**	**-317**	**-503**	**-807**	**-1,138**	**-1,627**
Bullard	0	-13	-42	-71	-124	-195
Community Water Company	-37	-88	-111	-132	-171	-227
Irrigation	-6	-36	-68	-100	-133	-168
Jackson WSC	0	0	-38	-83	-118	-157
Lindale Rural WSC	0	0	0	0	0	-73
Manufacturing	0	0	-6	-101	-182	-295
Mining	-47	-126	-159	-215	-255	-288
Whitehouse	-27	-54	-79	-105	-155	-224
Trinity	**0**	**0**	**0**	**-9**	**-32**	**-57**
County-Other	0	0	0	-9	-32	-57
Tyler	**0**	**-142**	**-239**	**-251**	**-232**	**-232**
County-Other	0	-142	-239	-251	-232	-232
Total	**-28,856**	**-83,032**	**-83,153**	**-106,900**	**-141,866**	**-182,145**

The steam-electric power shortages are due to increases in demand above current facilities generation capacities. 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. The manufacturing shortages in Angelina and Orange Counties and livestock shortages in Shelby County are also due to increased demands above current facilities' supplies. The city of Lufkin shows a deficit beginning in 2010, which is due to the production capacities of their existing groundwater wells. The City has purchased additional groundwater rights and is also planning on developing surface water supplies from their water rights in Lake Kurth and Sam Rayburn Reservoir. These supplies will also be used to meet the manufacturing shortages in Angelina County.

In addition to these shortages, there are several near-term mining shortages associated with renewed interest in natural gas exploration in the Haynesville/ Bossier Shale in East Texas.

4A.4 Comparison of Supply and Demand by Wholesale Water Provider

The comparison of supply versus demands for each WWP is presented in Appendix 4A-A. Of these providers, five were identified with projected shortages in the ETRWPA over the planning cycle. The SRA will need to implement strategies to meet demands outside the region. The WWPs with shortages are shown in Table 4A.6 and discussed below.

In addition to these providers, there are several WWPs that 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 4C.

Table 4A.6 Wholesale Water Providers with Projected Shortages for Current Customers (ac-ft per year)

Water Provider	2010	2020	2030	2040	2050	2060
ANRA	-53,870	-53,870	-53,870	-53,870	-53,870	-53,870
Athens MWA	0	-2,984	-3,602	-4,303	-5,219	-6,351
Houston County WCID 1	-194	-218	-238	-257	-277	-301
Lufkin	-8,294	-16,918	-19,664	-22,694	-26,189	-30,162
UNRMWA	-2,677	-4,708	-6,740	-8,773	-10,808	-12,843

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

4A.4.1 Angelina and Neches River Authority. ANRA is projected to have a shortage of 53,870 ac-ft per year. ANRA has contractual demands for water from Lake Columbia that are estimated to begin by 2020 (assuming that Lake Columbia is completed by 2020). 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.

4A.4.2 Athens Municipal Water Authority. The maximum projected shortage for Athens MWA is 6,351 ac-ft per year. Most of this shortage is associated with operational constraints of Lake Athens for the Athens Fish Hatchery. Several water management strategies are being considered for Athens MWA to meet this need, including reuse from return flows from the Athens Fish Hatchery, obtaining water from Forest Grove Reservoir and developing groundwater supplies from the Carrizo-Wilcox aquifer.

4A.4.3 City of Lufkin. The City of Lufkin is projected to have a water shortage under drought of record conditions of 8,294 ac-ft per year beginning in Year 2010, growing to 30,162 ac-ft per year for Year 2060. Much of the projected shortages are associated with increased demands for manufacturing needs and local growth. The City currently has a three-part plan to address these needs.

4A.4.4 Houston County Water Control and Improvement District No. 1. Houston County WCID 1 has contractual demands that exceed its permitted supply from Houston County Lake. Houston County WCID 1 is currently seeking a permit amendment to increase the permitted diversions from this source.

4A.4.5 Upper Neches River Municipal Water Authority. 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.

4A.5 Socioeconomic Impacts of Not Meeting Needs

Administrative Rules in 31 TAC §357.7 require regional planning groups to evaluate socioeconomic impacts of not meeting water needs as part of the regional planning process. Rules direct the TWDB to provide technical assistance upon request for water supply and demand analysis, including methods to evaluate the social and economic impacts of not meeting needs. The ETRWPG convened February 17, 2010, and directed Chairman Kelley Holcomb to write an official request for technical assistance from the TWDB. The official request was sent to the TWDB February 26, 2010, and is provided as correspondence in Appendix 2-A.

The TWDB prepared a report entitled *Socioeconomic Impacts of Projected Water Shortages for the East Texas Regional Water Planning Area (Region I).* The report assessed the economic impacts of not meeting water demands for agricultural, municipal, and industrial users, and assessed the social impacts of water shortages. The TWDB implemented a methodology consistent between all planning regions. The report is presented in Appendix 4A-B.

Economic impact was primarily gauged by change in gross state product, which is income plus state and local business taxes. The following is a summary of economic impacts of not meeting water demands in the ETRWPA.

- Agricultural Shortages Impacts – Irrigation
  - Shortages in Hardin, Houston, San Augustine, and Smith Counties.
  - Shortages amount to a reduction in gross state product of less than $1 million per year for each decade throughout planning horizon.
- Agricultural Shortages Impacts – Livestock
  - Shortages in Angelina, Henderson, Houston, Nacogdoches, Sabine, San Augustine, & Shelby Counties.
  - Shortages amount to a reduction in gross state product of $14 million per year in 2010, and $551 million in 2060.
- Municipal Shortages Impacts:

- Estimated economic value of domestic water shortages total $19 million in 2010 and $157 million in 2060.
- Shortages would reduce gross state product by $34 million in 2020, and $162 million in 2060.

- Manufacturing Shortages Impacts:
  - Shortages expected in Angelina, Henderson, Nacogdoches, Sabine, San Augustine, and Shelby Counties.
  - Reduction in gross state product by an estimated $41 million in 2010 and $1.2 billion in 2060.
- Mining Shortages Impacts:
  - Shortages in Angelina, Jefferson, Nacogdoches, Newton, San Augustine, & Rusk Counties
  - Reduction in gross state product by an estimated $1.2 billion in 2010, and $900 million in 2060.
- Steam-Electric Shortages Impacts:
  - Shortages in Anderson, Angelina, Jefferson, Nacogdoches, Newton, and Rusk Counties
  - Reduction in gross state product by an estimated $119 million in 2020, and $3.7 billion in 2060.

The TWDB also analyzed the social impacts of water shortages. Examples of social effects associated with drought or water shortages include changes in population and consequently school enrollment, loss of jobs, conflicts between water users, health-related low-flow problems, public safety issues, and loss of aesthetic property values.

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Chapter 4B

Types of Water Management Strategies

This section provides a review of the types of water management strategies considered for the ETRWPA. Included is a summary of the application of each strategy to meet the needs during the planning period. Chapter 4C provides a summary of the strategies considered for each WUG on a county basis and provides the costs for the strategies. WMSs considered include water conservation and drought management, wastewater reuse, expanded use of existing supplies, new supply development and interbasin transfers. WMSs to meet potential future demands, not presently approved by the TWDB, or those that require supply strategies within the ETRWPA to meet demands in other regions are not included. Details of these strategies are included under the discussion for wholesale water providers in Chapter 4C, specifically for the LNVA, UNRMWA, and SRA.

The ETRWPG evaluated WMSs available to meet the demands in the ETRWPA. The strategies considered include the following:

- Water conservation and drought management
- Wastewater reuse
- Expanded use of existing supplies
    - System operation,
    - Conjunctive use of groundwater and surface water,
    - Reallocation of reservoir storage
    - Voluntary redistribution of water resources
    - Voluntary subordination of water rights
    - Yield enhancement
    - Water quality improvements

- New supply development
  - Surface water resources
  - Groundwater resources
  - Brush control
  - Precipitation enhancement
  - Desalination
  - Water right cancellation
  - Aquifer storage and recovery
- Interbasin transfers

The screening criteria developed by the ETRWPG is provided in Appendix 4B-A.

4B.1 Water Conservation and Drought Management

Water conservation is defined as methods and practices that either reduce the demand for water supply or increase the efficiency of the supply or use so that available supply is conserved and made available for future use. Water conservation is typically a non-capital intensive alternative, although costs to individual customers can be significant (e.g., purchase costs for water-efficient appliances). All water supply entities and some major water right holders are required by regulations to have a Drought Contingency and Water Conservation Plan. These plans must detail the entity's procedures for reducing water demand at times when the demand threatens the total capacity of the water supply delivery system or when overall supplies are low.

If strong conservation measures are taken early in a drought and assumed in the planning stages, there is little or no flexibility remaining, should the drought exceed the conservation assumed during planning. The ability to adopt measures more stringent than planned could be limited in times of emergency.

4B.1.1 Regional Considerations. The water demand projections developed in Chapter 2 assume that approved conservation plans are in place and effective for all entities. The savings in water, associated with reduction in per capita usage attributed to the conservation measures, is estimated to be 20,600 ac-ft per year in 2060. Each entity has varying amounts of additional demand reduction included in the future demand projections described in Chapter 2. The assumed reductions tended to increase for future projections. Conservation activities that were assumed to be in place for the projections included:

- Water-efficient plumbing fixtures consistent with the State Water Efficient Plumbing Act of 1991;
- More thorough use of leak detection processes;
- More widespread use of water efficient appliances;

Water conservation actions implemented as strategies would result in savings above that assumed for the TWDB projections. The Texas Water Development Board Report 362, published by the Water Conservation Implementation Task Force in November 2004, provides a review of best management practices for water conservation for municipal, industrial and agricultural water users. Water conservation strategies, using the guidelines in TWDB Report 362, were evaluated for water users that demonstrated needs in the planning period and met the following conditions:

- Municipal users with current per capita water use greater than 140 gpcd,
- Municipal users that have industrial, commercial and institutional customers that account for more than 20% of the city’s total water use,
- Manufacturing users located in counties where manufacturing use is greater than 1,000 ac-ft per year or with an identifiable industry with water use greater than 500 ac-ft per year.

Water conservation strategies for other users (irrigation, steam-electric, livestock and mining) were not developed. These users comprise between 25% to 33% of the total water demand in the ETRWPA during the planning period. Water conservation has recently begun to be utilized in irrigation of rice in one area of the ETRWPA. The water conservation efforts were driven by economic reasons (i.e., billing of water used from metered flow as opposed to acreage farmed). The financial incentive has led to four conservation measures being implemented; irrigation scheduling, field maintenance, land leveling and tailwater recovery. Metering began in 2004, however, it was not until 2005 that billing on the amount metered was implemented. Comparison of the two years indicated average water consumption to be reduced from 3.79 ac-ft per acre farmed to 2.84 ac-ft per acre farmed. The demand for steam-electric use is projected to grow from 4% to 12% of the demand during the 50-year period. The projections for steam-electric use were provided by the TWDB. Most of the demand will be consumed by new projects, which include conservation in the projected water use. Livestock and mining comprise a total of 4% to 5% of the demand. The cost of water in these industries comprises a small percentage of the overall business cost and it is not expected these industries will see an economic benefit to water conservation

4B.1.2 Selected Water Conservation Strategies.

The following are selected water conservation strategies for municipal and manufacturing users.

Municipal Water Conservation Strategies. Water conservation strategies were evaluated for those municipal users showing a need during the planning period and have a per capita water use greater than 140 gpcd. Entities with this type of use customarily have larger commercial and industrial users in relation to the general population. Water conservation practices evaluated included public and school education, water conservation pricing, and passive implementation of new water conserving clothes washing machines. Public and school education would involve providing formal and indirect means of information on how to conserve water. Water conservation pricing requires an increasing rate structure with increasing use. The effectiveness of this measure is, in part, determined by whether water conservation pricing is currently implemented. The passive implementation of new water conserving clothes washing machines is the natural replacement of clothes washers with time.

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 $1.00 per capita or per 1,000 gallons water conserved, whichever was most restrictive. The total budget available will be an indication as to the effectiveness of the program. Table 4B.1 indicated efficiencies assigned to various ranges of available budget.

Table 4B.1 Water Conservation Efficiencies

Budget		Efficiency of Conservation
Low	**High**	
$1,500 (minimum)	$9,999	1.5%
$10,000	$19,999	2.0%
$20,000	$29,999	2.5%
$30,000	$40,000 (maximum)	3.0%

Water conservation pricing will be most effective in areas where groundwater resources are becoming less available and requires high expenditures in capital projects to supply water. Only those entities meeting the above criteria and located in counties that are reaching the limits of groundwater were considered for this strategy. Where the recommended strategies were less than $1.00 per 1,000 gallons the efficiency achieved is assumed to be 1.0%. A 2.0% efficiency is assumed where the recommended strategy exceeds $1.00 per 1,000 gallons.

Implementation of the passive clothes washer strategy was limited to areas where the recommended strategy exceeds $1.00 per 1,000 gallons. The assumptions made in this strategy include a replacement rate of 7.7% per year with a total saving of 5.6 gpcd where installed. Details of municipal conservation strategies are provided in Appendix B. The total savings in water during the planning period for the selected entities is provided in Table 4B.2.

Table 4B.2 Water Conservation Savings for Selected Entities

Entity (County)	Amount Conserved (ac-ft per year)					
	2010	2020	2030	2040	2050	2060
Frankston (Anderson)			6	7	8	9
Diboll (Angelina)	11	20	26	34	53	72
Lufkin (Angelina)	50	117	189	249	319	408
New Summerfield (Cherokee)		10	18	21	23	26
Rusk (Cherokee)				51	66	76
Lumberton/Lumberton MUD (Hardin)	76	116	146	167	190	215
Athens(Henderson)	1	6	12	17	22	30
County-Other (Henderson)	31	57	74	92	108	129
Kirbyville (Jasper)	3	4	5	6	7	7
Appleby WSC (Nacogdoches)				22	39	62
Nacogdoches (Nacogdoches)		229	425	514	654	787
Center (Shelby)	15	34	47	60	67	75
Bullard (Smith)		3	4	5	6	8
Lindale Rural WSC (Smith)			5	7	9	12
Tyler (Smith)	301	526	772	1,036	1,234	1,344
TOTAL	**488**	**1,122**	**1,729**	**2,288**	**2,805**	**3,260**

Water conservation strategies for municipal users that have industrial, commercial and institutional customers that account for more than 20% of the city's total water use were not considered individually. The water conservation strategies for this group are evaluated under conservation strategies considered for the manufacturing user group.

Manufacturing Water Conservation Strategies. The criteria for evaluating water conservation measures in manufacturing uses was limited to counties showing a need in this sector during the planning period with use greater than 1,000 ac-ft per year or with an identifiable industry with water use greater than 500 ac-ft per year. The counties meeting these criteria include Angelina, Nacogdoches, Newton, Orange and Polk. The distribution, by the general category of manufacturing use, on a county basis is provided in Table 4B.3.

Table 4B.3 Manufacturing Water Conservation

County	Manufacturing Type			
	Timber/Paper	Food	Manufacturing	Petrochemical
Angelina	90%	7%	3%	
Nacogdoches	7%	81%	12%	
Newton	100%			
Orange	40%		2%	58%
Polk	100%			

There are readily available supplies of water to meet manufacturing needs in Newton, Orange and Polk counties. Development of water management strategies for Angelina and Nacogdoches will require more intense planning. The timber and paper industries in Angelina County, for the most part, provide their own ground or surface water. Any conservation measures will more than likely be based on economic justification to expand plant capacity and will not affect water availability to the region as a whole. The remaining industries, food and manufacturing facilities in Angelina and Nacogdoches Counties, should be considered for water conservation. The majority of the water in these sectors is supplied by municipal suppliers that face the needs for major WMSs.

TWDB Report 362 lists fourteen best management practices for industrial users. Application of each of the practices to the food and manufacturing industries in Angelina and Nacogdoches Counties is not practical at this time. However, the industrial water audit practice is a feasible alternative to consider for implementation. The TWDB Report 362 determined that an audit should result in savings of 10 to 35 percent if an audit has not been performed. Table 4B.4 indicates the expected savings of implementation of this water conservation strategy is based on a savings of 10 percent.

Table 4B.4 Manufacturing Water Conservation Savings (ac-ft per year)

County	Demand or Savings					
	2010	2020	2030	2040	2050	2060
Angelina						
Total Demand	30,266	34,359	37,982	41,642	44,887	48,356
Food & Manufacturing Demand	3,066	7,159	10,782	14,442	17,687	21,156
Water Conservation Savings	307	716	1,088	1,444	1,769	2,116
Nacogdoches						
Total Demand	2,288	2,553	2,786	3,016	3,214	3,468
Food & Manufacturing Demand	2,118	2,383	2,616	2,846	3,044	3,298
Water Conservation Savings	212	239	262	285	304	330

Water Conservation Environmental Issues. No substantial environmental impacts are anticipated, as water conservation is typically a non-capital intensive alternative that is not associated with direct physical impacts to the natural environment. A summary of the few environmental issues that might arise for this alternative are presented in Table 4B.5.

Table 4B.5 Potential Environmental Issues Associated with Water Conservation

Environmental Issue	Evaluation Result
Implementation Measures	Voluntary reduction, water pricing, city drought contingency plans
Environmental Water Needs/Instream Flows	No substantial impact identified, assuming relatively low reduction in diversions and return flows: substantial reductions in municipal and industrial diversions from water conservation would result in possibly low to moderate positive impacts as more stream flow would be available for environmental water needs and instream flows.
Bays and Estuaries	No substantial impact identified, assuming relatively low reduction in diversions and return flows.
Fish and Wildlife Habitat	No substantial impact identified, assuming relatively low reductions in diversions and return flows; possible low to moderate positive impact to aquatic and riparian habitats with substantial reductions as more stream flow would be available to these habitats.

Table 4B.5 Potential Environmental Issues Associated With Water Conservation (Cont.)

Environmental Issue	Evaluation Result
Cultural Resources	No substantial impact anticipated
Threatened and Endangered Species	No substantial impact identified, assuming relatively low reduction in diversions and return flows; possible low to moderate positive impact to aquatic and riparian threatened and endangered species (where they occur) with substantial diversion reductions.
Comments	Assumes no substantial change in infrastructure

Water Conservation Cost Considerations. Since water conservation plans are required for each community, regular costs for implementing and enforcing a general conservation program were not estimated. Only the efforts needed to enforce a more stringent conservation plan over and above that assumed in the projections were studied. The only strategy that created a direct cost on the entity is school and public education.

Water Conservation Implementation Issues. Water conservation as a water supply option has been compared to the plan development criteria, as shown in Table 4B.6. Based on the table, it is evident that water conservation meets the evaluation criteria.

Table 4B.6 Water Conservation Evaluation

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 shortages.
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Not applicable

4B.2 Wastewater Reuse

Wastewater reuse utilizes treated wastewater effluent as either a replacement for a potable water supply or involves the treatment of wastewater to parameters that allows it to be returned to the water supply resource.

There are no wastewater reuse strategies defined for the ETRWPA. While Athens MWA has received a reuse permit that allows the City of Athens to discharge its wastewater effluent to Lake Athens, the City and MWA have decided not to pursue this strategy at this time due to costs. Athens MWA 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 obligations to do so.

4B.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.

4B.3.1 Expanded Use of Groundwater. Groundwater is still a viable and cost-effective supply of water for the ETRWPA. Approximately 60 percent of WUGs with a need during the planning period are expected to continue using groundwater as a source of new supplies. The supplies established in Chapter 3, Section 3.1 were used to evaluate the ability to meet demands for the ETRWPA. Where needs are shown for unspecified users such as irrigation and livestock, the expansion of groundwater use was evaluated on the same percentage usage of existing supplies. Counties that are near capacity in utilizing the groundwater resources are Angelina, Cherokee, Hardin, Nacogdoches, Orange, Shelby and Smith. Evaluation of the expanded use of groundwater is presented by aquifer and county in Tables 4B.7-11.

Table 4B.7 Water Management Strategies Utilizing Gulf Coast Aquifer

Entity	Projected Additional Groundwater Demand (ac-ft per year)					
	2010	2020	2030	2040	2050	2060
Hardin County						
County-Other	154	306	306	306	459	459
Manufacturing	114	114	114	114	114	114
Jasper County						
County-Other	632	632	632	632	632	632
Jefferson County						
Mining	0	0	0	0	5	9
Newton County						
Manufacturing	400	400	400	800	800	800
Orange County						
County-Other	140	140	140	140	140	140
Mauriceville WSC	0	203	203	203	203	203
Polk County						
County-Other	208	417	624	832	832	832
Tyler County						
County-Other	0	251	251	251	251	251
Woodville	0	300	300	300	300	300

Table 4B.8 Water Management Strategies Utilizing Carrizo-Wilcox Aquifer

Entity	Projected Additional Groundwater Demands (ac-ft per year)					
	2010	2020	2030	2040	2050	2060
Anderson County						
County-Other	0	0	0	100	100	100
Frankston	0	0	120	120	120	120
Mining	18	120	120	120	120	120
Angelina County						
Hudson WSC	0	0	600	600	2000	2000
Lufkin	4650	4650	4650	4650	4650	4650
Steam Electric	1000	1000	1000	1000	1000	1000
Cherokee County						
New Summerfield	0	0	121	242	242	242
Rusk	0	0	0	0	212	212
Henderson County						
County-Other	50	50	50	50	50	50
Athens MWA		1,400	1,400	1,400	1,400	1,400
Houston County						
Irrigation	766	1,149	1149	1,629	1915	2298
Livestock	211	211	422	633	844	1080
Nacogdoches County						
D&M WSC	0	0	310	310	310	310
Livestock	0	0	322	644	966	1350
Swift WSC	350	350	350	350	350	350
Rusk County						
Mining	0	0	0	158	158	158
Sabine County						
County-Other	32	32	32	64	64	64
Livestock	50	50	50	100	100	100
San Augustine County						
Irrigation	100	100	100	100	100	100
Livestock	150	150	250	300	400	400
Shelby County						
County-Other	100	200	300	300	350	350
Livestock	1500	2500	3000	3000	3500	3500
Smith County						
Bullard	0	100	100	100	200	200
Lindale Rural WSC	0	0	0	0	0	80

Table 4B.9 Water Management Strategies Utilizing Queen City Aquifer

Entity	Projected Additional Groundwater Demands (ac-ft per year)					
	2010	2020	2030	2040	2050	2060
Anderson County						
County-Other	0	0	0	0	0	100
Henderson County						
County-Other	50	50	50	100	200	500
Smith County						
Irrigation	40	40	80	120	168	168
Mining	47	141	188	235	282	329

Table 4B.10 Water Management Strategies Utilizing Yegua-Jackson Aquifer

Entity	Projected Additional Groundwater Demands (ac-ft per year)					
	2010	2020	2030	2040	2050	2060
Angelina County						
County-Other	0	0	150	150	300	300
Diboll	600	600	600	600	600	600
Trinity County						
County-Other	0	0	0	60	60	60

Expanded Use of Groundwater Environmental Issues. Consideration was given to limiting supply availability to the amount of groundwater that could be withdrawn from the aquifers over the planning period that will not cause more than 50 feet of water level declines, or 10% reduction in saturated thickness whichever is less.

Table 4B.11 Potential Environmental Issues Associated With Increased Use of Groundwater

Environmental Issue	Evaluation Result
Implementation Measures	Local impact resulting from development of well fields, storage facilities, pump stations and pipelines.
Environmental Water Needs/Instream Flows	Potential increase in return flows to streams.
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.

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 wells may require minor treatment.

Expanded Use of Groundwater Implementation Issues. This water supply option has been compared to the plan development criteria, and how the option meets each criterion as shown in Table 4B.12.

Table 4B. 12 Comparison of Wastewater Reuse Option 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 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	None

4B.3.2 Voluntary Redistribution For the purpose of the 2011 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 that it does not need the water 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 is important to remember that 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 below.

Voluntary Redistribution Strategies. Table 4B.13 includes a list of needs met by voluntary redistribution.

Table 4B.13 Needs Met by Voluntary Redistribution

Water Provider	Entity with Need	Water Supply (ac-ft per year)					
		2010	2020	2030	2040	2050	2060
City of Palestine (Lake Palestine)	Steam-Electric (Anderson County)		21,853	21,853	21,853	21,853	21,853
City of Lufkin (Lake Kurth, Sam Rayburn)	County-Other (Angelina County)	0	0	1,100	1,100	1,100	1,100
	Four Way WSC	0	0	0	0	0	225
	Diboll	800	800	800	800	1,600	1,600
	Manufacturing (Angelina County)	6,800	12,800	12,800	14,100	16,800	18,800
LNVA	Mining (San Augustine)	1,000	6,500	0	0	0	0
	Steam-Electric (Jefferson)	0	25,951	25951	25951	25951	25951
Athens MWA	City of Athens (Neches)	0	46	58	71	95	125
	Irrigation (Henderson)	0	70	83	95	108	121
UNRMWA	County-Other (Henderson County)	0	150	200	300	400	500
SRA	Steam-Electric (Newton)	0	0	15,000	15,000	15,000	15,000
	Manufacturing (Orange)	5,000	15,000	20,000	25,000	30,000	30,000
	Steam-Electric (Rusk)	0	0	0	0	1500	1500
	County-Other (Shelby)	150	150	150	150	150	150
	Livestock (Shelby)	0	0	0	4,000	4,000	4,000
	Mining (Shelby)	250	1250	0	0	0	0
City of Carthage	Manufacturing (Panola)	96	116	132	147	160	187
City of Tyler	Community Water Company	121	121	121	227	227	227
	Manufacturing (Smith)	0	0	294	294	294	294
	Whitehouse	27	0	0	0	0	0
City of Center	County-Other (Shelby County)	50	50	50	50	50	50
Houston County WCID	Manufacturing (Houston)	0	30	30	30	30	30
	Steam-Electric Power (Nacogdoches)	0	340	340	340	340	340
Hudson WSC	Hudson	0	0	125	400	800	1,200

*Alternative strategy

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 4B.14.

Table 4B.14 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.
Bays and Estuaries	No substantial impact identified
Fish and Wildlife Habitat	Impact dependent on location and size of project.
Cultural Resources	Impact dependent on location and size of project.
Threatened and Endangered Species	Impact dependent on location and size of project.

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;
- 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 4B.15.

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 4B.15 Comparison of Voluntary Redistribution Option 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. No impact identified. 2. Low impact in areas of construction. 3. Possible low impact. 4. No substantial 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	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	

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.

4B.3.3 Expanded Local Supplies. Expansion of existing supplies involves the development of supplies currently being used near the source of demand, usually groundwater or local supplies (supply ponds). The WUGs that would implement this strategy are limited to irrigation, livestock and mining. The implementation of this strategy involves the assumption that the future needs will be filled by the same percentage usage of current supplies. Where groundwater is being used as a current supply, the additional usage has been included with the increase in use of groundwater. The analysis contained in this section is limited to sources other than groundwater. The WUGs that would implement this strategy are included in Table 4B.16.

Table 4B.16 Water User Groups Utilizing Expanded Local Supplies

Entity	Project Supply Demand (ac-ft per year)					
	2010	2020	2030	2040	2050	2060
Livestock – Sabine County	50	100	107	200	210	300
Livestock – San Augustine County	0	0	0	0	0	300
Livestock – Shelby County (Sabine Basin)	0	0	500	500	500	500

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.

4B.4 New Reservoirs

Major water providers 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, and 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 major water providers located in the ETRWPA presenting information to the ETRWPG that 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 major water provider.

One new reservoir is recommended as potential strategies for the needs in the current planning cycle: Lake Columbia 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.

Lake Fastrill was a recommended strategy in the 2007 State Water Plan; however, due to the designation of the Neches River National Wildlife Refuge the sponsors of this project are considering alternative strategies. One alternative is the Neches River Run-of-the-River Diversion. This strategy would include the construction of several off-channel storage reservoirs, which would be located on tributaries of the Neches River in Anderson and Cherokee Counties downstream of Lake Palestine and upstream of the Weches Dam Site. With a total storage capacity of about 540,000 ac-ft, the firm yield of the strategy is estimated at 134,500 ac-ft per year. Of this amount, 112,100 ac-ft per year would be provided to Dallas Water Utilities in Region C. The evaluation of this strategy is discussed in more detail in the 2011 Region C Water Plan.

Needs that would potentially be met by the development of Lake Columbia are provided in Table 4B.17. 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 2011 Plan.

Table 4B.17 Demands Supplied by Lake Columbia

Entity	Projected Supply Demand (ac-ft per year)					
	2010	2020	2030	2040	2050	2060
Manufacturing (Angelina)	0	8,551	8,551	8,551	8,551	8,551
Mining (Angelina)	2,000	4,000	0	0	0	0
New Summerfield	0	1,000	1,000	1,000	1,000	1,000
Rusk	0	3,000	3,000	3,000	3,000	3,000
Mining (Cherokee)	500	1,500	0	0	0	0
Mining (Nacogdoches)	2,500	7,000	0	0	0	0
Steam Electric (Nacogdoches)	0	5,000	5,000	5,000	13,400	13,400
Steam Electric (Rusk)	0	0	0	0	0	8,500
Jackson WSC	0	600	600	600	600	600
Whitehouse	0	1,200	1,200	1,200	1,200	1,200

Water demands that would be satisfied by the development of the Lake Fastrill Replacement Project are indicated in Table 4B.18.

Table 4B.18 Demands Supplied by Lake Fastrill Replacement Project

Entity	Projected Supply Demand (ac-ft per year)					
	2010	2020	2030	2040	2050	2060
UNRMWA	0	0	0	134,500	134,500	134,500
City of Dallas				112,100	112,100	112,100
Steam-Electric Power (Anderson County)*				21,853	21,853	21,853
TOTAL				**134,500**	**134,500**	**134,500**

* Alternative Strategy

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 4B.19 provides a basic evaluation of issues. Environmental impacts for off-channel reservoirs may be less than on-channel reservoirs due to flexibility in locating these facilities.

Table 4B.19 Environmental Issues Associated with Development of New Reservoirs

Environmental Issues	Evaluation Result
Implementation Measures	Dam and reservoir covering 10,000 acres.
Environmental Water Needs/Instream Flows	Probable moderate impact
Bays and Estuaries	Possible cumulative impact to limited areas of coastal marsh
Fish and Wildlife Habitat	Possible high to moderate impact to species in general. Possible moderate impact on State-listed species.
Cultural Resources	Probable moderate impact.
Threatened and Endangered Species	Possible moderate to low impact pending identification of such species in the project area.

New Reservoirs Cost Consideration. As with any major reservoir project, the project costs are large. Based on comparison with other projects of similar size, it is estimated the proposed Lake Columbia project has an annualized cost of $16,280,500. This figure is an annualized estimate of cost that includes the construction of the dam, land acquisition, resolution of conflicts, environmental permitting and mitigation, and technical services.

Capital costs for the Neches River Run-of-the-River strategy are estimated at nearly $2 billion. Annualized costs are $193,301,000.

New Reservoirs Implementation Issues. This water supply option has been compared to the plan development criteria, as shown in Table 4B.20. The option meets each criterion.

Table 4B.20 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. Negligible impact
C. Impact on Other State Water Resources	Moderate impacts on state water resources (available water); 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 shortages
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

Chapter 4C

Water Management Strategies for Entities with an Identified Need

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The strategies are outlined for each WUG, by county, with a need identified in Chapter 4A. For each WUG with a defined shortage, a summary table is provided to review the projected need and the supply delivered by the strategy(ies). 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 4C-A provides a summary of the unit prices and general description of the project scope and cost for each strategy.

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 were implemented in the ETRWPA is provided in Chapter 4B.

4C.1 Water User Groups with Needs

Due to the level of uncertainty in the water supply allocation and projected water demands, WMS are only developed for WUGs with projected needs that are greater than 5 ac-ft per year.

4C.1.1 Anderson County. WMS for Anderson County include expanding groundwater resources. There is adequate aquifer capacity to allow for the projected expansions of groundwater supplies. However, development of future steam-electric facilities will be dependent on the development of surface water supply from Lake Palestine through a contract with the City of Palestine.

County-Other. Current supplies are from the Carrizo-Wilcox aquifer, Queen City aquifer, and Sparta aquifer. The recommended strategy for meeting the projected need in 2060 is to increase supply from the Queen City and Carrizo-Wilcox aquifers. For planning purposes, these strategies assume that two new wells will be drilled in the Queen City aquifer and one well in the Carrizo-Wilcox aquifer. The actual number and location of the wells will be determined by the user.

Anderson County-Other	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	0	0	-31	-132
Recommended Strategy ADC-1: Increase Supply from Queen City						100
Recommended Strategy ADC-2: Increase Supply from Carrizo-Wilcox				100	100	100

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
ADC-1: Increase Supply from Queen City	100	$212,732	$32,110	$321	$0.99
ADC-2: Increase Supply from Carrizo-Wilcox	100	$262,189	$40,631	$406	$1.25

Frankston. The City of Frankston's water supply is currently from groundwater wells in the Carrizo-Wilcox aquifer. The strategy selected to meet the future demands is to increase additional supplies from the Carrizo-Wilcox.

Frankston	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	-6	-24	-40	-54
Recommended Strategy FR-1: Increase Supply from Carrizo-Wilcox			121	121	121	121
Recommended Strategy FR-2: Water Conservation			6	7	8	9

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
FR-1: Increase Supply from Carrizo-Wilcox	120	$255,951	$42,846	$357	$1.10
FR-2: Water Conservation	9		$ 1,910	$212	$0.65

Mining. Water for mining is supplied by the Carrizo-Wilcox aquifer. The recommended strategy is to increase supply from this aquifer. The following table displays the projected future needs for the mining use in Anderson County.

Anderson County Mining	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-18	-22	-45	-70	-95	-119
Recommended Strategy ADN-1: Increase Supply from Carrizo-Wilcox	18	120	120	120	120	120

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
ADN-1: Increase Supply from Carrizo-Wilcox	120	$228,730	$28,233	$233	$0.72

Steam-Electric. Previous plans by Louisville Gas & Electric to construct a steam-electric power plant and contract with the City of Palestine for water were abandoned due to lack of funding. The current demand projections are based on a similar project being developed in the future, with plant operation beginning in 2020 and expected to require an annual average amount of 21,853 ac-ft per year by 2060. It is assumed that the future facility could contract with City of Palestine to use water from its existing 28,000 ac-ft per year from Lake Palestine. Construction of a pipeline and pump station would be required to supply the plant with water from Lake Palestine. Alternatively, water from Lake Fastrill Replacement Project could be used to supply some of the projected demands for steam-electric power. The following table displays the projected future needs for the steam-electric power use in Anderson County. The recommended strategy is to obtain water from Lake Palestine.

Anderson County Steam-Electric	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	-11,306	-13,218	-15,549	-18,390	-21,853
Recommended Strategy ADS-1: Water from Lake Palestine		21,853	21,853	21,853	21,853	21,853
Alternate Strategy ADS-1: Water from Lake Fastrill Replacement Project		21,853	21,853	21,853	21,853	21,853

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
ADS-1: Water from Lake Palestine	21,853	$24,917,400	$7,500,600	$343	$1.05
Alt. Strategy ADS 2: Water from Lake Fastrill Replacement Project	21,853	$24,917,400	$7,500,600	$343	$1.05

4C.1.2 Angelina County. Most of the WUGs in Angelina County are currently dependent on groundwater supplies. Both the Yegua aquifer and the Carrizo-Wilcox aquifer have limited capacity for expanded development. Although some communities will continue to rely on groundwater, the proposed construction of transmission lines and a surface water treatment plant at Lake Kurth by the City Lufkin is expected to supply water for Lufkin, Zavalla, Huntingdon, Four Way WSC, Angelina WSC, M&M WSC, and some manufacturing needs.

County-Other. Current supplies for County-Other water users are groundwater from the Carrizo-Wilcox and Yegua aquifers. Zavalla, Huntington, Angelina WSC and M&M WSC are expected to obtain water from the City of Lufkin as Lufkin develops additional supplies. Other users will likely increase self-supplied groundwater from the Yegua-Jackson aquifer. Two strategies are recommended to meet the projected needs of Angelina County-Other: 1) Purchase water from the City of Lufkin, and 2) increase supplies from the Yegua-Jackson aquifer.

Angelina County Other	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Supply(+)-Demand(-) (ac-ft per year)	0	0	-20	-135	-349	-661
ANC-1: Voluntary redistribution from City of Lufkin	0	0	1,100	1,100	1,100	1,100
ANC-2A: Increase Supply from Yegua-Jackson	0	0	150	150	300	300

For purposes of developing costs for purchasing water from Lufkin, costs were estimated at the current rates to wholesale customers. Actual costs will be determined during contract negotiations.

Strategy	**Yield (ac-ft per year)**	**Total Capital Cost**	**Total Annualized Cost**	**Unit Cost ($/ac-ft)**	**Unit Cost ($/1000 gal)**
ANC-1: Voluntary redistribution from City of Lufkin(1)	1,100	$10,604,000	$1,790,000	$1,627	$4.99
ANC-2A: Increase Supply from Yegua-Jackson	300	$419,717	$64,285	$214	$0.66

(1)See Section 4C.21 , Wholesale Water Providers, City of Lufkin, for costs of strategies for City of Lufkin

Diboll. Current supplies are from the Yegua-Jackson aquifer. Total pumpage from the Yegua-Jackson aquifer is approaching the long-term aquifer capacity in Angelina County, but there is some available water in the near-term. The City of Diboll is currently planning to expand its groundwater system to increase the supplies from the Yegua-Jackson aquifer. The City recently signed a contract with the City of Lufkin for 632 MGY of treated water from the former Abitibi well field. At this time the City of Diboll is pursuing both options to increase its reliable supplies. The recommended strategies for the City of Diboll are to: 1) expand the City's groundwater sources and 2) purchase water from Lufkin and build a pipeline to Diboll.

Diboll	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-32	-187	-374	-618	-965	-1,441
Recommended Strategy DI-1: Purchase water from Lufkin	800	800	800	800	1,600	1,600
DI-2: Water Conservation	11	20	26	34	53	72
Recommended Strategy DI-3A: Increase Supply from Yegua-Jackson	600	600	600	600	600	600

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
DI-1: Purchase water from Lufkin – Each Phase	800	$6,195,000	$1,144,900	$1,431	$4.39
DI-2: Water Conservation	72	$0	$8,955	$124	$0.38
DI-3: Increase Supply from Yegua-Jackson	600	$576,576	$140,344	$234	$0.72

Four Way WSC. Current supplies are from the Yegua aquifer. The recommended strategy for meeting the need projected in 2060 is to obtain treated surface water from the City of Lufkin. The following table displays the projected future needs for this entity.

Four Way WSC	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	0	0	0	-225
FW-1: Obtain water from Lufkin	0	0	0	0	0	225

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
FW-1: Obtain water from Lufkin[1]	225	$669,192	$211,421	$940	$2.88

[1]See Section 4C.21 , Wholesale Water Providers, City of Lufkin, for costs of strategies for the City of Lufkin

Hudson. The City of Hudson currently purchases water from Hudson WSC, which obtains water from the Carrizo-Wilcox aquifer. It is assumed that Hudson WSC will expand its well fields and production capacity to meet the projected shortages for the City of Hudson. The recommended strategy for meeting the need projected in 2060 is to purchase water from Hudson WSC. For cost purposes, it is assumed that the water is purchased at $1.25 per thousand gallons. Actual costs will be negotiated between the buyer and seller. The following table displays the projected future needs for this entity**.**

Hudson	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	-123	-360	-710	-1,174
HU-1A: Purchase water from Hudson WSC	0	0	125	400	800	1,200

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
HU-1A: Purchase water from Hudson WSC	1,200	$0	$380,703	$317	$0.97

Hudson WSC. Current supplies are from the Carrizo-Wilcox aquifer, and current production capacity is 3.2 MGD. To meet the projected needs of Hudson WSC and the City of Hudson, Hudson WSC will need to develop an additional 2,000 ac-ft per year. The recommended strategy for meeting the need projected in 2060 is to increase supply from the Carrizo-Wilcox aquifer. A two-phased strategy was considered to meet the future water demands.

Hudson WSC	2010	2020	2030	2040	2050	2060
Hudson WSC Supply(+)-Demand(-) (ac-ft per year)	0	0	0	-104	-367	-735
City of Hudson Supply(+)-Demand(-) (ac-ft per year)	0	0	-123	-360	-710	-1,174
HW-1A: Increase Supply from Carrizo-Wilcox – Phase I			600	600	600	600
HW-1B: Increase Supply from Carrizo-Wilcox – Phase II					1,400	1,400

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
HW-1A: Increase Supply from Carrizo-Wilcox – Phase I	600	$974,482	$190,352	$317	$0.97
HW-1B: Increase Supply from Carrizo-Wilcox – Phase II	1,400	$2,299,710	$447,897	$320	$0.98
TOTAL	**2,000**	**$3,274,192**			

Lufkin. The City of Lufkin currently relies on groundwater from the Carrizo-Wilcox aquifer. The City recently purchased additional groundwater and surface water rights from Abitibi Bowater Corporation. The City plans to develop this supply for its near-term needs and plans to utilize its water rights in Sam Rayburn Reservoir for its long-term water needs. The timing of the development of the Sam Rayburn water rights will depend on the reliable supplies from the new groundwater supplies and Lake Kurth and future demands on the city. At this time, the development of the water rights in Sam Rayburn Reservoir is planned for 2040. The proposed strategies for the City of Lufkin are discussed in Section 4C.21, Wholesale Water Providers, City of Lufkin.

Manufacturing. Much of the manufacturing water supplies in Angelina County are obtained from groundwater. Some water is provided by reuse from Temple Inland. The City of Lufkin supplies approximately 35% of the current manufacturing needs; however, it would be expected that the City's percentage of the supply may increase with the acquisition of Lake Kurth and future development of surface water supply from Sam Rayburn. It is anticipated that growth in manufacturing will be supplied by the City of Lufkin and Temple-Inland, which is currently under contract with ANRA for supply from Lake Columbia. It is expected that Temple-Inland will use the Lake Columbia supply as it becomes available.

Two potentially feasible strategies were considered to meet the future water demands. The first strategy is purchase of water from the City of Lufkin. Raw surface water is currently available from Lake Kurth for manufacturing use but there is limited infrastructure. Costs to use this source were estimated based on a 10-mile transmission line. Treated water sales from Lufkin could be provided through the city's groundwater sources and/or new surface water from Lake Kurth and Sam Rayburn Reservoir. Costs for this strategy are based on treated water purchase costs for large industries with no additional transmission costs. The second strategy is Temple-Inland's participation in the Lake Columbia development. For this strategy it was assumed that water would be diverted from the Angelina River and transported to a facility within 3 miles of the diversion location. It was also assumed that no treatment was needed.

Angelina County Manufacturing	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-3,117	-10,513	-12,983	-15,486	-17,739	-20,161
ANM-1: Obtain water from City of Lufkin	6,800	12,800	12,800	14,100	16,800	18,800
ANM-2: Obtain raw water from Lake Columbia via contract with ANRA		8,551	8,551	8,551	8,551	8,551

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
ANM-1: Obtain water from City of Lufkin	18,800	$18,573,800[(1)]	$8,536,000	$454	$1.39
ANM-2: Obtain raw water from Lake Columbia via contract with ANRA	8,551	$7,603,000	$2,736,000	$320	$0.98

[(1)]See Section 4C.21 , Wholesale Water Providers, City of Lufkin, for costs of strategies for City of Lufkin. It was assumed that 6,800 ac-ft per year would be raw water and 12,000 ac-ft per year would be treated water.

Livestock. Demands are projected to increase over the planning period and will exceed the current supplies. It is recommended that these shortages (up to 90 ac-ft per year by 2060) be met with increases in local surface water supplies.

Angelina County Livestock	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	0	-17	-52	-89
Recommended Strategy ANL-1 (ac-ft per year): Increase local surface water supplies (stock ponds)				90	90	90

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
ANL-1 Stock ponds	90	$168,800	$14,700	$163	$0.50

Mining. There has been recent interest in natural gas exploration in the Haynesville/ Bossier Shale that has placed new mining demands in Angelina County. As a result, there are near-term projected mining shortages in Angelina County. To meet these demands, it is recommended to use water from Lake Columbia and/or run-of-the-river diversions from the Angelina River. It is assumed that ANRA would be the sponsor for this water. Alternatively, water could be obtained from Lake Kurth through the City of Lufkin. The following tables show the projected mining shortages, recommended strategies and projected costs.

Angelina County Mining	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-1,990	-3,989	0	0	0	0
Recommended Strategy ANMi-1 (ac-ft per year): Obtain water from ANRA (Lake Columbia or Angelina River)	2,000	4,000	0	0	0	0
Alternate Strategy ANMi-2: Obtain water from Lufkin (Lake Kurth)	2,000	4,000	0	0	0	0

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
ANMI-1 Supply from ANRAs	4,000	$5,793,150	$1,527,000	$382	$1.17
ANMI-2 Supply from Lufkin	4,000	$5,793,150	$1,527,000	$382	$1.17

Steam-Electric. Steam electric power demands in Angelina County are based on the demands for the proposed Aspen Power facility, which are projected to be 1,000 acre-feet over the planning period. The facility is planning on using groundwater from the Carrizo-Wilcox aquifer to meet this shortage. There are existing wells at the project site, but it is uncertain whether these wells can meet all of the facilities water needs. For planning purposes, it is proposed that these shortages be met with new wells.

Angelina County Steam-Electric Power	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000
ANP -1: New wells in the Carrizo-Wilcox	1,000	1,000	1,000	1,000	1,000	1,000

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
ANP -1: New wells in the Carrizo-Wilcox	1,000	$1,724,909	$230,665	$1,538	$4.72

4C.1.3 Cherokee County. The Carrizo-Wilcox aquifer is almost fully allocated in Cherokee County. There is additional water available from the Queen City aquifer and a small amount available from the Sparta aquifer, but these aquifers do not cover the entire county. Where feasible, water from the Queen City or Sparta aquifers may be substituted for Carrizo-Wilcox water in the following potential WMS. However, the ETRWPG has made a policy decision that, for planning purposes, water from the Queen City and Sparta aquifers will be used primarily for livestock and irrigation uses because of the unreliable supply and quantity. No proposed management strategies for municipal water shortages involve the Queen City and Sparta aquifers.

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.

New Summerfield. The City of New Summerfield currently obtains water supply from the Carrizo-Wilcox aquifer. Although near term needs are adequate, the City has a contract with ANRA for 2,565 ac-ft per year of water from Lake Columbia. Development of plant farms in the New Summerfield area, with the City being the supplier of the water, will increase the City's need for new sources. The selected strategy is to obtain water from Lake Columbia and implement water conservation. The first phase of this strategy would develop 1,000 ac-ft per year of supply, with expansions beyond 2060. An alternate strategy is to increase its supply from the Carrizo-Wilcox aquifer.

New Summerfield	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	-40	-76	-117	-165
NS-1: Obtain treated water from Lake Columbia via contract with ANRA		1,000	1,000	1,000	1,000	1,000
NS-2: Water Conservation		10	18	21	23	26
Alt. NS-3: Increase supply from Carrizo-Wilcox			121	242	242	242

Strategy	Contract Amount (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
NS-1: Obtain treated water from Lake Columbia via contract with ANRA	1,000	(1)	$1,140,479	$1,140	$3.50
NS-2: Water Conservation	26		$2,388	$92	$0.28
Alt. NS-3: Increase supply from Carrizo-Wilcox	242	$299,452	$63,329	$262	$0.80

(1)Capital costs are shown for ANRA. Costs for New Summerfield are based on the unit costs for the project.

Rusk. Current supplies are obtained from Carrizo-Wilcox aquifer and Rusk City Lake. The City presently has a contract with ANRA for 4,275 ac-ft per year of water from Lake Columbia, when constructed. The selected strategy is to obtain water from Lake Columbia. It is assumed that the City of Rusk will take raw water from Lake Columbia and develop water treatment facilities. It is also assumed that Rusk would provide treated water to other Lake Columbia participants located near the city (Rusk Rural WSC and the City of Alto). The transmission costs to these entities are not included in the costs below. An alternate strategy is to expand the City's well field and obtain additional water from the Carrizo-Wilcox aquifer. Future water needs are shown in the following table.

Rusk	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	0	-42	-116	-212
RU-1: Obtain treated water from Lake Columbia via contract with ANRA		3,000	3,000	3,000	3,000	3,000
RU-2: Water Conservation				51	66	76
Alternate Strategy RU-3: Increase supply from Carrizo Wilcox				212	212	212

Strategy	Contract Amount (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
RU-1: Obtain treated water from Lake Columbia via contract with ANRA	3,000	$28,435,800	$3,968,000	$1,323	$4.06
RU-2: Water Conservation	76		$9,552	$126	$0.39
Alternate RU-3: Increase supply from Carrizo Wilcox	212	$299,452	$60,386	$285	$0.87

Mining. Current mining water needs in Cherokee County are met through groundwater from the Carrizo-Wilcox aquifer and mining local supply. With the increased interest in natural gas exploration in East Texas, there are expected water shortages for mining in the near-term. To meet these demands, it is recommended to use water from Lake Columbia and/or run-of-the-river diversions from the Angelina River. It is assumed that ANRA would be the sponsor for this water. The small projected shortage in 2060 is below the 5 ac-ft per year threshold for developing strategies and can likely be met through existing supplies.

Cherokee County Mining	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-490	-1,494	0	0	0	-2
CHMi-1: Purchase water from ANRA (Lake Columbia or Angelina River)	500	1,500				0

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
CHMi-1: Purchase water from ANRA (Lake Columbia or Angelina River)	1,500	$3,619,300	$728,000	$485	$1.49

4C.1.4 Hardin County. The Gulf Coast aquifer supplies most users in Hardin County. The available supply for Hardin County from the Gulf Coast aquifer, based on the results of this plan, is limited to 23,500 ac-ft per year. The current supplies, associated with the Gulf Coast aquifer, total 23,164 ac-ft per year. The City of Beaumont accounts for 9,000 ac-ft per year of this current supply.

Due to the nearly full allocation of groundwater, surface water alternatives need to be considered. Municipal and manufacturing shortages are relatively small and will be supplied by continued use of the Gulf Coast aquifer.

County-Other. The current supply for County-Other is from the Gulf Coast aquifer. The selected strategy is to obtain additional supply from the Gulf Coast aquifer either through purchasing water from a water provider or developing new wells. For this plan, the costs were developed for new wells in the Gulf Coast aquifer with the understanding that water that is not being used by a provider (shown as a surplus in the supply-demand comparison) is available to meet the projected shortages without overdrafting the aquifer.

Hardin County Other	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-154	-263	-284	-305	-358	-431
Recommended Strategy HAC-1A (ac-ft/year): Use additional water from Gulf Coast Aquifer (Phases I-III).	154	306	306	306	459	459

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
HAC-1: Use additional water from Gulf Coast Aquifer. Each Phase (I-III)	154	$556,888	$65,857	$430	$1.32
Total for all phases	**459**	**$1,670,664**			

Manufacturing. Current supply is from the Gulf Coast aquifer. The selected strategy is to obtain additional supply from the Gulf Coast aquifer either from a local water provider or directly through new wells. As with the strategy for County-Other, the costs were determined based on drilling new wells, and it is assumed that the additional supplies from this strategy will not result in overdrafting the aquifer in Hardin County.

Hardin County Manufacturing	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-27	-46	-63	-81	-97	-114
Recommended StrategyHAM-1 (ac-ft/year): Use additional water from Gulf Coast Aquifer	114	114	114	114	114	114

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
HAM-1: Use additional water from Gulf Coast Aquifer	114	$429,542	$43,444	$381	$1.17

Irrigation. The needs for irrigation total approximately 1,000 ac-ft per year over the planning period. Due to the limitations of groundwater needs are shown to be met through the use of surface waters.

Hardin County Irrigation	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-1,002	-1,002	-1,002	-1,002	-1,002	-1,002
Recommended StrategyHAI-1 (ac-ft/year): Use surface water surfaces	1,002	1,002	1,002	1,002	1,002	1,002

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
HAI-1: Use surface water sources	1,002	$2,405,001	$296,920	$296	$0.91

Mining. The mining water demands in Hardin County are based on historical water usage that is no longer in place. The TWDB currently reports only a small amount of groundwater use for mining purposes. As a result the projected demands do not accurately reflect the current usage in Hardin County. The TWDB has commissioned a study on water use for mining purposes across the State. This study should be completed for the development of the projected water demands for the 2016 water plan. Since this demand does not appear to be valid at this time, no strategies have been developed to meet the projected shortages.

4C.1.5 Henderson County.

Henderson County is located in both Region C and the ETRWPA. The portion of the county in the Neches River Basin lies in the ETRWPA, and the portion in the Trinity River Basin lies in Region C. Much of the water supplies to users in the ETRWPA is obtained from groundwater with a small amount of surface water supplied from Lake Athens and Lake Palestine. Most of the needs in Henderson County are associated with shortages from Lake Athens.

Athens. The City of Athens receives treated surface water from the Athens MWA and groundwater from local wells. Most of the City is located in Region C with a small portion extending into the ETRWPA. The strategies to meet water shortages for Athens are to implement conservation and purchase water from the Athens MWA through the strategies identified for this wholesale water provider. Since most of Athens lies in Region C, conservation for the portion of Athens in the ETRWPA was estimated using the recommended conservation packages identified by Region C.

Athens	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	-52	-70	-88	-117	-155
AT-1: Conservation	1	6	12	17	22	30
AT-2: Overdraft Carrizo-Wilcox through Athens MWA	0	27	29	29	30	31
AT-3: Purchase water from Athens MWA	0	19	29	42	65	94

The costs of the strategies are presented in the following table.

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
AT-1: Conservation	30	NA	$5,223	$174	$0.53
AT-2: Develop additional groundwater [(1)]	31	NA	NA	NA	NA
AT-3: Water from Athens MWA[(1)]	94	NA	NA	NA	NA

[(1)] See Section 4C.21, Wholesale Water Providers, Athens MWA, for costs for strategies for Athens MWA.

County-Other. Current supplies are from the Carrizo-Wilcox aquifer and Queen City aquifer, with a small amount of water from Lake Palestine. The Carrizo-Wilcox aquifer is nearly fully allocated in the Neches basin part of the county. There is available water from the Queen City aquifer, but the quality of water from this source is variable. The recommended strategies to meet the projected shortage of 964 ac-ft per year are to purchase additional water from the UNRMWA (Lake Palestine), expand groundwater use of the Queen City aquifer, conservation, and use the available groundwater from the Carrizo-Wilcox aquifer.

Henderson County-Other	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-75	-216	-348	-479	-683	-964
Recommended Strategy HECo-1: Conservation	31	57	74	92	108	129
Recommended Strategy HECo-2: Expand use of Carrizo-Wilcox Aquifer	50	50	50	50	50	50
Recommended Strategy HECo-3: Expand use of Queen City Aquifer	50	50	50	100	200	500
Recommended Strategy HECo-4: Purchase water from UNRMWA		150	200	300	400	500

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
HECo-1: Conservation	129	$0	$17,911	$139	$0.43
HECo-2: Expand use of Carrizo-Wilcox	50	$609,900	$64,900	$1,298	$3.98
HECo-3: Expand use of Queen City	500	$4,420,100	$504,400	$1,009	$3.10
HECo-4: Water from UNRMWA	500	$8,937,350	$982,000	$1,964	$6.02

Brownsboro. There is a small shortage identified for Brownsboro in 2060 (less than 5 ac-ft per year). Since this shortage is below the 5 ac-ft per year threshold for developing strategies, no strategies were developed for Brownsboro. It is likely that this shortage can be met through existing supplies.

Irrigation. There is a small amount of irrigation demand in Henderson County. This demand is met with water from Lake Athens. The strategy is to continue to use water from Lake Athens through the Athens MWA strategies.

Henderson County Irrigation	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	0	0	0	0
Recommended Strategy HEI-1 (ac-ft/year): Obtain water from Lake Athens	0	70	83	95	108	121

Strategy	Yield (ac-ft per year))	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
HEI-1: Obtain water from Lake Athens	(1)	(1)	$29,490	$163	$ 0.50

(1) See Section 4C.21, Wholesale Water Providers, Athens MWA, for costs for strategies by Athens MWA.

Livestock. The livestock water demands in Henderson County include the Athens Fish Hatchery. This facility is located at Lake Athens and receives water directly from the lake. The intake structure for the hatchery is set at 9 feet below the normal pool elevation, which limits the available supply from this source. The hatchery has a water contract for 3,023 ac-ft per year from Lake Athens, which it intends to fully utilize. Currently, the Athens Fish Hatchery returns about 95 percent of the diverted water from Lake Athens back to Lake Athens. While this is the hatchery's current operation, it is under no contractual obligation to return water to the lake. To meet the projected needs, it is recommended that the hatchery continue to recycle its water through Lake Athens and participate with Athens MWA in obtaining additional water at Lake Athens.

Henderson County Livestock	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	-29	-218	-388	-561	-724
Recommended Strategy HEL-1 (ac-ft/year) Fish Hatchery Reuse	0	2,872	2,872	2,872	2,872	2,872

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
HEL-1: Fish Hatchery Reuse	2,872	$0	$0	$0	$0

(1) See Section 4C.21, Wholesale Water Providers, Athens MWA, for costs for strategies by Athens MWA.

4C.1.6 Houston County. Water supplies in Houston County include surface water from Houston County Lake (through Houston County WCID), run-of-the river supplies for irrigation and groundwater from the Carrizo-Wilcox, Yegua-Jackson, Sparta, Queen City and local aquifers. There are projected water shortages in Houston County are for irrigation and livestock uses, with small shortages for manufacturing water use. The Carrizo-Wilcox aquifer has adequate capacity for expanded development in this county.

Manufacturing. The current supply for manufacturing in Houston County is from Houston County Lake, and the projected shortages are associated with the wholesale water provider Houston County WCID. The demands on Houston County WCID exceed the permitted supply for Houston County Lake. The WCID is presently seeking a permit amendment for the full yield of the lake (7,000 ac-ft per year). When this amendment is granted, there would be sufficient supplies to meet all of the manufacturing demands in Houston County. It is assumed that there are no capital costs associated with this strategy.

Houston County Manufacturing	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-3	-5	-7	-9	-12	-15
Recommended Strategy HOMa-1 (ac-ft/year): Obtain water from Houston County WCID	30	30	30	30	30	30

Irrigation. Irrigation needs in Houston County are mostly supplied by run-of-river diversions from the Neches and Trinity Rivers. Based on available data from TWDB, roughly 10 to 15 percent of the irrigation needs in 1999 were supplied from groundwater sources. More recent data indicates an increased use of groundwater for irrigation. Consistent with this trend, it is recommended that the projected irrigation shortage be met with groundwater. The recommended strategy is to expand development of groundwater supplies.

Houston County Irrigation	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-567	-667	-986	-1,334	-1,720	-2,146
HOI-1: Increase Supply from Carrizo-Wilcox – Phase I-VI	766	1,149	1,149	1,629	1,915	2,298

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
HOI-1: Increase Supply from Carrizo-Wilcox – Phase I-VI	766	$1,068,520	$158,307	$207	$0.63
TOTAL	**2,298**	**$3,205,560**			

Livestock. Livestock demands are supplied by groundwater sources and local supply. If adequate local supplies are not available, expansion of groundwater sources may be required.

Houston County Livestock	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-72	-211	-403	-610	-835	-1,078
HOL-1: Increase Supply from Carrizo-Wilcox – Phase I-V	221	221	442	663	884	1,080

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
HOL-1: Increase Supply from Carrizo-Wilcox – Phase I-V	221	$534,260	$79,154	$375	$1.15
TOTAL	**1,080**	**$2,671,300**			

4C.1.7 Jasper County. Future needs will have minimal impact on existing supplies. The Gulf Coast aquifer will be capable of handling the increase in needs.

County-Other. Current supply is from the Gulf Coast aquifer. Future demands can be met by use of additional groundwater from Gulf Coast aquifer.

Jasper County-Other	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-374	-470	-488	-430	-403	-403
Recommended Strategy JAC-1 (ac-ft/year): Use of additional water from Gulf Coast Aquifer. (Neches)	550	550	550	550	550	550
Recommended Strategy JAC-2 (ac-ft/year): Use of additional water from Gulf Coast Aquifer. (Sabine)	82	82	82	82	82	82

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
JAC-1: Use additional supply from Gulf Coast Aquifer	632	$1,369,957	$410,551	$650	$1.99

4C.1.8 Jefferson County. Water supply is largely provided by the Lower Neches Valley Authority with the exceptions of water taken by the City of Beaumont from both the Neches River and groundwater wells in Hardin County and wells for Bevil Oaks.

Mining. Current supply is from the Gulf Coast aquifer. Future demands can be met by use of additional groundwater from Gulf Coast aquifer.

Mining	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	0	0	-5	-9
Recommended Strategy JEM-1 (ac-ft/year): Use additional supply from Gulf Coast Aquifer					5	9

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
JEM-1: Use additional supply from Gulf Coast Aquifer	9	$103,083	$12,746	$1,416	$4.35

Steam-Electric. The projected demands for steam-electric power are based on several proposed facilities in Jefferson County that have been delayed or temporarily cancelled. It is anticipated that as the need for electric power increases, these facilities will be constructed. Presently there is no infrastructure to supply water for steam-electric power. The proposed strategy to meet this need is to use surface water supplies in the Neches River Basin. There are sufficient supplies to meet these needs, which could be supplied from LNVA sources or directly from the Neches River. The actual source of water will be negotiated when the facilities are constructed.

Jefferson County Steam-Electric Power	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	-13,426	-15,696	-18,464	-21,838	-25,951
Recommended Strategy JESE-1 (ac-ft/year): Use water from the Neches River		25,951	25,951	25,951	25,951	25,951

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
JESE-1: Use additional water from the Neches River	25,951	$13,647,296	$2,240,124	$92	$0.28

4C.1.9 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 study was completed in 1992 that evaluated a potential regional water system using water from Lake Naconiche. To provide water to Nacogdoches County-Other users and several rural WSCs, it is recommended to develop this source for water supply. A brief description of the proposed strategy is presented below.

Lake Naconiche Regional Water Supply System. Lake Naconiche is located in northeast Nacogdoches County on Naconiche Creek. It is permitted to store 9,072 acre-feet of water. To use water from Lake Naconiche for water supply, the County must seek a permit amendment for diversions for municipal use. According to the Neches WAM, the firm yield of the lake would be approximately 3,239 acre-feet per year. It is assumed that the regional water system would serve County-Other entities in Nacogdoches County (including Caro WSC, Lilbert-Looneyville, Libby and others), Appleby WSC, Lily Grove WSC and Swift WSC. At this time the primary sponsor of the system has not been confirmed. It could possibly be one of the entities served or a new water provider dedicated to the operation of this system.

The project is initially sized for 3 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. Overall unit costs are estimated at $5.17 per 1,000 gallons during amortization. After amortization, costs will decrease to $1.30 per 1,000 gallons. 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 by each user.

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Nac-1: Develop Lake Naconiche	1,700	$24,890,000	$2,866,000	$1,686	$5.17

D&M WSC. D&M WSC currently relies on groundwater from the Carrizo-Wilcox. The recommended strategy is to expand development of supplies from Carrizo-Wilcox.

D & M WSC	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	-21	-70	-182	-310
DM-1: Increase Supply from Carrizo-Wilcox			310	310	310	310

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
DM-1: Increase Supply from Carrizo-Wilcox	310	$492,348	$100,361	$324	$0.99

Swift WSC. Swift WSC obtains water from the Carrizo-Wilcox aquifer in Nacogdoches County. Its current production capacity is limited to 1.2 MGD. The recommended strategy for Swift WSC is to initially expand its groundwater use in the Carrizo-Wilcox aquifer, and then participate in the Lake Naconiche regional water supply system. The groundwater strategy is based on one well being constructed in 2010. The Lake Naconich strategy is discussed above. An alternate strategy would be for Swift WSC to contract with ANRA for water from Lake Columbia.

Swift	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	0	-64	-237	-427
SW-1: Increase supply from Carrizo-Wilcox	350	350	350	350	350	350
SW-2: Lake Naconiche regional system			400	400	400	400
Alternate SW-3: Obtain water from Lake Columbia via contract with ANRA		688	688	688	688	688

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
SW-1: Increase supply from Carrizo-Wilcox	350	$498,171	$107,277	$307	$0.94
SW-2: Lake Naconiche regional system	400	$5,856,500	$674,370	$1,686	$5.17
SW-3: Obtain treated water from Lake Columbia via contract with ANRA	688	$0.00	$784,649	$1,140	$3.50

Lilly Grove Special Utility District. Water supplies for Lilly Grove Special Utility District (SUD**)** are from the Carrizo-Wilcox. The available water supply for the Lilly Grove SUD is affected by the impacts of oil and gas mining in the area on the water quality of the SUD's wells. The recommended strategy to supply projected shortages is to participate in the Lake Naconiche regional water supply system. As an alternate strategy, Lily Grove could develop a new well field that is not impacted by water quality and can sufficiently meet its needs.

Lilly Grove SUD	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	0	0	-221	-463
LG-1: Lake Naconiche regional system					500	500
Alt: LG-2: Increase Supply from Carrizo-Wilcox					500	500

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
LG-1: Lake Naconiche regional system	500	$7,320,600	$842,940	$1,686	$5.17
Alt: LG-2: Increase Supply from Carrizo-Wilcox	500	$580,504	$134,877	$270	$0.83

Appleby WSC. Appleby WSC does not show a shortage over the planning period. However, it is located close to the proposed Lake Naconiche regional water supply system. It is recommended that Appleby WSC participate with this project at a level of 300 ac-ft per year. The proportional estimated costs are shown below. Actual costs may be less due to the close proximity to the lake and infrastructure needed to deliver the water.

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
APL-1: Lake Naconiche regional system	300	$4,392,350	$505,765	$1,686	$5.17

County-Other. It is recommended that County-other entities participate in the Lake Naconiche regional water supply project. The estimated share of the costs is shown below.

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
NaCo-1: Lake Naconiche regional system	500	$7,320,600	$843,000	$1,686	$5.17

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 sources may be required.

Nacogdoches County Livestock	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	-242	-559	-926	-1,347
NCL-1: Increase Supply from Carrizo-Wilcox			322	644	966	1,350

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
NCL-1: Increase Supply from Carrizo-Wilcox	1,350	$1,969,392	$315,594	$234	$0.72

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. To meet these demands, it is recommended to use water from Lake Columbia and/or run-of-the-river diversions from the Angelina River. It is assumed that ANRA would be the sponsor for this water. Alternatively, some or all of this demand could be met through supplies from LNVA.

Nacogdoches County Mining	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-2,495	-6,993	0	0	0	0
NCMI-1: Purchase water from ANRA (Lake Columbia or Angelina River)	2,500	7,000	0	0	0	0
Alternate NCMI-2: Purchase water from LNVA (Sam Rayburn)	2,500	7,000				

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
NCMI-1: Purchase water from ANRA (Lake Columbia or Angelina River)	7,000	$9,593,450	$2,574,000	$368	$1.13
Alternate NCMI-2: Purchase water from LNVA	7,000				

Steam-Electric. No current supply exists. There have been discussions with Houston County WCID 1 regarding providing water for a new biomass power generation facility in Nacogdoches County. In addition to this facility, another plant was planned for Nacogdoches County. This would be a much larger facility with greater demands for cooling water. For planning purposes it is recommended that the projected need for steam-electric power be met with water from Houston County Lake and Lake Columbia. It is assumed that each of these sources would supply separate generating facilities.

Nacogdoches County Steam-Electric	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-2,588	-190	-1,358	-2,783	-11,241	-13,358
NCS-1: Obtain raw water from Lake Columbia	0	5,000	5,000	5,000	13,400	13,400
NCS-2: Obtain raw water from Houston County Lake	0	340	340	340	340	340

Strategy	Contract Amount (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
NCS-1: Obtain raw water from Lake Columbia	13,358	$10,718,000	$4,225,000	$315	$0.97
NCS-2: Obtain raw water from Houston County Lake	340	$2,012,400	$263,000	$774	$2.37

4C.1.10 Newton County. Most of the WUGs in Newton County use groundwater from the Gulf Coast aquifer. According to the groundwater availability estimates, there are 29,000 ac-ft per year of water available from the Gulf Coast aquifer in Newton County. Currently about 5,400 ac-ft per year is being used. 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.

Manufacturing. Current manufacturing supply is from the Gulf Coast aquifer and a small run-of-the-river source. The projected demands for manufacturing are expected to double by 2060. The recommended strategy is to expand groundwater use. An alternative strategy would be to purchase surface water from SRA.

Newton County Manufacturing	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-149	-264	-370	-477	-574	-667
Recommended Strategy NWM-: Additional supply from Gulf Coast Aquifer	400	400	400	800	800	800
Alternative Strategy NWM-2: Purchase water from SRA	700	700	700	700	700	700

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
NWM-1: Additional Groundwater Well	800	$891,529	$203,045	$254	$0.78
NWM-2: Purchase water from SRA	700	$1,389,500	$199,600	$285	$0.87

Steam-Electric. The SRA supplies surface water to two facilities in Newton County. Current supplies are sufficient to need the needs for power generation through 2020. By 2030, there is a projected shortage due to expected increases in power demands. This shortage is estimated to be over 13,000 ac-ft per year by 2060. The recommended strategy to meet this demand is to purchase additional surface water from SRA.

Newton County Steam Electric	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	-2,343	-5,257	-8,808	-13,138
Alternative Strategy NWP-1: Purchase water from SRA	0	0	15,000	15,000	15,000	15,000

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
NWP-1: Purchase water from SRA	15,000	$12,515,350	$3,991,000	$266	$0.82

4C.1.11 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 for Orange is estimated at 20,000 ac-ft per year. Substantial further development of groundwater in the county could result in subsidence and salt water intrusion into the aquifer. Current groundwater use in Orange County is nearly 20,000 ac-ft per year. Because the long-term sustainable availability of the aquifer has been reached, it is recommended that any new large-scale water needs be met with surface water. It is recommended that those entities currently on 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, which is located in Orange County, has a conveyance capacity of 346,000 ac-ft per year. SRA has water rights of 147,100 ac-ft per year associated with the canal system (100,400 ac-ft per year for municipal and industrial and 46,700 ac-ft per year for irrigation). Currently, SRA has demands of approximately 75,000 ac-ft per year in the Canal System. This leaves approximately 72,000 ac-ft per year available to be contracted. 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 at the canal location.

County-Other. This category includes numerous small water supply entities. Their current supply is from the Gulf Coast aquifer. The Neches portion of the county shows a maximum shortage of 132 ac-ft per year in 2010, while the Sabine portion shows a corresponding surplus of 44 ac-ft per year. Since this is such a relatively small amount of shortage, it is assumed that it can be taken from the Gulf Coast aquifer with few problems. It is assumed that only four entities will need a small amount of additional supply and will need one well each. The cost estimate reflects the development of four wells.

County-Other (Neches Basin)	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-132	-93	-53	-7	0	-6
Recommended Strategy ORC-1 (ac-ft/year): Use additional supply from Gulf Coast Aquifer	140	140	140	140	140	140

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
ORC-1: Additional Wells	140	$432,222	$57,756	$413	$1.27

Mauriceville WSC. Mauriceville WSC serves customers in Orange, Jasper and Newton Counties. Their current supply is from wells in Orange County in the Gulf Coast aquifer. Since groundwater is fully allocated in Orange County and the WSC service area extends beyond Orange County, it is proposed that new wells be drilled in nearby Jasper County to meet the projected shortages.

Mauriceville WSC	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	-37	-81	-96	-158	-202
Recommended Strategy ORMa-1 : New well in Jasper County in Gulf Coast Aquifer		203	203	203	203	203

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
ORMa-1: New well in Jasper County	203	$550,848	$106,749	$526	$1.61

Manufacturing. Current supply is from the Gulf Coast aquifer, the Sabine River (SRA Canal), and the Neches River. Additional water is needed from 2010-2060. There is a shortage in the Sabine portion of the county and a surplus from the Neches Basin portion of the county. This surplus cannot fully meet the projected needs in the county. By year 2010, new supplies must be made available. The total 2060 unmet demand in the Sabine Basin is 34,127 ac-ft per year. The net shortage for both basins is 31,536 ac-ft per year.

To meet these shortages, it is recommended that additional supply from SRA's canal system and Toledo Bend Reservoir be used. It is assumed that the future facilities will be located along the SRA Canal and will require minimal transmission facilities. Water from Toledo Bend could be released downstream for diversion at the facilities. The only cost presented here is the cost of raw water purchase. It is assumed that no treatment of the water will be necessary.

Orange County Manufacturing	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	-5,006	-10,855	-16,686	-21,863	-27,686
Recommended Strategy OR-1SRA (ac-ft/year): Raw surface water supply from SRA Canal.	5,000	15,000	20,000	25,000	25,000	28,000
Recommended Strategy ORM-2 (ac-ft/year): Raw water from Toledo Bend Reservoir	-	-	-	-	5,000	8,000

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
OR-1SRA Surface Water Contract	36,000	$0.00	$2,932,700	$ 81.50	$ 0.25

4C.1.12 Panola County. Panola County has only one entity with projected water shortages. Generally, demands in Panola County are expected to increase slightly and can be met through existing supplies. Both groundwater from the Carrizo-Wilcox and surface water supplies, mostly from Lake Murvaul, are used in Panola County. The Carrizo-Wilcox aquifer has a long-term availability of approximately 5,800 ac-ft per year 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.

Manufacturing. The City of Carthage currently provides approximately 75 percent of the manufacturing water needs in Panola County. It was assumed that Carthage would continue to provide this level of supply though the planning period. Based on the projected demands, shortages for manufacturing in Panola County are expected beginning in 2010. It is recommended that this shortage be met by purchasing additional water from the City of Carthage.

Panola County Manufacturing	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-96	-116	-132	-147	-160	-187
Purchase water from Carthage	96	116	132	147	160	187

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/acre-feet)	Unit Cost ($/1000 gal)
Strategy : Purchase Water from Carthage	187	$0	$182,802	$978	$3.00

4C.1.13 Polk County. Polk County is partially located in the ETRWPA and partially in Region H. The county uses water from the Gulf Coast aquifer and local surface water and groundwater supplies. Based on the groundwater availability estimates for this plan, the Gulf Coast aquifer is sufficient to provide future demands.

County-Other. Current supplies are from the Gulf Coast aquifer and local groundwater sources. The selected strategy is to obtain additional supply from the Gulf Coast aquifer.

Polk County-Other	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-208	-417	-578	-681	-745	-828
Recommended Strategy POC-1A (ac-ft/year): Use additional supply from Gulf Coast Aquifer (Phases I-IV).	208	417	624	832	832	832

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 Gal.)
POC-1: Use additional supply from Gulf Coast Aquifer. Phase I-IV	208	$747,785	$75,513	$363	$1.11
Total	**832**	**$2,991,140**			

Manufacturing. Supplies are from the Gulf Coast aquifer and Other Undifferentiated Groundwater Supply. The selected strategy is to obtain additional supply from the Gulf Coast aquifer.

Polk County Manufacturing	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	-64	-164	-269	-365	-449
Recommended Strategy POM-1 (ac-ft/year): Expand existing supplies (Phases I and II)		225	225	450	450	450

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
POM-1: Expand existing supplies Phase I-II	225	$290,672	$32,678	$884	$0.45
Total	**450**	**$581,344**			

4C.1.14 Rusk County. Rusk County uses both surface water and groundwater to meet the water needs in the county. There are projected shortages for mining and steam-electric power use in Rusk County. The Carrizo-Wilcox groundwater aquifer is sufficient to supply the mining needs of Rusk County, and it is assumed that steam-electric power demands will continue to be met with surface water.

Mining. Current supply is groundwater and surface water. It is recommended that additional groundwater from Carrizo-Wilcox aquifer be used to meet the projected shortage.

Rusk County Mining	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	0	-30	-60	-88
Recommended Strategy RUL-1 (ac-ft/year): Increase supply from Carrizo-Wilcox	0	0	0	158	158	158

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
RUL-1: Increase supply from Carrizo-Wilcox	158	$241,600	$27,550	$174	$0.54

Steam-Electric. The demands for steam-electric power are based on projected demands from two existing power plants that have existing supplies: Luminant’s Martin Lake and Teneska Gateway facilities. Martin Lake is shown to have a firm yield of 25,000 ac-ft per year. The Teneska Gateway facility uses water from Toledo Bend and has a contract for 17,929 ac-ft per year. Based on the projected demands for steam-electric power in Rusk County, there is a projected shortage of 9,900 ac-ft per year in 2060. It is uncertain whether this demand will be placed on an existing facility or a new facility. For planning purposes, it is assumed that 1,500 ac-ft per year of this demand will be at the Tenaska facility and can be met through additional supplies from SRA with little to no infrastructure improvements. It is assumed that the additional demand for water will occur through a new facility, which does not have a specified location. As such, this demand could be met through supplies from Lake Columbia. Water could be released from Lake Columbia and diverted from the Angelina River at the location of use.

Rusk County Steam-Electric	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	0	0	-1,501	-9,912
Recommended Strategy RUSE-1 (ac-ft/year): Supply from SRA	0	0	0	0	1,501	1,500
Strategy RUSE-2: Supply from Lake Columbia					0	8,500

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
RUSE-1: Supply from SRA, Toledo Bend Reservoir	1,500	$1,318,500	$305,000	$203	$0.62
RUSE-2: Supply from ANRA (Lake Columbia)	8,500	$8,640,450	$2,396,000	$282	$0.86

4C.1.15 Sabine County. Water supply in Sabine County is comprised of water from the Carrizo-Wilcox aquifer, Sparta, Yegua-Jackson and other minor aquifers, Toledo Bend Reservoir, and local surface supplies. The total available supply from groundwater in Sabine County is 9,400 ac-ft per year. Of this amount, about 1,500 ac-ft per year is currently being used. This leaves considerable groundwater to meet projected shortages. In addition, Toledo Bend Reservoir, which is located along the eastern border of Sabine County, has available supply (through contracts with SRA).

County-Other. Sabine County-Other includes users in both the Sabine and Neches River basins. Supply is generally from groundwater with some surface water provided from the SRA in the Sabine Basin. Considering historical use there is a surplus of water in the Sabine Basin and a shortage in the Neches Basin. The maximum shortage in the Neches Basin is 193 ac-ft per year in year 2060. To meet this shortage it is recommended that additional wells be drilled in the Carrizo-Wilcox in the Neches Basin. Since there may be several users, the costs for the strategy were estimated based on two wells producing 50 ac-ft per year each. It was assumed that no additional transmission is needed since the demands remain fairly steady over the planning period. As an alternative, local users could purchase treated water from the City of Hemphill. For this strategy, a 5-mile pipeline was assumed from Hemphill.

Sabine County-Other	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-3	-12	-18	-24	-31	-43
Recommended Strategy SBC-1 (ac-ft/year): Increase supply from Carrizo-Wilcox (Neches Basin)	32	32	32	64	64	64
Alternative Strategy SBC-2: Purchase water from Hemphill	100	100	100	100	100	100

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
SBC-1: Additional Groundwater Phase I-II	64	$328,840	$35,300	$552	$1.69
SBC-2: Purchase water from Hemphill	100	$ 1,021,000	$ 148,200	$1,482	$4.55

Livestock. Supplies for livestock are from both groundwater (Carrizo-Wilcox, Sparta, and local aquifers) and local surface water (stock ponds). To meet the projected shortage by 2060 of 325 ac-ft per year, it is recommended that use from the existing supplies be expanded.

Sabine County Livestock	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-37	-80	-129	-186	-252	-324
Recommended Strategy SBL-1 (ac-ft/year): Expand Carrizo-Wilcox supplies (Sabine)	50	50	100	100	100	100
Recommended Strategy SBL-1 (ac-ft/year): Expand current surface water supplies (Neches and Sabine)	50	100	107	200	210	300

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
SBL-1: Expand Carrizo-Wilcox supplies (Sabine)	100	$226,430	$42,707	$427	$1.31
SBL-2: Stock Ponds	300	$562,700	$49,100	$164	$0.50

4C.1.16 San Augustine County. San Augustine County lies within both the Neches and Sabine River Basins. Current water supplies for the county include groundwater from the Carrizo-Wilcox, Sparta, and Yegua-Jackson, surface water from San Augustine Lake and other small local supplies. Available supplies to meet projected shortages include 1,400 ac-ft per year of unallocated groundwater and a small amount of surface water from San Augustine.

Irrigation. Current water supply for irrigation in San Augustine County is exclusively from groundwater. There are no surface water rights associated with irrigation. Pumpage data by basin appears to show that water pumped from the Sabine Basin portion of the County is being used to meet needs in the Neches portion of the County. It is assumed this will continue. Even with this use of water, there is a shortage for irrigation in the Neches Basin. It is recommended additional groundwater from the Carrizo-Wilcox be used to meet irrigation needs in the Neches Basin.

San Augustine County Irrigation	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-100	-100	-100	-100	-100	-100
Recommended Strategy SAI-1 (ac-ft/year): Obtain water from Carrizo-Wilcox aquifer	100	100	100	100	100	100

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
SAI-1: Carrizo-Wilcox aquifer	100	$224,690	$43,639	$485	$1.49

Livestock. Supplies for livestock are from both groundwater (Carrizo-Wilcox, Sparta and Yegua-Jackson) and local surface water stock ponds. Demands are projected to increase by about one third over the planning period. It is recommended that these shortages (up to 621 ac-ft per year by 2060) be met with increases in both the local groundwater and surface water supplies.

San Augustine County Livestock	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-91	-169	-260	-365	-487	-621
Recommended Strategy SAL-1 (ac-ft/year): Increase local surface water supplies (stock ponds) – Neches Basin		50	100	200	200	300
Recommended Strategy SAL-2 (ac-ft/year): Increase groundwater water supplies from Carrizo-Wilcox aquifer - Sabine Basin	50	50	50	100	100	100
Recommended Strategy SAL-3 (ac-ft/year): Increase groundwater water supplies from Carrizo-Wilcox aquifer- Neches Basin	100	100	200	200	300	300

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
SAL-1: Stock ponds	300	$562,700	$49,100	$164	$0.50
SAL-2: Carrizo-Wilcox (Sabine)	100	$ 189,570	$ 41,168	$528	$0.84
SAL-3 Carrizo-Wilcox (Neches)	300	$ 379,140	$ 82,336	$ 528	$ 0.840

Manufacturing. Manufacturing shortages in San Augustine County are estimated at 2 ac-ft per year by 2060. Since this shortage is below the 5 ac-ft per year threshold for developing strategies, no strategies were developed for San Augustine Manufacturing. It is likely that this shortage can be met through existing supplies.

Mining. There are little to no current mining activities in San Augustine County; however, with the increased interest in natural gas exploration in East Texas, there are new projected water demands for mining in San Augustine County. To meet these demands, it is recommended to use water from Sam Rayburn Reservoir or run-of-the-river diversions from the Attoyac Bayou. It is assumed that ANRA would be the sponsor for the run-of-the river water. This would require a new diversion right.

San Augustine County Mining	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-1,500	-7,000	0	0	0	0
SAMi-1: Purchase water from ANRA (Attoyac Bayou)	500	500	0	0	0	0
SAMi-2: Purchase water from LNVA (Sam Rayburn)	1,000	6,500	0	0	0	0

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
SAMi-1: Purchase water from ANRA (Angelina River)	500	$2,627,850	$363,000	$726	$2.23
SAMi-2: Purchase water from LNVA (Sam Rayburn)	6,500	$8,212,450	$1,993,000	$307	$0.94

4C.1.17 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 2060. 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 per year. The Carrizo-Wilcox aquifer has a long-term availability of 12,750 ac-ft per year, and its estimated current use is approximately 3,700 ac-ft per year. There is groundwater available for development, and there is considerable supply available from Toledo Bend Reservoir, which would require infrastructure development to the areas with needs. 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.

County –Other. Water users that fall into the County-Other category receive water from the Carrizo-Wilcox aquifer, and sales from Center, Joaquin, SRA, and Shelby County FWSD #1. Based on current use and supply location, there is a surplus of water in the Neches Basin and a shortage in the Sabine Basin. The shortage in the Sabine Basin is 259 ac-ft per year in 2010 increasing to 478 ac-ft per year by 2060. These shortages will be met through expanded use of groundwater from the Carrizo-Wilcox and expanded use from Toledo Bend Reservoir through sales from SRA.

Shelby County-Other	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year) (Neches and Sabine Basins)	-126	-190	-244	-253	-288	-344
Recommended Strategy SHCo-1: Expand groundwater from the Carrizo-Wilcox (Sabine)	100	200	300	300	350	350
Recommended Strategy SHCo-2 (ac-ft/year): Purchase additional water from Center	50	50	50	50	50	50
Recommended Strategy SHCo-3 (ac-ft/year): Purchase water from SRA (Toledo Bend Reservoir)	150	150	150	150	150	150

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
SHCo-1: Carrizo-Wilcox wells	350	$2,278,400	$275,097	$786	$2.41
SHCo-2: Purchase from Center	50	$0	$48,878	$978	$3.00
SHCo-3: Purchase from SRA	150	$3,024,150	$347,400	$2,316	$7.10

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. Some individual livestock water users may be able to drill individual wells or develop local stock ponds, but any large-scale user should obtain surface water from Toledo Bend Reservoir through a contract with SRA.

Shelby County Livestock	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-777	-1,707	-2,841	-4,222	-5,907	-7,961
Recommended Strategy SHL-1 (ac-ft/year): Increase Groundwater Supplies (Sabine Basin)	1,000	2,000	2,000	2,000	2,000	2,000
Recommended Strategy SHL-2 (ac-ft/year): Increase Groundwater Supplies (Neches Basin)	500	500	1,000	1,000	1,500	1,500
Recommended Strategy SHL-3 (ac-ft/year): Increase Local Supplies (Sabine Basin)			500	500	500	500
Long Term Scenario SHL-4 (ac-ft/year): Supplies from Toledo Bend (Sabine Basin)				4,000	4,000	4,000

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
SHL-1: Additional Groundwater Wells (Sabine Basin)	2,000	$1,387,600	$213,000	$107	$0.33
SHL-2: Additional groundwater wells (Neches Basin)	1,500	$1,040,800	$159,700	$106	$0.33
SHL-3: Increase local supplies	500	$689,600	$60,100	$120	$0.37
SHL-4: Purchase Raw Water from SRA (Toledo Bend)	4,000	$4,763,200	$1,177,000	$294	$0.90

Manufacturing. Current supply for manufacturing is from the Carrizo-Wilcox aquifer and sales from the City of Center. There is also a small amount of reuse water being used by local manufacturers. The majority of the use is from Center Lake and Pinkston Reservoir by manufacturing customers of Center, the largest of which is Tyson Foods. The projected shortage is associated with increased demands above the amount assumed to be supplied by the City of Center. This shortage can be met through existing supplies for the City of Center. It is recommended that any new manufacturing facility purchase water from the City of Center. No new infrastructure was assumed for cost purposes, but new industries may require additional transmission facilities, depending on their location.

Shelby County Manufacturing	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	0	0	-5	-12
Recommended Strategy SHM-1 (ac-ft/year): Purchase water from City of Center	0	0	0	0	5	12

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
SHM-1: Purchase surface water from City of Center	12	$0	$11,731	$978	$3.00

Mining. There are little to no current mining activities in Shelby County; however, with the increased interest in natural gas exploration in East Texas, there are new projected water demands for mining. To meet these demands, it is recommended to use water from Toledo Bend Reservoir and/or run-of-the-river diversions from the Attoyac Bayou. It is assumed that ANRA would be the sponsor for water from Attoyac Bayou and SRA would be the sponsor for water from Toledo Bend reservoir. Water from Attoyac Bayou would require a new diversion right.

Shelby County Mining	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-500	-1,500	0	0	0	0
SHMi-1: Purchase water from ANRA (Attoyac Bayou)	250	250	0	0	0	0
SHMi-2: Purchase water from SRA (Toledo Bend)	250	1,250	0	0	0	0

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
SHMi-1: Purchase water from ANRA (Attoyac Bayou)	250	$1,543,400	$209,000	$836	$2.56
SHMi-2: Purchase water from SRA (Toledo Bend)	1,250	$3,847,950	$619,000	$495	$1.52

4C.1.18 Smith County. Smith County is located partially in the ETRWPA and partially in Region D. Much of the water in Smith County in the ETRWPA comes from sources for the City of Tyler, with the remainder coming from groundwater. 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 supplies is from the Carrizo-Wilcox aquifer.

The groundwater in Smith County is heavily used by current users. The Carrizo-Wilcox aquifer, which is the reliable groundwater source is nearly fully allocated to water users (175 ac-ft per year of water that is not allocated to current users). There is water available from the Queen City aquifer, but water quality concerns limit its potential use. Due to the complexity of the available sources, the most likely sources for municipal water needs include surface water supplies from the City of Tyler and voluntary transfers from other users. 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 200 ac-ft per year by 2060. Based on its proximity to other sources is recommended that Bullard expand its groundwater supplies in the Carrizo-Wilcox aquifer.

Bullard	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	-13	-42	-71	-124	-195
Recommended Strategy BU-1 (ac-ft/year): Increase supply from Carrizo-Wilcox	0	100	100	100	100	100
Recommended Strategy BU-2 (ac-ft/year): Increase supply from Carrizo-Wilcox	0	0	0	0	100	100
BU-3: Water Conservation		3	4	5	6	8

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Strategy BU-1A: Increase supply from Carrizo-Wilcox	200	$305,674	$51,736	$517	$1.59
BU-3: Water Conservation	8		$2,388	$299	$0.92

Community Water Company. Community Water Company serves multiple counties in Regions C and D and Smith County in the ETRWPA. Water supplies to Smith County are from the Carrizo-Wilcox aquifer. Due to competition for this source, it is recommended that Community Water Company purchase water from a local provider. For planning purposes, it is assumed that the City of Tyler would supply Community Water Company.

Community Water Co.	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-37	-88	-111	-132	-171	-227
Recommended StrategyCWI-1A (ac-ft/year): Purchase water from the City of Tyler or other local water provider.	121	121	121	227	227	227

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Strategy CW-1A: Purchase water from the City of Tyler or other local water provider.	227	$1,640,776	$395,561	$1,743	$5.35

Jackson WSC. Current supplies for Jackson WSC are from Carrizo-Wilcox. Jackson WSC has a contract with ANRA for water from Lake Columbia. It is recommended that Jackson WSC participate with the ANRA treated water system project to meet its projected shortage (see Section 4C.21 for discussion of ANRA's strategies).

Jackson WSC	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	-38	-83	-118	-157
Recommended Strategy JA-1 (ac-ft/year): Purchase treated water from ANRA (Lake Columbia)	0	600	600	600	600	600

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Strategy JA-1 (ac-ft/year): Purchase water from ANRA (Lake Columbia)	600	(1)	$741,000	$1,235	$3.50

Lindale Rural WSC. Lindale Rural WSC is located in both Region D and the ETRWPA. The WSC obtains most of its water from the Carrizo-Wilcox aquifer. With the projected growth, Lindale WSC is projected to have a small shortage in 2060. This shortage can likely be met through additional groundwater from the Carrizo-Wilcox aquifer. Pending availability, some water may come from wells located in Region D. For planning purposes, it is assumed that the additional supply can be met with water in the ETRWPA.

Lindale Rural WSC	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	0	0	0	-73
Recommended Strategy LIR-1 (ac-ft/year): Increase supply from Carrizo-Wilcox	0	0	0	0	0	80
LIR-2: Water Conservation	0	0	5	7	9	12

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Strategy LIR-1: Increase supply from Carrizo-Wilcox	80	$347,259	$65,938	$824	$2.53
LIR-2: Water Conservation	12		$3,582	$299	$0.92

Whitehouse. Whitehouse has shortages which are expected to increase over the planning period from 27 acre-feet in 2010 to 224 acre-feet in 2060. The City of Whitehouse is a participant in the Lake Columbia project. It is recommended that the City of Whitehouse meet this shortage with the purchase of treated water from ANRA in 2020. In the interim, it is recommended that Whitehouse increase the amount of water it purchases from the City of Tyler.

Whitehouse	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-27	-54	-79	-105	-155	-224
Strategy WH-1: Purchase water from ANRA	0	1,200	1,200	1,200	1,200	1,200
Strategy WH-2: Purchase water from Tyler	27					

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Strategy WH-1: Purchase Water from ANRA	1,200	(1)	$1,368,000	$1,140	$3.50
Strategy WH-2: Purchase additional water from Tyler	27	$0			$3.00

Irrigation. There is little traditional irrigation water use in Smith County in the ETRWPA. Most of the irrigation demand is associated with the irrigation of golf courses, which is currently supplied by the City of Tyler and UNRMWA. Considering the unknown locations of the increased demands, it is recommended that the projected shortages be met by water from the Queen City aquifer. Alternatively, surface water could be used to meet these demands through increased sales from Tyler and/or UNRMWA.

Smith County Irrigation	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-6	-36	-68	-100	-133	-168
Recommended Strategy SMI-1 (ac-ft/year): Increase supply from the Queen City	40	40	80	120	168	168

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Strategy SMI-1: Increase supply from Queen City	168	$357,794	$39,333	$234	$0.72

Manufacturing. Manufacturing is expected to have shortages beginning in 2030 at 5 ac-ft per year and increasing to 294 ac-ft per year in 2060. It is recommended that the manufacturing shortage be met through the purchase of additional supplies from the City of Tyler.

Smith County Manufacturing	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	-6	-101	-182	-295
Strategy SMMa-1 (ac-ft/year): Purchase water from City of Tyler	0	0	6	101	183	295

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Strategy SMMa-1 (ac-ft/year): Purchase water from City of Tyler	295	$1,476,152	$438,811	$1,493	$4.58

Mining. The mining water demands in Smith County are based on historical water usage that appears to be no longer in place. The TWDB currently reports only a small amount of groundwater use in Smith County for mining purposes. As a result the projected demands do not accurately reflect the current usage. The TWDB has commissioned a study on water use for mining purposes across the State. This study should be completed for the development of the projected water demands for the 2016 water plan. Until such time as new mining demands are developed, it is assumed that any new mining water needs will be met from groundwater from the Queen City aquifer.

Smith County Mining	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	-47	-126	-159	-215	-255	-288
Recommended Strategy SMM-1 (ac-ft/year): Increase supply from the Queen City.	47	141	188	235	282	329

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Strategy SMM-1: Increase supply from Queen City	329	$655,416	$72,108	$219	$0.67

4C.1.19 Trinity County.

County-Other. Small water suppliers in Trinity County rely on the Yegua-Jackson, the Gulf Coast aquifer and other undifferentiated groundwater sources. The recommended strategy is to expand groundwater supplies. For planning purposes, it is assumed that this supply will come from the Yegua-Jackson aquifer.

Trinity County-Other	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	0	0	-9	-32	-57
TRC-1: Increase Supply from Yegua-Jackson				60	60	60

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
TRC-1: Increase Supply from Yegua-Jackson	60	$249,851	$36,990	$616	$1.89

4C.1.20 Tyler County.

County-Other. All of the municipal water supply in Tyler County is from the Gulf Coast aquifer. Increases in projected County-other demands result in a shortage beginning in 2020. The recommended strategy is to continue use of groundwater from Gulf Coast aquifer. The strategy assumes that four separate groundwater wells will be constructed to meet the needs of various entities.

Tyler County-Other	2010	2020	2030	2040	2050	2060
Supply(+)-Demand(-) (ac-ft per year)	0	-142	-239	-251	-232	-232
Recommended Strategy TYC-1 (ac-ft/year): Increase supply from Gulf Coast Aquifer.	0	251	251	251	251	251

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
TYC-1: Increase supply from Gulf Coast Aquifer.	251	$366,241	$49,441	$197	$0.60

Woodville. The City of Woodville obtains water from the Gulf Coast aquifer in Tyler. There is sufficient supply to meet the City's needs. However, the City also provides water to two prison facilities. Including these demands and considering the TCEQ's requirements to meet a maximum day demand equivalent to 0.6 gpm per connection, the City of Woodville will need a new water well. It is assumed that the City will drill one new well within one mile of its existing transmission system or the distribution point.

Strategy	Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
WDV-1: Increase supply from Gulf Coast Aquifer.	300	$511,400	$72,700	$242	$0.74

4C.2 Wholesale Water Providers with Needs

This section provides discussions for wholesale water providers (WWP) located in the ETRWPA that meet one of the following criteria:

- Has a projected shortage in supplies based on demands of current customers and current reliable supplies. These WWPs include ANRA, Athens MWA, City of Lufkin, Houston County WCID, SRA (Upper Basin) and the UNRMWA.
- Has supply sources in the ETRWPA that are listed as WMS for WUGs outside the Region. Both the UNRMWA and the SRA are included under this criterion.
- Are currently pursuing WMS to increase the reliability and/or distribution of their supplies. These include the cities of Nacogdoches, Tyler and Jacksonville, SRA and the LNVA.

4C.2.1 Angelina and Neches River Authority. ANRA is the sponsor for the Lake Columbia project on Mud Creek in Cherokee and Rusk Counties. ANRA currently has contracted customers for 63 percent of the 85,507 ac-ft per year permit of the proposed Lake Columbia reservoir. In addition, ANRA has been approached to supply water for mining purposes associated with the exploration of the Haynesville/ Bossier Shale. Some of this demand could be met through Lake Columbia, while some may be met with run-of-the-river diversions. The City of Dallas is also considering Lake Columbia as an alternative strategy.

Lake Columbia has a water right 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. As required, public and agency comments on the draft EIS are being received until March 30, 2010. Both ANRA and participating entities will share in the costs associated with the Lake Columbia water management strategy. Construction costs are divided into three separate categories: reservoir, water treatment plant and transmission system. For reservoir construction, unit costs are based on the WAM Run 3 yield estimate of 75,700 ac-ft per year. Costs for water treatment are shared among currently contracted entities that are assumed to buy treated water from ANRA. These include most of the municipal water users in Cherokee, Rusk and Smith Counties. The cities of Nacogdoches, Jacksonville, and Rusk and Temple Inland were assumed to purchase raw water and develop their own treatment facilities. Transmission system costs are shared among the contracted suppliers that receive treated water. The water suppliers currently under contract with ANRA are listed with the current participation percentage in the table below.

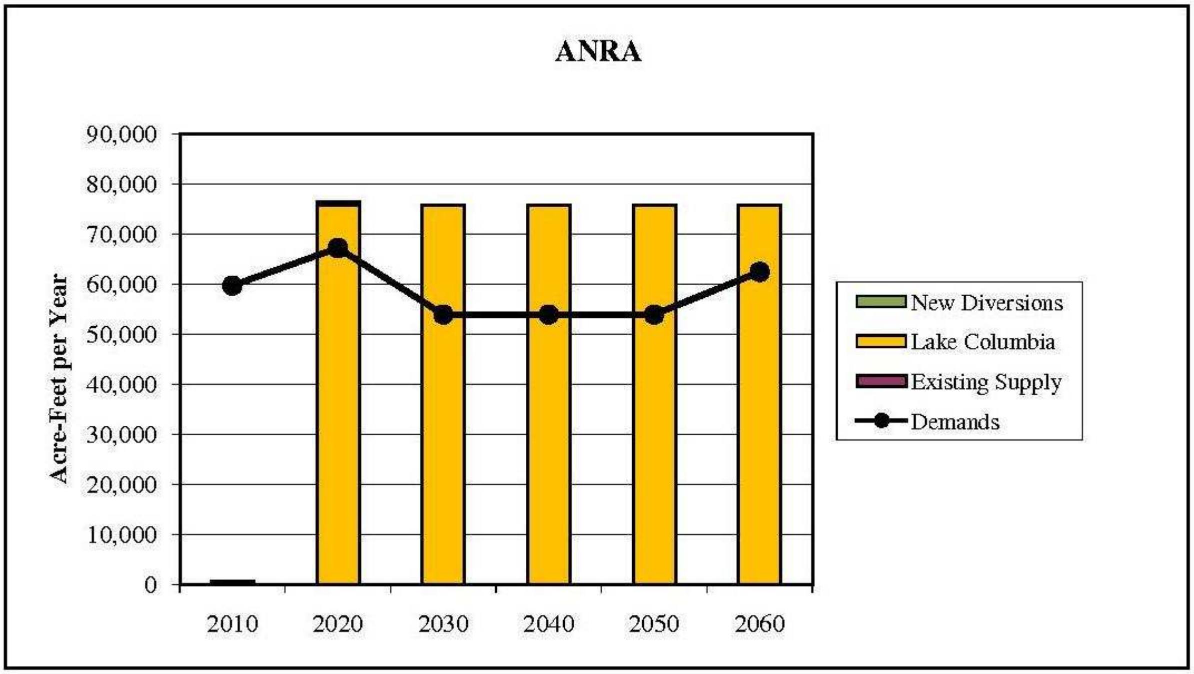
Current Participants in Lake Columbia

Recipient	County	Basin	Percent Participation	Contract Amount (ac-ft per year)
Temple Inland	Angelina	Neches	10.0%	8,551
Afton Grove WSC, Stryker Lake WSC, Cherokee County	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
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
City of Alto	Cherokee	Neches	0.5%	428

A comparison of the water supplies versus the demands and the recommended strategies to be implemented follows. A summary of the strategy costs is also provided.

Water Management Strategies

	2010	2020	2030	2040	2050	2060
Existing Supplies						
Jasper Aquifer	60	65	70	70	70	70
Water Management Strategies						
Lake Columbia	0	75,700	75,700	75,700	75,700	75,700
New Run-of River Diversions	750	750	0	0	0	0
Total Supplies from Strategies	0	76,450	75,700	75,700	75,700	75,700
Total Supplies	**810**	**77,265**	**75,770**	**75,770**	**75,770**	**75,770**
Demands (ac-ft per year)						
Demand (Current Customers)	53,929	53,934	53,939	53,939	53,939	53,939
Demand (Potential Future)	5,750	13,250	0	0	0	8,500
Potential Demand (Total)	59,679	67,184	53,939	53,939	53,939	62,439
Surplus or (Shortage)	**-58,869**	**10,081**	**21,831**	**21,831**	**21,831**	**13,331**



Strategy	Yield (ac-ft per year)	Capital cost	Annual Cost	Unit Cost ($/AF)	Unit Cost ($/1000 gal)
New River Diversions	750	$500,000	$0	$0	$0
Lake Columbia Reservoir	75,700	$231,865,000	$16,280,500	$215	$0.66
ANRA Treatment Plant and Distribution System	5,100	$35,127,250	$5,868,950	$1,151	$3.53

4C.2.2 Athens MWA. Athens MWA has a water right to divert 8,500 ac-ft per year from Lake Athens. Of this amount, 5,477 ac-ft per year can be used to meet projected municipal and manufacturing demands of the City of Athens. There is also a projected local demand of 155 ac-ft per year for lawn irrigation around the lake. This demand is expected to increase to 185 ac-ft per year by 2060. The Athens Fish Hatchery, located at the lake, has a contract with Athens MWA to divert 3,023 ac-ft per year from Lake Athens to serve the hatchery. Currently, approximately 95 percent of the diverted water is returned to Lake Athens; however, the Fish Hatchery is under no contractual obligations to continue this practice. Due to operational constraints of the hatchery's intake structure and the assumption that the hatchery's diversions will not be returned to the lake, the operational yield of Lake Athens is 2,900 ac-ft per year. The total projected shortages associated with Lake Athens for current customers are 5,521 ac-ft per year by 2060.

Recognizing the limitations of its existing supplies, Athens MWA has received a reuse permit that allows the City of Athens to discharge its wastewater effluent to Lake Athens, which can then be rediverted for use. The reuse permit is for 2,677 ac-ft per year. However, a recent study by Region C shows that this strategy is less economically feasible than other alternatives. At this time, Athens MWA and the City of Athens are not pursuing reuse to Lake Athens.

Other strategies considered include:

- Conservation for the city of Athens
- Continued reuse of diverted water by the Athens Fish Hatchery
- Develop groundwater from the Carrizo-Wilcox aquifer near Lake Athens and transport to Athens water treatment plant
- Temporary pumping facility for the fish hatchery to utilize water below its existing intake
- Water from Forest Grove Reservoir

Based on projected demands on Athens MWA, additional water treatment will be needed by 2040. The total treatment capacity needed by 2060 is estimated at 11 MGD. Existing treatment capacity is 6 MGD, with a 7.5 MGD treated water pipeline to the city of Athens.

With these considerations, it is recommended that Athens MWA implement the following strategies:

- Indirect reuse to Lake Athens from fish hatchery
- New groundwater from the Carrizo-Wilcox aquifer
- Water from Forest Grove Reservoir
- Construct new 4 MGD treatment plant near City of Athens, with a 4 MGD expansion in 2060.

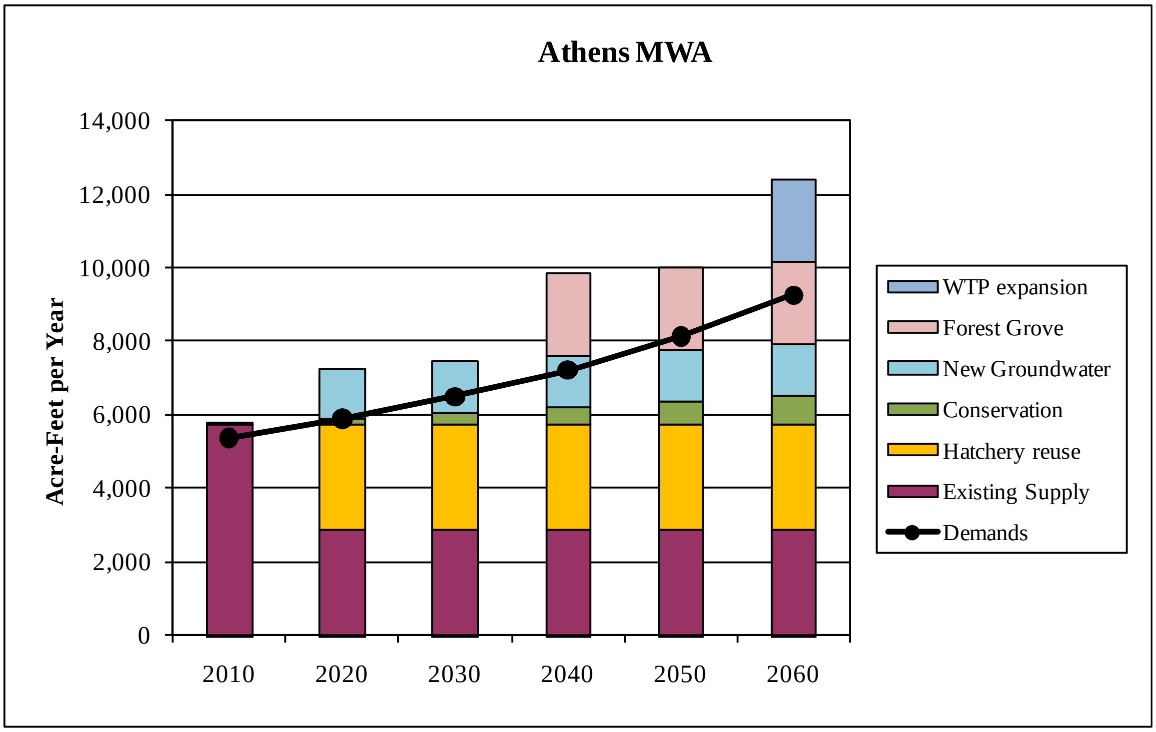
Indirect Reuse to Lake Athens from Fish Hatchery. To assure adequate supplies for the fish hatchery and other uses, Athens MWA should work with the fish hatchery to assure that the hatchery continues to return diverted water to Lake Athens for subsequent reuse. For purposes of this plan, it is assumed that 95 percent of the contracted water will be returned. This equates to 2,872 ac-ft per year of additional supply.

New Groundwater. Athens MWA is currently pursuing developing groundwater on property near Lake Athens. It is anticipated that four new wells would be drilled to provide a total of 2.5 mgd of groundwater supply. The water would be transported by pipeline to a storage facility near the existing city of Athens water treatment plant for subsequent distribution.

Forest Grove Reservoir and New Treatment Plant. This strategy assumes that up to 4,500 ac-ft per year would be diverted from Forest Grove Reservoir. This water would be treated at a new water treatment plant. The water treatment plant will be constructed for 4 mgd initially, supplying 2,240 ac-ft per year (2040), and be expanded to supply and additional 2,240 acre-feet per year by 2060. This strategy requires a change in permitted use from the lake and an agreement with Luminant to acquire the Forest Grove water rights.

In addition, conservation savings identified for the city of Athens will decrease the demands on the lake and Athens MWA. A summary of the amounts and timing of the proposed strategies is presented in the following table and figure.

	2010	2020	2030	2040	2050	2060
Existing Supplies						
Lake Athens	2,900	2,900	2,900	2,900	2,900	2,900
Fish Hatchery Reuse	2,872	0	0	0	0	0
Water Management Strategies						
Conservation (City of Athens)	47	111	298	451	589	765
Fish Hatchery Reuse	0	2,872	2,872	2,872	2,872	2,872
New groundwater (Carrizo-Wilcox)	0	1,400	1,400	1,400	1,400	1,400
Forest Grove w/ WTP at City	0	0	0	0	0	2240
WTP Expansion				2240	2240	2240
Total Supplies from Strategies	47	4,383	4,570	6,963	7,101	9,517
Total Supplies	5,819	7,283	7,470	9,863	10,001	12,417
Total from Conservation and Reuse	47	2,983	3,170	3,323	3,461	3,637
Percent of Strategy Supplies from Conservation and Reuse	100%	68%	69%	48%	49%	38%
Demands						
Demands (ac-ft per year)	5,367	5,884	6,502	7,203	8,119	9,251
Surplus or (Shortage)	**452**	**1,399**	**968**	**2,660**	**1,882**	**3,166**



Strategy	Yield (ac-ft per year)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Fish Hatchery Reuse	2,872	$ 0	$ 0	$ 0	$ 0
New Groundwater (Carrizo-Wilcox)	1,400	$3,799,000	$513,900	$367	$1.13
Forest Grove water with 4 MGD New WTP at City	2,240	$26,619,000	$2,628,600	$1,173	$3.60
4 MGD WTP Expansion	2,240	$16,575,556	$1,651,300	$ 843	$2.92

Alternative water management strategies for Athens MWA include:

- Reuse of City of Athens Discharges
- Developing additional yield from Lake Athens by building a new fish hatchery intake and expanding the existing water treatment plant.

4C.2.3 Houston County WCID 1. Houston County WCID 1 owns and operates Houston County Lake in the Trinity River Basin in Houston County. This reservoir is currently permitted for 3,500 ac-ft per year. The firm yield using the TCEQ-approved Trinity WAM with the original storage capacity is approximately 7,000 ac-ft per year. Houston County WCID 1 has increased interest from its current customers and potential future customers to provide additional water. To meet these demands, the WCID is currently seeking a permit amendment for the full yield of the reservoir. It is assumed that there are little to no capital costs associated with the amendment (only engineering and legal costs).

4C.2.4 City of Jacksonville. The City of Jacksonville has sufficient raw water and treatment capacity to meet its projected demands. However, the City has several constraints to providing treated surface water to all its customers. The ability to move additional surface water to the eastern part of Jacksonville to meet increasing demands is limited. The City's existing surface water treatment plant is currently underutilized and could provide more surface water with the necessary infrastructure improvements. It is recommended that the City of Jacksonville implement infrastructure improvements to fully utilize its existing water sources.

In addition, the City of Jacksonville is a participant in the Lake Columbia project. This lake provides 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. Jacksonville has a contract with ANRA for 4,275 ac-ft per year from Lake Columbia. It is assumed that the first phase of this project would develop 1,700 ac-ft per year (3 MGD). Subsequent phases would fully develop the City's contracted amount.

Strategy	Yield (ac-ft per year)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Infrastructure Improvements	1,000	$1,000,000	97,200	$97.20	$0.30
Lake Columbia	1,700	$ 19,133,700	$ 2,503,000	$ 1,472	$ 4.52

4C.2.5 Lower Neches Valley Authority. The projected water demands supplied by the LNVA total 1,082,654 ac-ft per year in 2060. In addition to these demands there are 32,000 ac-ft per year in potential future demands and 40,000 ac-ft per year in potential future irrigation demand increases. The LNVA is pursuing six strategies to increase its reliable water supplies. These include:

- Water conservation associated with its irrigation deliveries
- Modification of operations of the Neches River Saltwater Barrier, Lake BA Steinhagen and Sam Rayburn Reservoir as a system to maximize yield
- Permit amendment for storage and unpermitted yield in Sam Rayburn Reservoir that is associated with the flood reallocation from elevation 164 ft msl to 164.4 ft msl
- Flood storage reallocation and water right for associated storage and yield
- Sediment reduction in Lake B.A. Steinhagen
- Purchase of water from the SRA

In addition to these strategies, the construction of Rockland Reservoir is recommended as an alternate strategy. A brief discussion of each strategy is presented below.

Water Conservation. The LNVA has implemented programs to increase the efficiency of water use in agricultural applications and deliveries. The results of these programs are showing reductions in irrigation losses and use of up to nearly 30 percent of the irrigation water provided to current users. These water savings are reported as water supply but are actually demand reductions for current irrigation users. It is expected that the increased irrigation efficiencies will result in increases in irrigated acres (potential future irrigation demand). The projected water conservation savings should offset these increases in demands resulting from future growth.

System Operations. The LNVA completed a salt water barrier in 2003. Operation of the LNVA reservoirs with the salt water barrier may result in some water conservation by reducing the flow for fresh water needed to prevent the intrusion of salt water into the fresh water supply intakes. The Corps of Engineers conducted an Environmental Assessment of the impacts of the salt water barrier and reported that the average expected conservation, assuming no flow is required for prevention of salt water intrusion, is on the order of 111,000 ac-ft per year[1]. In drought years, the LNVA has realized savings as much as 500,000 ac-ft. However, some flow may be required for other purposes and the exact value of this strategy is unknown at this time. For planning purposes, it is assumed that average required flow will be available as additional supply. To realize this supply, LNVA will need to seek a systems operation permit from TCEQ.

Permit Amendment for Unpermitted Yield in Sam Rayburn Reservoir. In 1969 the Corps of Engineers converted 43,000 ac-ft of flood storage in Sam Rayburn Reservoir to water supply by raising the conservation pool from 164.0 ft msl to 164.4 ft msl. The associated firm yield was estimated at 28,000 ac-ft per year. A contract between the Corps and the City of Lufkin for this storage was approved on May 22, 1969; however, a water right for the additional yield was never submitted to the TCEQ. When the City of Lufkin began preliminary design to use this supply the LNVA converted 28,000 ac-ft per year of its Sam Rayburn water right to Lufkin, with the intent of submitting a water right application to TCEQ for this amount. This strategy recommends that the LNVA submit a water rights application for the 28,000 ac-ft per year of supply that is associated with the increase of conservation elevation to 164.4 ft msl. The implementation of this strategy would not require construction of additional infrastructure or additional studies.

Reallocation of Flood Storage in Sam Rayburn Reservoir. One of the primary purposes for the Sam Rayburn Reservoir is flood control with approximately 1,099,000 ac-ft of flood storage. Under current operations at Sam Rayburn water is released from the flood pool such that the flows at the Evadale gage on the Neches River do not exceed 20,000 cfs. When the flood pool elevation drops to 166 ft msl, the gates are closed and the remaining flood water is released through the hydropower turbines. This is the same operation for when the water is in the conservation pool (below 164.4 ft msl).

This strategy recommends that the flood storage between elevations 164.4 and 166.0 ft msl be converted to water supply purposes. There would be minimal impacts to current operations and the amount of additional water supply that could be made available is estimated at 122,000 ac-ft per year. This strategy requires Congressional action for the reallocation. It also would require the LNVA to enter into a contract with the Corps of Engineers for the additional storage, which is estimated at 186,500 ac-ft, and submit a water rights permit to TCEQ for the 122,000 ac-ft per year of additional diversion.

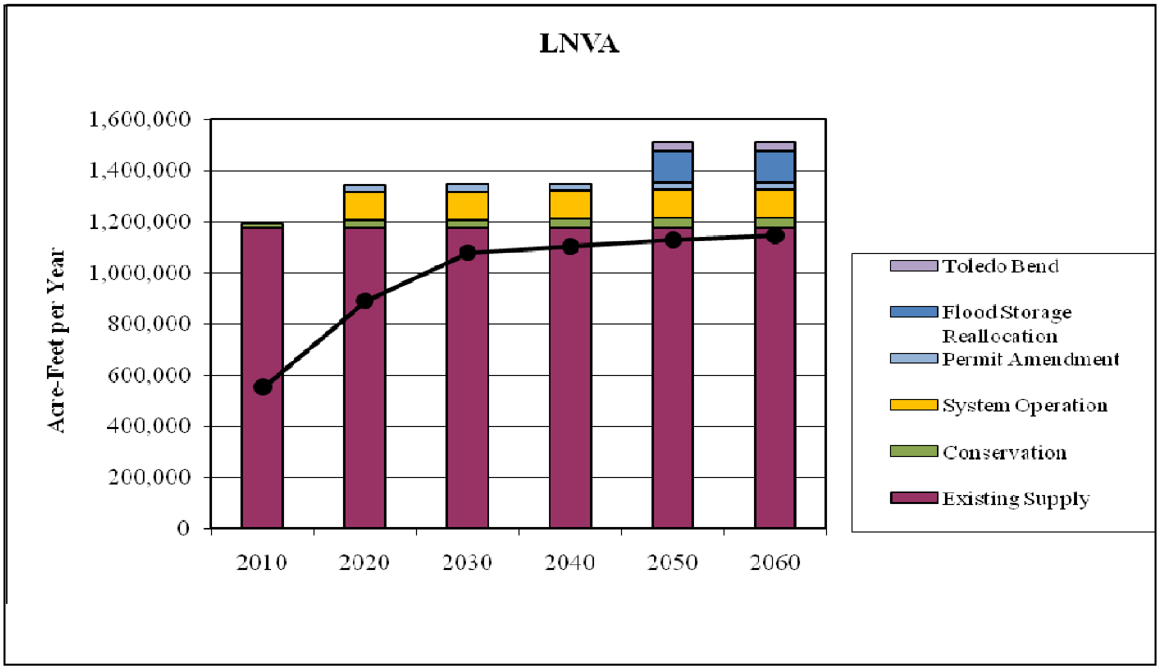
Sediment Reduction. The LNVA pursued a study of the feasibility of recapturing storage in Lake B.A. Steinhagen. The recent sediment survey of Lake B.A. Steinhagen shows a loss of nearly one third of its original capacity due to sediment. An additional loss of nearly one third (30,000 acre-feet) is projected over the planning period. Limiting the sediment accumulation and/or recapturing lost storage allow the LNVA more flexibility in its operations of its water system. The Neches WAM shows that LNVA is able to fully divert the current permitted amount from Lake B.A. Steinhagen and Sam Rayburn Reservoir through the planning period (considering projected sediment accumulations). Therefore, increasing the storage will not increase diversion; however, it will allow more water to be stored in Lake B.A. Steinhagen for operational purposes.

(Note: recapturing storage will not increase the storage amount in B.A. Steinhagen above the permitted volume.) The volume of water from this strategy is minimal, while the cost would be significant. Therefore, LNVA has determined that this project will not be pursued further at this time as a water management strategy for LNVA.

Purchase Water from the Sabine River Authority. The proximity of the Sabine River Basin could make the transfer of water from the Sabine River a feasible alternative. Infrastructure that would be required includes pump stations and transfer through open canal or closed pipe systems.

Rockland Reservoir. Rockland Reservoir was authorized for construction, as a federal facility, in 1945 along with Sam Rayburn, B. A. Steinhagen and Dam A lakes. A 1947 report recommended construction of Sam Rayburn and 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 feet, msl with top of conservation pool of 165 feet, 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 per year and the unit cost of water is $115 per ac-ft (updated to 2008 dollars). More detailed studies are needed to confirm the yield and costs for this project.

	2010	2020	2030	2040	2050	2060
Existing Supplies (ac-ft per year)						
Sam Rayburn / B.A. Steinhagen	792,000	792,000	792,000	792,000	792,000	792,000
Pine Island	381,876	381,876	381,876	381,876	381,876	381,876
Water Management Strategies (ac-ft per year)						
Conservation (Irrigation)	20,000	30,000	33,000	35,000	40,000	40,000
System Operation with Saltwater Barrier	0	111,000	111,000	111,000	111,000	111,000
Unpermitted Yield of Sam Rayburn	0	28,000	28,000	28,000	28,000	28,000
Reallocation of Flood Storage	0	0	0	0	122,000	122,000
Purchase from SRA (Toledo Bend)					36,000	36,000
Total Supplies from Strategies	20,000	169,000	172,000	174,000	337,000	337,000
Total Supplies	**1,193,876**	**1,342,876**	**1,345,876**	**1,347,876**	**1,510,876**	**1,510,876**
Total from Conservation and Reuse	20,000	141,000	144,000	146,000	151,000	151,000
Percent of Strategy Supplies from Conservation and Reuse	100%	83%	84%	84%	45%	45%
Demands (ac-ft per year)						
Demand (Current Customers)	530,781	829,286	1,021,528	1,043,078	1,063,682	1,082,654
Demand (Potential Irrigation)	20,000	30,000	33,000	35,000	40,000	40,000
Demand (Potential Future)	1,000	32,091	25,591	25,591	25,591	25,591
Potential Demand (Total)	551,781	891,377	1,080,119	1,103,669	1,129,273	1,148,245
Surplus or (Shortage)	**642,095**	**451,499**	**265,757**	**244,207**	**381,603**	**362,631**



Strategy	Quantity (ac-ft per year)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
LNVA-1: Water Conservation	40,000	$1,400,000[1]	$30,000	$3.80	$0.01
LNVA-2: System Operations	111,000	$2,000,000	$500,000[2]	$4.50	$0.01
LNVA-3: Permit amendment Sam Rayburn	28,000	$200,000[2]	$0	$0	$0
LNVA-4:Reallocation of Flood storage	122,000	$31,736,500[3]	$3,089,700	$25.33	$0.08
LNVA-6: Purchase of Water from Sabine River Authority	36,000	$39,168,200	$ 5,967,000	$166	$0.51
Alt. Strategy LNVA-7: Rockland Reservoir	614,400	$1,050,000,000	$70,400,000	$115	$0.35

1. Based on a 10-year meter replacement program at $140,000 per year. Cost data provided by LNVA.
2. Capital costs are for water rights application. No costs for storage or O&M.
3. Costs are based on $163 per ac-ft of storage purchase from the Corps of Engineers

4C.2.6 City of Lufkin. The City of Lufkin currently relies on groundwater from the Carrizo-Wilcox aquifer. The City provides water to Huntington, Angelina WSC, Redland WSC, Woodlawn WSC and currently provides about one-third of the manufacturing needs in Angelina County. The City has recently contracted with the City of Diboll for 632 MGY. With the acquisition of Lake Kurth and additional groundwater from the Abitibi Bowater Corporation, the City expects to provide up to an additional 12 MGD of water for industrial demands. In addition to these demands, the City of Lufkin is contracted to provide up to 5 MGD to the Abitibi facility. This is a potential future demand pending final outcome of the Abitibi facilities.

Considering the currently available supply and expected demands on the City of Lufkin, the City shows a water supply shortage beginning in 2010 and increasing to over 28,000 acre-feet per year by 2060. To meet these shortages Lufkin has secured multiple water resources, including the Abitibi groundwater rights in the Carrizo-Wilcox aquifer, Lake Kurth, and water rights in Sam Rayburn Reservoir. While the former Abitibi well system is able to provide some water to the city, infrastructure improvements are needed to fully utilize each of these sources.

The City of Lufkin is developing a long-term water supply plan that develops their water supplies in the following stages:

- Rehabilitate existing wells and fully develop additional groundwater in the Carrizo-Wilcox aquifer;
- Develop surface water supplies from Lake Kurth; and
- Develop surface water supplies form Sam Rayburn Reservoir
- Develop Additional Groundwater

The groundwater rights formerly associated with the Abitibi facility are permitted for 8.3 MGD. There are 10 existing wells on the property that are in good condition and can be used to supply the 8.3 MGD. There are several other wells that will likely need to be plugged or reconditioned, if used. Three wells are located in Nacogdoches County and the other wells are located in Angelina County. The Nacogdoches County wells are permitted for 524 MG/yr, which is approximately 1.4 MGD.

To fully utilize these water rights, the City plans to construct a new groundwater treatment facility near the existing well field and install a new 24-inch pipeline to deliver the treated groundwater to the south side of Lufkin for distribution. Planning and design for groundwater treatment and distribution system has begun, and the project is expected to be completed in the next few years.

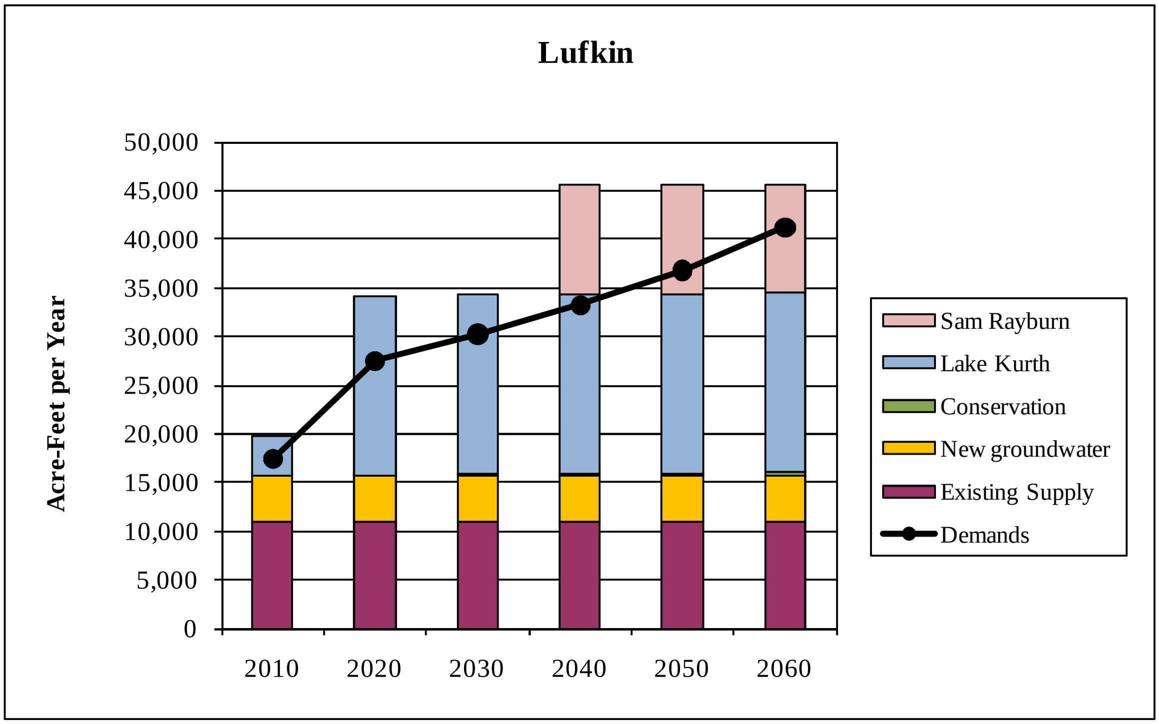
Develop Lake Kurth Surface Water. The water rights associated with Lake Kurth include the right to divert up to 19,100 acre-feet per year from the Angelina River for industrial purposes and to impound 16,200 acre-feet of water in Lake Kurth. To utilize these rights, Lufkin plans to construct a surface water treatment plant at Lake Kurth and construct a distribution system to move water to Lufkin and to current and potential wholesale customers. Upon development of this new source, Zavalla, Four Way WSC, Angelina WSC, and M&M WSC are expected to become wholesale customers of the City of Lufkin. These customers would be served with a new pipeline from the new water treatment plant at Lake Kurth. Some raw water may be sold directly from Lake Kurth for industrial purposes. As part of this strategy, a portion of the Angelina run-of-the-river rights will need to be changed from industrial use to municipal use or multi-purpose use. If the timing of this water right conversion is delayed, the City may need to develop its Sam Rayburn water rights for municipal use earlier than shown in this plan. The Lake Kurth strategy is expected to be developed in phases, with the first phase to utilize raw water from Lake Kurth for industrial purposes by 2010, followed by the construction of a surface water treatment facility by 2020. The initial size of the treatment facility will depend on the projected needs at the time. For cost purposes, it was assumed that a 15 MGD facility would be needed to utilize treated water from Lake Kurth.

Develop Sam Rayburn Reservoir Water Rights. 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 Lower Neches Valley Authority (LNVA) and the U.S. Army Corp of Engineers. The City has a water right to divert up to 28,000 acre-feet 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 would be diverted from the northern end of the lake and transported through a 36-inch pipeline. The treatment plant would be initially expanded to 25 MGD with the potential for further expansions beyond this planning period. This water management strategy is expected to be on line by 2040, pending the demands of potential future customers.

The supplies and demands associated with the City of Lufkin are shown in the following table and figure.

	2010	2020	2030	2040	2050	2060
Existing Supplies (ac-ft per year)						
Carrizo-Wilcox	11,000	11,000	11,000	11,000	11,000	11,000
Water Management Strategies (ac-ft per year)						
Conservation (City of Lufkin)	50	117	189	247	319	408
Groundwater - Carrizo-Wilcox	4,650	4,650	4,650	4,650	4,650	4,650
Lake Kurth	6,800	18,400	18,400	18,400	18,400	18,400
Sam Rayburn Reservoir				11,210	11,210	11,210
Total Supplies from Strategies	11,500	23,167	23,239	34,507	34,579	34,668
Total Supplies	22,500	34,167	34,239	45,507	45,579	45,668
Total from Conservation and Reuse	50	117	189	247	319	408
Percent of Strategy Supplies from Conservation and Reuse	0.4%	0.5%	0.8%	0.7%	0.9%	1.2%
Demands (ac-ft per year)						
Demand (Current Customers)	19,294	27,918	30,664	33,694	37,189	41,162
Demand (Potential Future)	2,800	2,800	2,800	3,900	3,900	3,900
Total Demand	22,094	30,718	33,464	37,594	41,089	45,062
Surplus or (Shortage)	**406**	**3,449**	**775**	**7,913**	**4,490**	**606**



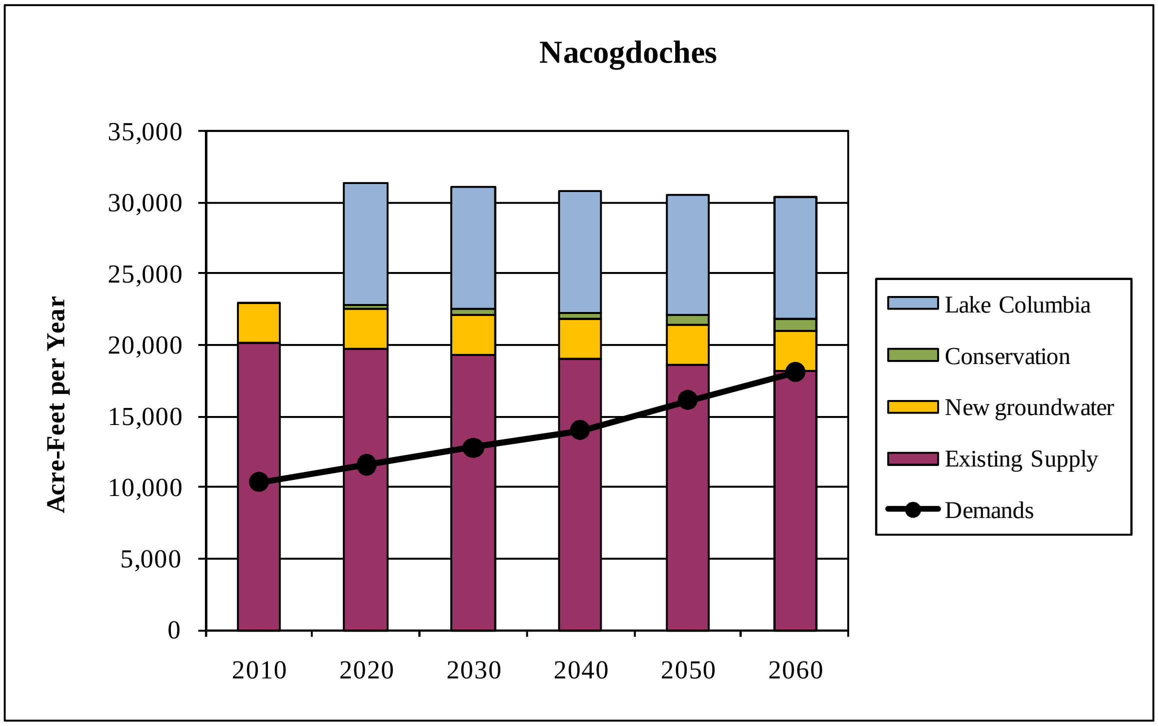
Estimates of capital costs for the Lufkin groundwater facilities are based on planning information provided by the City of Lufkin.

Strategy	Yield (ac-ft per year)	Total Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Conservation	408		$40,000	$98	$0.30
New Groundwater	4,650	$ 14,097,000	$1,986,800	$427	$1.31
Lake Kurth	18,400	$56,488,600	$8,387,700	$455	$1.39
Sam Rayburn Supply	11,200	$53,164,000	$17,679,000	$1,577	$4.84

4C.2.7 City of Nacogdoches. The City of Nacogdoches utilizes groundwater from the Carrizo-Wilcox aquifer and surface water from Lake Nacogdoches. The City provides water to Appleby WSC and D&M WSC. Most, if not all, of the manufacturing demands in the county are also supplied by the City of Nacogdoches. The Neches WAM shows the current firm yield of Lake Nacogdoches to be approximately 17,000 ac-ft per year, reducing to 15,100 ac-ft per year by 2060. With the City's existing groundwater supplies, Nacogdoches has a reliable supply of approximately 20,000 ac-ft per year. 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.

The City of Nacogdoches is pursuing two strategies to increase the reliability of its supplies and provide for projected growth: additional groundwater from the Carrizo-Wilcox and surface water from Lake Columbia. Groundwater from the Carrizo-Wilcox is used to supply much of the southern part of the city and the City of Nacogdoches is considering increasing its groundwater supplies to better serve this section of the City. 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. As a long-term alternative, the City of Nacogdoches is considering developing strategies to use water from Sam Rayburn Reservoir and/or Toledo Bend Reservoir as potential future water sources. Raw water would be transmitted to the City and treated by Nacogdoches. Costs were developed for the Toledo Bend strategy and a more detailed evaluation of the Sam Rayburn alternative will be developed for the 2016 Regional Water Plan.

	2010	2020	2030	2040	2050	2060
Existing Supplies (ac-ft per year)						
Carrizo-Wilcox	3,100	3,100	3,100	3,100	3,100	3,100
Lake Nacogdoches	17,067	16,683	16,300	15,917	15,533	15,150
Water Management Strategies (ac-ft per year)						
Expand groundwater	2,800	2,800	2,800	2,800	2,800	2,800
Conservation (City)	0	229	425	514	654	787
Lake Columbia		8,551	8,551	8,551	8,551	8,551
Total Supplies from Strategies	2,800	11,580	11,776	11,865	12,005	12,138
Total Supplies	22,967	31,363	31,176	30,882	30,638	30,388
Total from Conservation and Reuse		229	425	514	654	787
Percent of Strategy Supplies from Conservation and Reuse	0.0%	2.0%	3.6%	4.3%	5.4%	6.5%
Demands (ac-ft per year)						
Demand (Current Customers)	10,344	11,573	12,812	14,006	16,096	18,062
Demand (Potential Future)						
Potential Demand (Total)	10,344	11,573	12,812	14,006	16,096	18,062
Surplus or (Shortage)	**12,623**	**19,790**	**18,364**	**16,875**	**14,542**	**12,326**



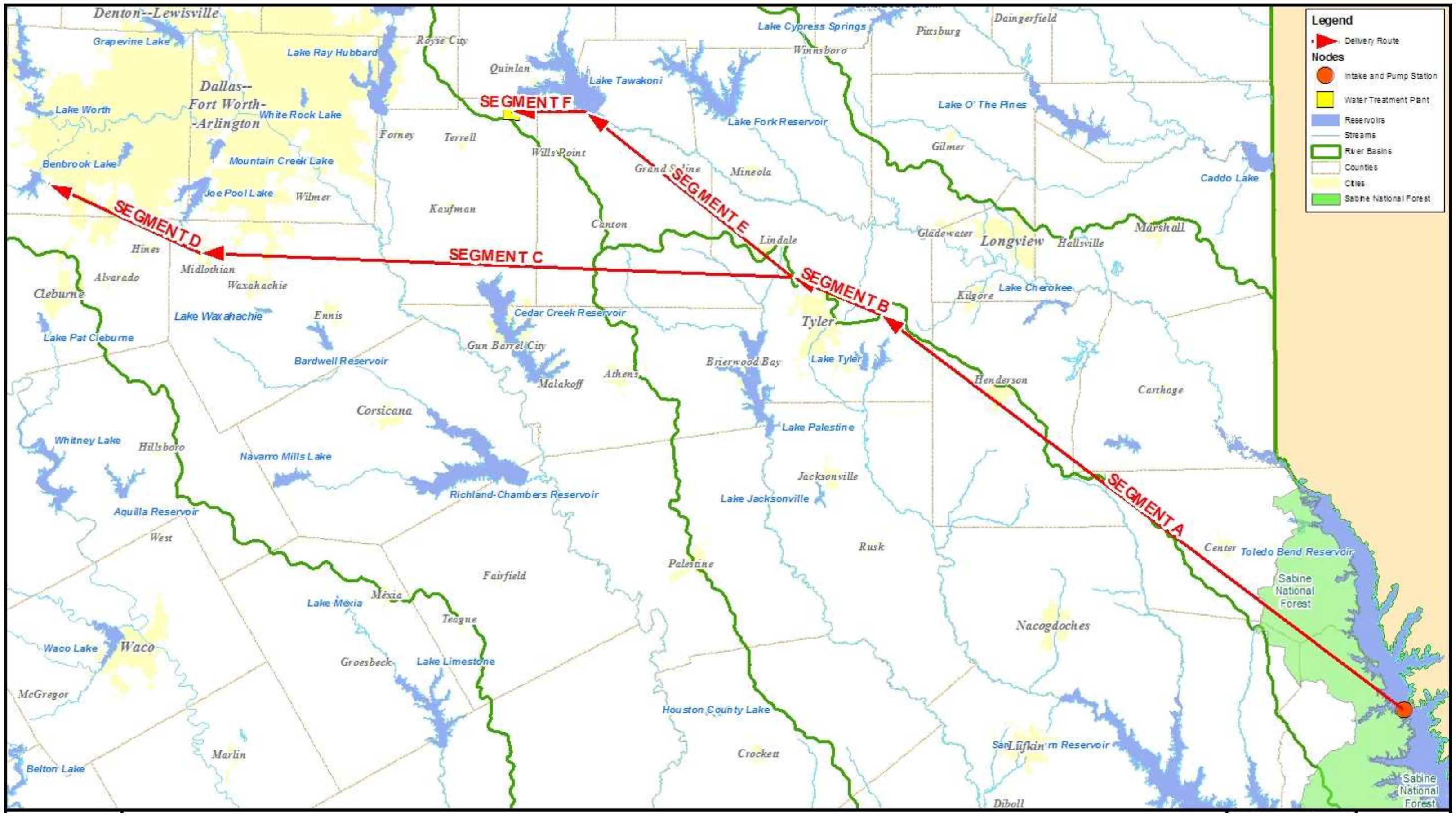
Strategy	Yield (ac-ft per year)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Conservation	787		$40,000	$51	$0.16
New Groundwater	2,800	$2,727,000	$724,600	$259	$0.79
Lake Columbia	8,551	$37,282,000	$7,287,000	$852	$2.61
Toledo Bend (Alt)	5,175	$114,419,000	$10,602,000	$2,049	$6.29

4C.2.8 Sabine River Authority (SRA). The SRA is based in North East Texas and ETRWPA. SRA currently provides water from its Lower Basin system (Toledo Bend reservoir and 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 Regions C, Region D, and the ETRWPA. These sources are fully contracted and SRA has requests for additional water in the Upper Basin. There are sufficient supplies from the Lower Basin system to meet water demands, but SRA cannot fully meet the current and future demands in the Upper Basin. To meet these shortages, SRA plans to participate in the Toledo Bend Pipeline project that would transport 500,000 ac-ft per year of water from Toledo Bend to the Upper Basin area and Region C. Of this amount, 100,000 ac-ft per year would be used for users in the Upper Sabine Basin, 200,000 ac-ft per year would be for the North Texas Municipal Water District, and 200,000 ac-ft per year would be for the Tarrant Regional Water District. Both the North Texas Municipal Water District and Tarrant Regional Water District are based in Region C. A map of the proposed project is shown on Figure 4C-1. A pipeline route has not been selected. The route indicated on Figure 4C.1 is only for illustrative purposes. Costs were developed for the full amount of the project. The project may be developed in phases, with Phase 1 supplying approximately half of the total project amount.

A recommended alternate strategy is to transport an additional 200,000 ac-ft per year from Toledo Bend to Dallas Water Utilities for a total of 700,000 ac-ft per year from Toledo Bend Reservoir. A special study for this project was conducted for the ETRWPG and the summary report, *Inter-regional Coordination on the Toledo Bend Project*, was submitted to the TWDB in March 2008. Details of the development of Toledo Bend Project can be found in this report. Recommendations for users in Region C are discussed in the 2011 Region C Water Plan.

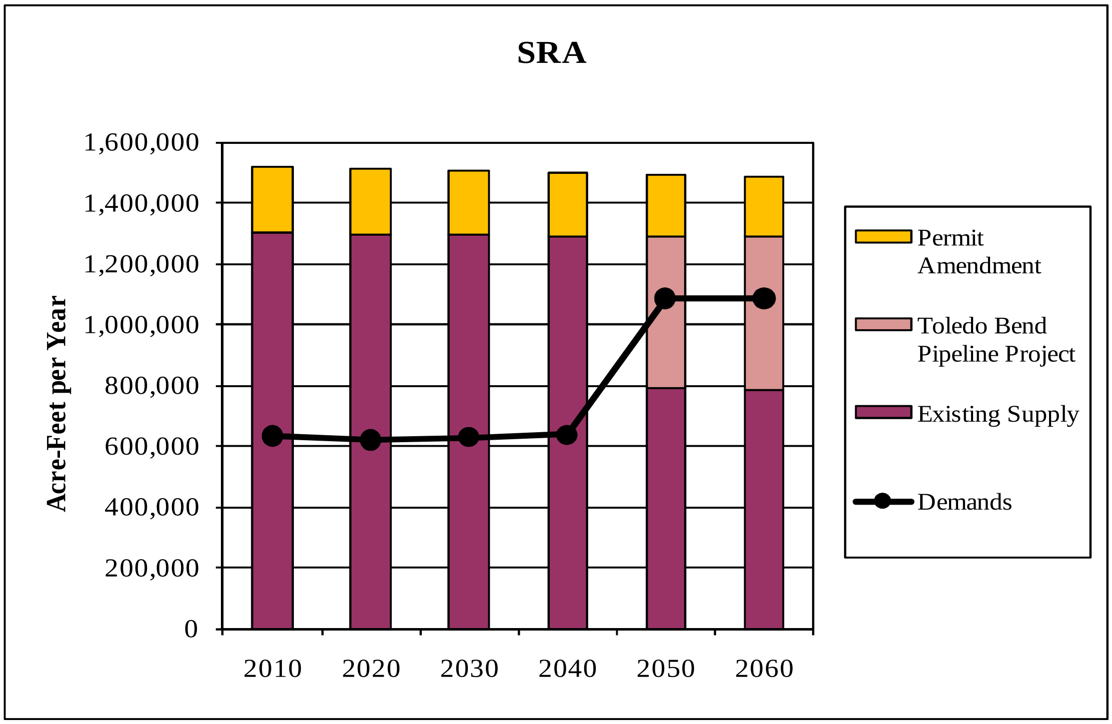
To support the increased use of water from Toledo Bend reservoir, the SRA has submitted a permit amendment to TCEQ to fully utilize Texas' share of the reservoir's firm yield. The application requested an additional 293,300 ac-ft per year of supply based on the TCEQ-approved Sabine River Basin WAM. The application has been declared administratively complete and TCEQ is currently reviewing the permit request. For planning purposes, the supply available from the permit amendment is based on the unpermitted yield for Toledo Bend as determined by the Sabine WAM that was used for regional water planning. The actual amount will be determined through the permitting process.

Toledo Bend Pipeline Project



	2010	2020	2030	2040	2050	2060
Existing Supplies (ac-ft per year)						
Lake Tawakoni	229,807	228,093	226,380	224,667	222,953	221,240
Lake Fork	173,035	171,820	170,605	169,390	168,175	166,960
Toledo Bend Reservoir	750,000	750,000	750,000	750,000	750,000	750,000
Canal System	147,100	147,100	147,100	147,100	147,100	147,100
Water Management Strategies (ac-ft per year)						
Permit Amendment	219,900	215,300	210,800	206,200	201,600	197,000
Toledo Bend Project	0	0	0	0	500,000	500,000
Total Supplies from Strategies	219900	215300	210,800	206,200	701,600	697,000
Total Supplies	1,519,842	1,512,313	1,504,885	1,497,357	1,489,828	1,482,300
Demands (ac-ft per year)						
Demand (Current Customers)	561,237	541,237	521,237	521,237	521,237	521,237
Demand (Potential Future)	72,015	78,015	106,765	115,765	563,440	563,440
Potential Demand (Total)	633,252	619,252	628,002	637,002	1,084,677	1,084,677
Surplus or (Shortage)	**886,590**	**893,061**	**876,883**	**860,355**	**405,151**	**397,623**

Note: Supplies for the Toledo Bend Pipeline Project are included in the yield of Toledo Bend.



Strategy	Yield (ac-ft per year)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Toledo Bend Pipeline Project	100,000 [(1)]	$475,648,000	$59,751,911	$598	$1.83

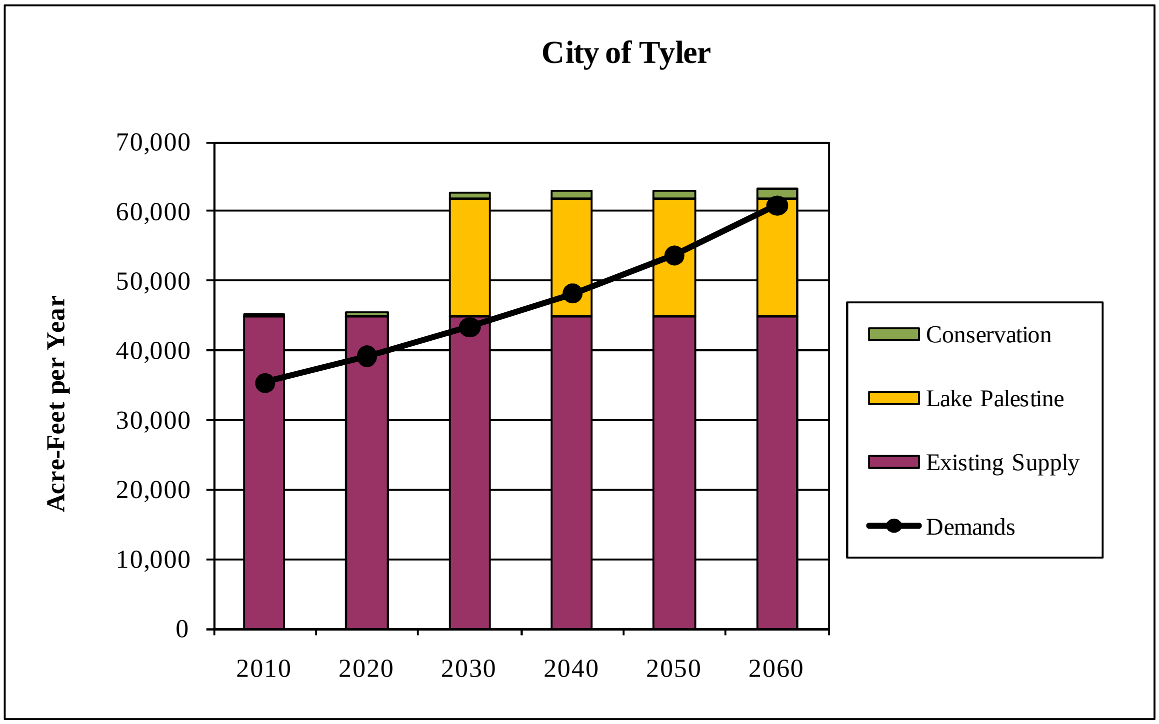
(1) Quantity shown is the amount for SRA. Total amount of strategy is 500,000 ac-ft per year. The costs for the supply difference (400,000 ac-ft per year) will be borne by other participants.

4C.2.9 City of Tyler. The City of Tyler is shown to have sufficient supplies through the planning period using the TWDB approved demand projections. Recent population data show that the City is growing at a much faster rate than previously estimated. Data reported by the State Demographer show the population in the City of Tyler has increased at an average annual growth rate of 2.4 percent, which equates to a projected decadal population growth of 26 percent. The TWDB shows a decadal growth of 7 percent for the City of Tyler. This difference is significant for the expected water demands on the City.

Assuming that only half of this observed growth for Tyler occurs for subsequent decades (2020 to 2060), the projected water demands for the City are nearly 20,000 acre-feet per year higher in 2060 than the projected demands in this plan. In addition, there is considerable interest in other users in Smith County contracting with the City of Tyler for water supplies. There are recommended strategies for Tyler to provide additional water to Community Water, Whitehouse and Manufacturing in Smith County. With these potential future demands the City of Tyler will need to develop additional supplies and expand its treatment capacities.

The City has developed about half of its contracted supply in Lake Palestine and plans to develop the remaining supply as part of its long-term water supply plan. It is recommended that the City of Tyler develop the additional 30 MGD of Lake Palestine water.

	2010	2020	2030	2040	2050	2060
Existing Supplies (ac-ft per year)						
Carrizo-Wilcox	4,340	4,340	4,340	4,340	4,340	4,340
Lakes Tyler/ Tyler East	23,541	23,541	23,541	23,541	23,541	23,541
Lake Palestine	16,815	16,815	16,815	16,815	16,815	16,815
Lake Bellwood	300	300	300	300	300	300
Water Management Strategies (ac-ft per year)						
Conservation (City of Tyler)	301	526	772	1,036	1,234	1,344
Lake Palestine	0	0	16,815	16,815	16,815	16,815
Total Supplies from Strategies	301	526	17,587	17,851	18,049	18,159
Total Supplies	45,297	45,522	62,583	62,847	63,045	63,155
Total from Conservation and Reuse	301	526	772	1036	1234	1344
Percent of Strategy Supplies from Conservation and Reuse	100%	100%	4.4%	5.8%	6.8%	7.4%
Demands (ac-ft per year)						
Demand (Current Customers)	30,506	31,903	33,224	34,506	36,865	40,656
Demand (Potential Future)	4790	7256	10133	13655	16874	20178
Potential Demand (Total)	35,296	39,159	43,357	48,161	53,739	60,834
Surplus or (Shortage)	**10,001**	**6,363**	**19,226**	**14,686**	**9,306**	**2,321**



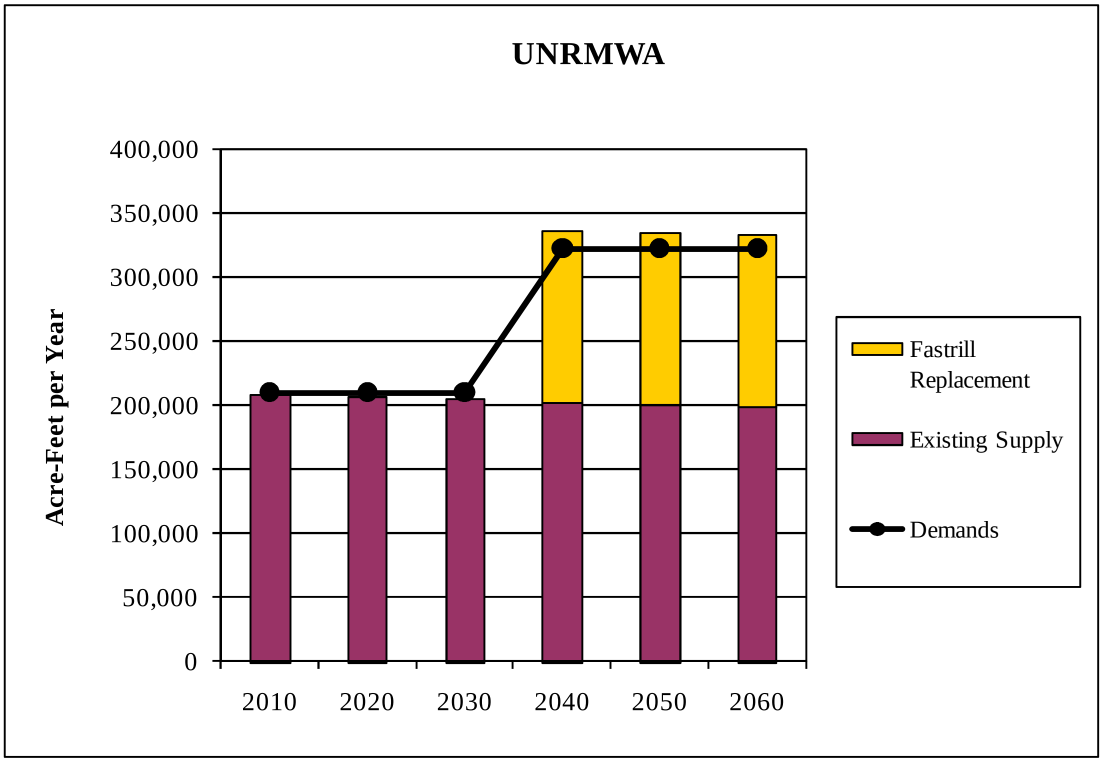
Strategy	Yield (ac-ft per year)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Conservation	1,344	$0	$60,000	$45	$0.14
Lake Palestine Infrastructure	16,815	$79,389,250	$13,957,000	$ 830	$ 2.55

4C.2.10 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. Based on current contracts, the UNRMWA shows a small shortage during the planning period. This shortage is primarily associated with the reduced firm yield of Lake Palestine due to projected sediment accumulation in the lake.

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 have 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. One alternative that is being considered is the Neches River Run-of-the-River Diversion. This project would divert water from the Neches River in Anderson and Cherokee Counties downstream of Lake Palestine and the Neches River National Wildlife Refuge and upstream of the Weches Dam site. The water would be pumped to off-channel storage reservoirs for subsequent diversion. The run-of-the-river diversions would be subject to senior water rights and environmental flows. Based on a total off-channel storage capacity of 540,000 ac-ft, the firm supply from this strategy is estimated at 134,500 ac-ft per year. Of this amount, 112,100 ac-ft per year would be purchased by Dallas Water Utilities, and the remaining 22,400 ac-ft per year would be available for users in the ETRWPA. The Lake Fastrill Replacement Project is a recommended water management strategy for Region C to provide 112,100 ac-ft per year of water to Dallas Water Utilities. Details of the development of this strategy to supply Dallas Water Utilities are discussed in the *2011 Region C Water Plan*.

	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Existing Supplies (ac-ft per year)						
Palestine System	207,458	205,417	203,375	201,333	199,292	197,250
Water Management Strategies (ac-ft per year)						
Lake Fastrill Replacement Project	0	0	0	134,500	134,500	134,500
Total Supplies from Strategies	0	0	0	134,500	134,500	134,500
Total Supplies	207,458	205,417	203,375	335,833	333,792	331,750
Demands (ac-ft per year)						
Demand (Current Customers)	210,135	210,124	210,115	210,106	210,099	210,093
Demand (Potential Future)	0	0	0	112,100	112,100	112,100
Potential Demand (Total)	210,135	210,124	210,115	322,206	322,199	322,193
Surplus or (Shortage)	**-2,677**	**-4,708**	**-6,740**	**13,627**	**11,592**	**9,557**

Strategy	Yield (ac-ft per year)	Capital cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Neches River Run-of-the-River	134,500	$1,980,278,000	$193,301,000	$1,437	$4.41



4C.3 Texas Water Development Board Database

The 2012 Regional Water Planning Data Web Interface (DB12) is an electronic database provided by the Texas Water Development Board which functions to collect, maintain and analyze electronic 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. A copy of the data from the DB12 is provided in Appendix 4C-B.

Chapter 4D

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 water management strategies and groundwater surface water interrelationships;

(4) Impacts of water management strategies 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 water management strategies 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;

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 4D-A.

Chapter 5

Impacts of Selected Water Management Strategies on Key Parameters of Water Quality and Impacts of Moving Water from Rural and Agricultural Areas

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The regulations that describe the content and process for the development of regional water plans direct that the plan "include a description of the major impacts of recommended water management strategies on key parameters of water quality identified by the regional water planning group . . ." and "impacts on agricultural resources." [30 TAC 357.7(a)(12); 30 TAC 357.7(a)(8)]. In the 2006 East Texas Regional Water Plan, this chapter provided information and recommendations to assist the ETRWPG in identifying the key water quality parameters that may be impacted by implementation of recommended WMSs that were new to the regional water plan in 2006. Chapter 5 for the 2011 Plan reviews the selected water quality parameters, discusses how various types of WMSs could affect water quality, and presents a listing of the WMS developed in the 2011 Plan. Also included is an assessment of the key water quality parameters that could be affected by the implementation of each new WMS. In addition, this chapter provides information relating to the potential impacts of moving water used for rural or agricultural purposes to urban uses.

5.1 Key Water Quality Parameters

The following water quality parameters were selected by the ETRWPG in the 2006 Plan as parameters that could be impacted by WMS recommended for the ETRWPA:

- Total Dissolved Solids (TDS)
- Dissolved Oxygen (DO)
- Nutrients
- Metals
- Turbidity

A discussion of these parameters and the rationale for their selection by the ETRWPG is contained in the 2006 Plan. The ETRWPG has determined that these same parameters will be evaluated for the 2011 Plan.

5.2 Summary of Potential Impacts of Water Management Strategies on Water Quality

The implementation of specific WMS can potentially impact both the physical and chemical characteristics of water resources in the region. An assessment of the characteristics of each WMS that can affect water quality follows. The assessment includes a discussion of how the specific water quality parameters identified above could be affected by various types of WMS. In addition, WMS that have been identified for the first time in the 2011 Plan will be evaluated for their specific potential impacts on water quality.

The following WMS types are employed in the ETRWPA:

- Expanded use of existing surface water resources
- Interbasin water transfers
- New reservoirs
- Expanded use of groundwater resources
- Indirect Reuse
- Expansion of local supplies
- Voluntary redistribution
- Water conservation

Table 5.1 summarizes how the various types of water management strategies could impact water quality.

Table 5.1 Evaluation of Potential Water Management Strategy Impacts on Water Quality

Water Quality Parameter	Water Management Strategy Types							
	Expanded Use of Surface Water	Inter-basin Transfers	New Reservoirs	Expanded Use of Ground-water	Indirect Reuse	Expanded Use of Local Supplies*	Voluntary Re-distribution**	Water Conservation***
TDS	•	•	•	•	•		•	
Dissolved Oxygen	•	•	•		•			
Nitrogen	•	•	•		•		•	
Phosphorus	•	•	•		•		•	
Metals	•	•	•	•	•		•	
Turbidity		•					•	

*Expanded use of local supplies would not typically be expected to have a significant impact on water quality.
**Voluntary Redistribution could have an impact on the water quality of the receiving water body
***Water conservation would not typically be expected to have a significant impact on water quality

5.2.1 Expanded Use of Existing Surface Water Resources. The expanded use of existing surface water resources will provide much of the increased water supply for the ETRWPA during the planning period. The primary physical impact of this expanded use of surface water is a change in the volume of water remaining in the river basin (i.e., flow in a stream or storage in a lake).

Impacts on key water quality parameters vary depending on factors such as the location of the source and the intended destination of the water transfer. For strategies that involve pumping existing surface water directly to a water treatment plant, no impact on water quality is anticipated. However, when water is pumped from one source to another, the impacts will depend on the existing water quality of the two sources, as well as the quantities to be transferred and any mitigation that may be applied.

5.2.2 Interbasin Water Transfers. ETRWPA interbasin water transfers currently occur in Jefferson, Nacogdoches, Orange, and Rusk Counties. The major water transfers occur in Jefferson and Orange Counties. Major municipal populations and industrial activities are located in both Jefferson and Orange Counties. Water transfers in these counties are designed to compensate for the deficit of available water in specific portions of each county. Some voluntary redistribution or surface water expansion strategies may involve interbasin transfers within the region.

In cases where the water characteristics of the source and destination river basins are significantly different, the interbasin transfer can cause changes in the receiving water body. Changes in TDS, alkalinity, hardness, or turbidity can impact water users, particularly industrial users that have treatment processes to produce high quality waters (for boiler feed, for example) and water treatment plants. Water treatment processes are tailored to the quality of the water being treated. If the quality of the feed water changes, the treatment process may have to be changed as well. Changes in nutrient concentrations or water clarity can affect the extent of growth of algae or aquatic vegetation in a stream. The same concentration of nutrients can produce different levels of algal growth in different water bodies depending on factors such as water clarity, shading, stream configuration, or other chemical constituents in the waters. With respect to water clarity, there are also aesthetic considerations. It is generally not desirable to introduce waters with higher turbidity, or color, into high clarity waters. Because the river basins within the ETRWPA have similar water characteristics, interbasin transfers within the region generally do not have significant water quality impacts.

Some of the recommended and alternative strategies for the Region C water planning area call for increased use of water from reservoirs located in Region I (or proposed to be located in the region). In general, reservoirs in East Texas have higher concentrations of nutrients (i.e., nitrogen and phosphorus) than many of the Region C reservoirs. The ultimate impact of importing water with higher nutrient concentrations to Region C reservoirs is difficult to predict due to the complex kinetic relationships between nutrients and chlorophyll-a. Strategies that involve importing water from East Texas reservoirs to Region C reservoirs may result in increases in nitrogen and phosphorus, but are not likely to lead to impacts that would impair the designated uses of the Region C water bodies.

In general, the TDS concentrations in East Texas reservoirs are lower than in Region C reservoirs. Therefore, in nearly all cases, transfer of water from the ETRWPA to Region C reservoirs will have a positive impact on TDS concentrations in the receiving water bodies. All of the recommended water management strategies involving exportation of East Texas water to Region C reservoirs are anticipated to have minimal impact on key water quality parameters.

5.2.3 New Reservoirs. One proposed WMS to serve needs in the ETRWPA is the development of Lake Columbia on Mud Creek. The most significant potential impact of new reservoir construction is the inundation of bottomlands and a decrease in instream flows below the reservoir. If this occurs, the potential impacts include those described in the previous section when instream flow is reduced due to increased stream usage, i.e., potential impacts on TDS, nutrients, DO, and, in some cases, metals. Other impacts from new reservoirs on water quality could be associated with changes to the flow regime downstream of the dam that would result. Such changes in flow would result in significant changes to sediment loads, scouring in the stream, and other geomorphic changes.

Significant water quality impacts resulting from new reservoir construction could occur when the dam release structures are designed to release water from the hypolimnion (e.g., bottom release of water through the dam). During the summer season, water quality concerns with respect to waters in the hypolimnion include decreased oxygen levels, low temperature, and high nutrient concentrations.

The development of a reservoir requires extensive environmental impact analysis prior to its approval that examines all such potential water quality issues. Any water quality issue anticipated by construction of the reservoir would likely be investigated and mitigation plans developed, if deemed necessary. Therefore, adverse water quality impacts anticipated by construction of new reservoirs should be considered low, due to mitigation requirements.

5.2.4 Expanded Use of Groundwater Resources. Proposed ETRWPA WMS include increased uses of groundwater from the Carrizo-Wilcox aquifer, Gulf Coast aquifer, Yegua-Jackson aquifer, Queen City aquifer, and Sparta aquifer. The increased withdrawal of groundwater can affect both the quantity and quality of water resources in the region. There is significant potential that increased use of groundwater will increase TDS concentrations in area streams. Groundwaters frequently contain higher concentrations of TDS or hardness than are considered desirable for domestic uses. Some homeowners may install treatment systems to reduce TDS or hardness. Operation of these systems may introduce high concentrations of TDS to municipal wastewater systems or area streams. However, because these discharges are expected to be small, the overall impacts should be negligible. Increased withdrawal of groundwater resources can also affect the quality of the water in the aquifers by increasing the potential for the intrusion of saltwater and/or brackish water into the aquifers, especially in coastal regions.

5.2.5 Indirect Reuse. This strategy involves the discharge of treated wastewater effluent into a body of water used for water supply. The purpose of the discharge may simply be a result of the need to dispose of the treated wastewater or may be for the specific purpose of augmenting the water supply. Treated wastewater can contain nutrient and TDS concentrations that are high in comparison to the receiving water. However, for most of the recommended strategies that include indirect reuse, advanced wastewater treatment, constructed wetlands, or blending, etc., would be required to mitigate potential water quality impacts associated with nutrients and TDS. For the purposes of this evaluation, it is assumed that some form of mitigation for potential water quality impacts associated with the key parameters will be implemented, if necessary. For this reason, impacts on water quality resulting from indirect reuse are expected to be minimal.

5.2.6 Expansion of Local Supplies (Livestock Ponds). The development of additional livestock ponds involves the capture of localized water for individual use, generally. In East Texas, where rainfall is generally abundant, this diversion of small volumes of localized runoff would not result in a significant reduction in overall flow in streams. It is not expected to cause significant impacts to water quality.

5.2.7 Voluntary Redistribution. The voluntary redistribution of water from one water supplier to another does not cause impacts on water quality unless the redistribution includes expanded use of surface water or groundwater, or involves a transfer of water from one basin to another. Potential water quality impacts of the expansion of existing water supplies, or interbasin transfers, have been previously described.

5.2.8 Water Conservation. Water conservation is the development of water resources and practices to reduce the consumption or loss of water, increase the recycling and reuse of water, and improve the efficiency in the use of water. Water Conservation Plans are designed to implement practices to conserve water and quantitatively project water savings. The water conservation measures recommended in the ETRWPA are not expected to affect water quality adversely. The results should generally be beneficial because the demand on surface and groundwater resources will be decreased. Quantifying such positive impacts could be very difficult. Chapter 6 contains additional discussion of water conservation in the ETRWPA.

5.3 Impacts of Moving Rural and Agricultural Water to Urban Uses

As the population of Texas increases, municipal and industrial water demands will rise accordingly, even with the implementation of conservation measures. The largest proportion of additional municipal water supply that will be utilized in The ETRWPA over the planning period will be from expanded use of existing surface water supplies and, to some extent, development of new surface water supplies such as Lake

Columbia. Surface water demand will increase for municipal and industrial water users as addressed in Chapter 4. However, as currently planned, the expanded use of surface water is not expected to involve significant transfers of agricultural supplies to municipal or industrial supplies. The proposed increases in municipal water surface water supplies will rely on existing water rights or new water rights from currently unpermitted supplies.

Chapter 6

Water Conservation and Drought Management 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 and increase the recycling and reuse of water to be made available for future or alternative uses. Water conservation plans are long-term, permanent strategies to reduce water use. Drought contingency plans are similar to conservation plans in that they aim to reduce water use, but are only intended for temporary periods during drought conditions.

Some 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 the State Water-Efficiency Plumbing Act. On a regional basis, this is about an 8 percent reduction in municipal water use (23,860 ac-ft per year) by year 2060. Additional municipal water savings may be expected as the Federal mandate for low flow clothes washing machines took effect in 2007.

Conservation savings were also included in the steam-electric power demands. Demands for steam-electric power were developed with the assumption that long-term power needs will be met with more water-efficient facilities. The estimated water savings associated with the higher efficiency power plants is nearly 27 percent of the total demands or 57,100 ac-ft per year in the ETRWPA. Reductions in demands due to conservation were not quantified by the TWDB for manufacturing, mining, irrigation and livestock needs.

SB1 requires each region's water plan to address drought management and conservation for both groundwater and surface water supply sources.

The ETRWPA is a water-rich region and water conservation in the region is driven by economics and not by lack of water supply. The 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 conservation strategies included in this planning period represent an economically achievable level of conservation. Currently, over one fourth of the municipal water users in the ETRWPA have per capita water use less than 100 gallons per person per day and 57 percent are less than the Water Conservation Task Force recommended state average of 140 gallons per person per day. While municipal use represents about 20 percent of the total regional water demands, the potential savings from advanced municipal conservation are relatively small. This opinion may change as economics and water supply conditions change in East Texas.

6.1 Water Conservation Plans

The TCEQ requires water conservation plans for all municipal and industrial water users with surface water rights of 1,000 ac-ft per year or more and irrigation water users with surface water rights of 10,000 ac-ft per year or more. Water conservation plans are also required for all water users applying for a State water right, and may also be required for entities seeking State funding for water supply projects. Legislation passed in 2003 requires all conservation plans to 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, 2009.

In the ETRWPA, 28 entities hold municipal or industrial rights in excess of 1,000 ac-ft per year and three entities have irrigation water rights greater than 10,000 ac-ft per year. A list of the users in the ETRWPG required to submit water conservation plans is shown in Table 6.1. Others have contracts with regional and wholesale water providers 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 wholesale water provider may request that its customers prepare a conservation plan to assist in meeting the goals and targets of the wholesale water provider's plan.

To assist entities in the ETRWPA with developing water conservation plans, model plans for municipal water users (wholesale or retail public water suppliers), industrial users and irrigation districts may be found in the appendices of Chapter 6 in the 2006 Plan. Additionally, model conservation plans are available on the TCEQ website at http://www.tceq.state.tx.us/permitting/water_supply/water_rights/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.

Water conservation strategies vary by water user and are shown in Table 6.2. This table lists water conservation strategies for individuals who have submitted water conservation plans as of August 25, 2009. 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 water audits and maintenance of water systems.
- Water rate structures that discourage water waste.

Industrial water users include large petrochemical industries as well as smaller local manufacturers. Conservation activities associated with industries are very site and industry-specific. Some industries can utilize brackish water supplies or wastewater effluent while others require only potable water. 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.

Table 6.1 Water Users and Types of Use that are Required to have Water Conservation Plans

Municipal/Domestic	Industrial	Mining	Other	Irrigation Water Users
Angelina & Neches River Authority *	Angelina & Neches River Authority*	United States Department of Energy	Jefferson Co. Drainage District No. 6	Sabine River Authority
Athens Municipal Water Authority*	Angelina-Nacogdoches WCID No.1		Texas Parks and Wildlife Department	Joe Broussard
City of Beaumont	Athens Municipal Water Authority			M Half Circle Ranch Company
City of Center	City of Lufkin			
City of Jacksonville	E I Dupont De Nemours & Co			
City of Lufkin*	Entergy Texas, Inc.			
City of Nacogdoches	Exxon Mobil Oil Company			
Houston Co WCID No. 1	Independent Refining Corp.			
Lower Neches Valley Authority	Luminant Generation Co. LLC			
Panola Co FWSD No. 1	Panola Co FWSD No. 1			
Sabine River Authority*	Premcor Refining Group, Inc.			
City of Tyler*	Sabine River Authority			
Upper Neches River MWD	Temple-Inland Forest Prod Corp			
	Texas Petrochemicals LP			
	City of Tyler			
	Union Oil of California			

* Water users with multiple types of use.

Table 6.2 Primary Water Conservation Strategies Documented in Water Conservation Plans

Water User Group	Primary Water Conservation Strategies								
	Plumbing Fixture Requirements	Reduce Water Loss/Leak Detection	Public Education/Awareness Programs	Pressure Control	Universal Metering or Meter Calibration or Replacement	Rate Structure Not Promoting Excessive use	Retrofit Program/2003 International Plumbing Code	Require/Request retail water suppliers to have conservation plan/conservation strategies	Other
	Passive Strategies	**Active Conservation Strategies**							
Angelina & Neches River Authority	•	•	•	•	•	•		•	•
Angelina-Nacogdoches WCID No.1		•							
City of Beaumont	•	•	•		•				•
City of Jacksonville	•	•	•	•	•		•	•	•
City of Lufkin	•	•	•		•	•	•	•	•
City of Nacogdoches	•	•	•		•	•			
Entergy Texas, Inc.		•							•
Houston Co WCID No.1		•	•		•			•	•
Luminant Generation Co. LLC		•							
Sabine River Authority		•			•			•	•
United States Dept of Energy		•							•
Upper Neches River MWD	•	•	•		•		•	•	•

In the ETRWPA, where water is readily available, requiring costly changes to processes and equipment may not be practical and beneficial to the region. In light of these considerations, the focus of the conservation activities for industrial users is:

- Evaluation of water saving equipment and processes.
- Water rate structures that discourage water waste.

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. Appropriate conservation activities for the large irrigators in the ETRWPA include the following:

- Reduction in operational losses and losses associated with conveyance systems.
- Coordination of irrigation deliveries to maximize efficiencies (tailwater recovery).
- Encourage water saving irrigation equipment and land practices for customers (e.g., land leveling).

6.2 Water Trends

The State of Texas Water Conservation Implementation Task Force (WCITF) has set a recommended goal of an average per capita consumption of 140 gpcd for water suppliers. Based on a study conducted in Phase I Round 3 of Regional Water Planning, water use in the ETRWPA is well below the target value.

Study No. 3, "Study of Municipal Water Uses to Improve Water Conservation Strategies and Projections," reviewed water production and sales surveys, which were sent to 65 WUGs in the ETRWPA with approximately 1,000 connections or more. Residential and total water production and water use were calculated from the survey responses. Median residential water use and median total water production for all but two of the responding 27 WUGs demonstrated water use below 140 gpcd. Median residential water use for the region was calculated to be 68 gpcd. Based on total water production, median water use was 86 gpcd.

The City of Tyler and City of Woodville demonstrated median residential water sales above the target value at 177 and 311 gpcd, respectively. The City of Tyler is required to submit a water conservation plan and drought contingency plan to the TCEQ and RWPG. As of August 28, 2009, plans for water conservation and drought contingency were not received. Based on water supply and water demand for the City of Tyler, the city does not demonstrate a need through the end of the planning period and does not require additional water conservation strategies.

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.

6.3 Drought Contingency Plans

Drought management is a temporary strategy to conserve available water supplies during times of drought or emergencies. This strategy is not recommended to meet long-term growth in demands, but rather acts as a means to minimize the adverse impacts of water supply shortages during drought. The TCEQ requires drought contingency plans for wholesale water suppliers and irrigation districts, as well as retail public water suppliers serving 3,300 or more connections. A drought contingency plan may also be required for entities seeking State funding for water projects.

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. As with the water conservation plans, drought contingency plans are to be updated and submitted to the TCEQ and ETRWPG by May 1, 2009.

Model drought contingency plans address the latest regulations and TCEQ requirements for retail and wholesale public water suppliers, irrigation districts, water supply corporations and investor owned utilities. Model drought contingency plans may be found in appendices of Chapter 6 of the 2006 Plan. Model plans are also available at http://www.tceq.state.tx.us/permitting/water_supply/water_rights/contingency.html. Each plan identifies three to six drought stages: mild, moderate, severe, critical and emergency. The recommended responses range from notification of drought conditions and voluntary reductions in the "mild" stage to mandatory restrictions during an "emergency" stage. Each entity will select the trigger conditions for the different stages and appropriate response.

The majority of the drought contingency plans in the ETRWPA use trigger conditions based on a combination of water supply and demands placed on the water distribution system. A list of water users that are required by Texas Water Code 12.1272 to submit a drought contingency plan are included in Table 6.3. Table 6.4 lists triggers and drought response stages for individuals who submitted drought contingency plans by August 28, 2009. All plans include water conservation measures which range from voluntary water restrictions in Stage I to mandatory restrictions in the final stage. Some drought contingency plans include an emergency stage not directly related to drought, but as a result of system rupture or failure. In these instances, they are listed as the final trigger stage.

Table 6.3 Water Users Required to Submit Drought Contingency Plans

Athens Municipal Water Authority	City of Orange
Angelina and Neches River Authority	City of Palestine
Angelina-Nacogdoches WCID	City of Port Arthur
City of Athens	City of Port Neches
City of Beaumont	City of Silsbee
City of Bridge City	City of Tyler
City of Carthage	GM WSC
City of Center	Houston County WCID No. 1
City of Crockett	Lumberton MUD
City of Groves	Lower Neches Valley Authority
City of Henderson	Orange County WCID 1
City of Jacksonville	Panola County Fresh Water Supply District No. 1
City of Jasper	Sabine River Authority
City of Lufkin	Southern Utilities Company
City of Nacogdoches	Upper Neches River Municipal Water Authority
City of Nederland	

Table 6.4 Drought Trigger Conditions and Strategies Documented in Drought Contingency Plans

Water User	Drought Contingency Strategies													
	Trigger based on:		Stage I		Stage II		Stage III		Stage IV		Stage V		Stage VI	
	Supply	Demand	Voluntary Measures	Mandatory Measures	Voluntary Measures	Mandatory Measures	Voluntary Measures	Mandatory Measures	Voluntary Measures	Mandatory Measures	Voluntary Measures	Mandatory Measures	Voluntary Measures	Mandatory Measures
Athens Municipal Water Authority*														
Angelina and Neches River Authority	●	●	●		●	●	●	●	●	●	●	●		
Angelina-Nacogdoches WCID	●		●		●	●	●	●	●	●				
City of Beaumont	●	●	●		●	●	●	●	●	●	●	●		
City of Bridge City	●		●		●	●	●	●	●	●	●	●		
City of Carthage	●	●	●		●	●	●	●						
City of Groves	●	●	●		●	●	●	●						
City of Henderson	●	●	●		●	●	●	●						
City of Jacksonville	●	●	●		●	●	●	●						
City of Lufkin	●		●		●	●	●	●						
City of Nacogdoches	●	●	●		●	●	●	●	●	●				
City of Nederland	●	●	●		●	●	●	●						
City of Orange	●	●	●		●	●	●	●						
City of Palestine	●	●	●		●	●	●	●						
City of Port Arthur	●	●	●		●		●	●						
City of Silsbee	●	●	●		●	●	●	●	●	●				

Table 6.4 Drought Trigger Conditions and Strategies Documented in Drought Contingency Plans (Cont.)

Water User	Drought Contingency Strategies													
	Trigger based on:		Stage I		Stage II		Stage III		Stage IV		Stage V		Stage VI	
	Supply	Demand	Voluntary Measures	Mandatory Measures	Voluntary Measures	Mandatory Measures	Voluntary Measures	Mandatory Measures	Voluntary Measures	Mandatory Measures	Voluntary Measures	Mandatory Measures	Voluntary Measures	Mandatory Measures
Houston County WCID No. 1	●	●	●		●	●	●	●	●	●				
Lumberton MUD	●	●	●		●	●	●	●	●	●	●	●	●	●
Lower Neches Valley Authority	●		●		●	●	●	●						
Orange County WCID 1	●	●	●		●	●	●	●	●	●	●	●	●	●
Sabine River Authority	●		●		●	●	●	●	●	●	●	●		
Southern Utilities Company	●	●	●		●	●	●	●						
Upper Neches River Municipal Water Authority	●	●	●		●	●	●	●	●	●				

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Chapter 7

Description of How the Regional Water Plan is Consistent with Long-Term Protection of the State's Water Resources, Agricultural Resources, and Natural Resources

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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 2011 Plan is consistent with the long-term protection of the State's water resources, agricultural resources, and natural resources. The requirement to evaluate the consistency of the regional water plan with protection of resources is found in 31 TAC Chapter 357.14(2)(C), which states, in part:

"The regional water plan is consistent with the guidance principles if it is developed in accordance with §358.3 of this title (relating to Guidelines), §357.5 of this title (relating to Guidelines for Development of Regional Water Plans), §357.7 of this title (relating to Regional Water Plan Development), §357.8 of this title (relating to Ecologically Unique River and Stream Segments), and §357.9 of this title (relating to Unique Sites for Reservoir Construction)."

Chapter 7 addresses this issue 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 2011 Plan with the State's water planning requirements. To demonstrate compliance with the State's requirements, a matrix has been developed and is addressed in Section 7.4.

7.1 Consistency with the 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, the Neches River Basin, and the Trinity River Basin. The respective boundaries of these basins are depicted in Figure 1.2, 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 and Queen City aquifers and localized aquifers, such as the Yegua-Jackson. The extents of these aquifers within the region are depicted on Figures 1.9 and 1.10 in Chapter 1.

Surface water accounts for approximately 75% of the total water use in the region. Sources 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% of the available groundwater. Over the past decade or more, significant water level declines have been observed in the Carrizo-Wilcox aquifer around the cities of Tyler, Lufkin, and Nacogdoches. 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.

To be consistent with the long-term protection of water resources, the 2011 Plan must recommend strategies that minimize threats to the region's sources of water over the planning period. The water management strategies identified in Chapter 4 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. Descriptions of some of the major strategies for the 2011 Plan and the ways in which they minimize threats are the following:

- **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 23,860 ac–ft of water annually by 2060, 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.
- **Development of Lake Columbia**. This strategy will increase surface water supplies available for cities, industry and agriculture in the ETRWPA.
- **Use of water from Toledo Bend by Regions C and D**. This strategy is planned for near the end of the planning horizon. If economically feasible, it could reduce the need for additional reservoirs in Regions C and D.
- **Optimized use of existing surface water resources**. Water management strategies that involve existing surface water resources work to optimize these resources and reduce the need for development of new surface water reservoirs. The WAM, a part of the regional planning process, assesses how the increased use of surface water resources will impact the Region's water resources. The WAMs developed for the ETRWPA indicate adequate availability of surface water in the region.
- **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 the sustainable level.

7.2 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 LNVA, primarily, with water from the Rayburn/Steinhagen system. The WAMs indicate adequate availability of surface water to meet the projected irrigation demands for the planning period.

7.3 Consistency with Protection of Natural Resources

The ETRWPA contains many natural resources, which must be considered in water planning. Natural resources include threatened or endangered species; local, state, and federal parks and public land; and energy/mineral reserves. Following is a brief discussion of how the 2011 Plan is consistent with the long-term protection of these resources.

7.3.1 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 19 species of birds, eight insects, six mammals, 15 reptiles/amphibians, nine fish, 13 mollusks, 22 vascular plants, and two crustaceans. In general, water management strategies planned for the ETRWPA would not affect threatened or endangered species. Development of new reservoirs in the region could affect threatened or endangered species and their habitat. 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.

7.3.2 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 water management strategies 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. It would be unlikely, therefore, that a proposed water management strategy for the ETRWPA would be permitted to adversely impact such properties.

7.3.3 Timber Resources. Much of the ETRWPA is heavily forested and timber is an important economic resource for the region. 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. An environmental impact statement for Lake Columbia has been prepared and is under review by the U.S. Army Corps of Engineers.

7.3.4 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 1.19 and 1.20, 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 1.22. These resources represent an important economic base for the region. None of the water management strategies is expected to significantly impact oil, gas, or coal production in the region.

7.4 Consistency with State Water Planning Guidelines

To be considered consistent with long-term protection of the State's water, agricultural, and natural resources, the ETRWPA Water Plan must also be determined to be in compliance with the following regulations:

- 31 TAC Chapter 358.3
- 31 TAC Chapter 357.5
- 31 TAC Chapter 357.7
- 31 TAC Chapter 357.8
- 31 TAC Chapter 357.9

The information, data, evaluation, and recommendations included in Chapters 1 through 6 and Chapters 8 and 9 of the 2011 Plan collectively demonstrate compliance with these regulations. To assist with demonstrating compliance, the ETRWPA has developed a matrix addressing the specific recommendations contained in the above referenced regulations. Table 7.1 is a completed matrix, which is a checklist highlighting each pertinent paragraph of the regulations. The content of the 2011 Plan have been evaluated against this matrix.

Column 1 includes a regulatory citation for all subsections and paragraphs contained in the above regulations. A summary of each cited regulation is included in Column 2. It should be understood that this summary is intended only to provide a general description of the particular section of the regulation and should not be assumed to contain all specifics of the actual regulation. The evaluation of the Regional Water Plan should be performed against the complete regulation, as contained in the actual 31 TAC 358 and 31 TAC 357 regulations.

Column 3 of the checklist provides the evaluation response as affirmative, negative, or not applicable. A “Yes” in this column indicates that the ETRWPG believes the Regional Water Plan complies with the stated section of the regulation. A “No” response indicates that the ETRWPG believes the Regional Water Plan does not comply with the stated regulation. A response of “NA” (or not applicable) indicates that the stated section of the regulation does not apply to the Regional Water Plan.

The evidence of where in the Regional Water Plan the stated regulation is addressed is provided in Column 4. Where the regulation is addressed in multiple locations within the Regional Water Plan, this column may cite only the primary locations. In addition to identifying where the regulation is addressed, this column may include commentary about the application of the regulation in the Regional Water Plan.

The above-listed regulations are repetitive, in some instances. One section of the regulations may be restated or paraphrased elsewhere within the regulations. In some cases, multiple sections of the regulations may be combined into one separate regulation section. Column 5 indicates cross-referencing for water planning regulations.

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Table 7.1 Checklist for Comparison of the Regional Water Plan to Applicable Water Planning Regulations

(Column 1) Regulatory Citation	(Column 2) Summary of Requirement	(Column 3) 2011 Plan Complies? (Yes/No/ NA)	(Column 4) Location(s) in Regional Plan and/or Other Commentary	(Column 5) Regulatory Cross References
31 TAC §358.3				
(a)	TWDB shall develop a State Water Plan (SWP) with 50-year planning cycle, and based on the Regional Water Plan (RWP)	NA	Applies to the State Water Plan. The Regional Water Plan is based on a 50-year planning cycle, however.	
(b)	RWP is guided by the following principles:			
(b)(1)	Identified policies and actions so that water will be available at reasonable cost, to satisfy reasonable projected use and protect resources	Yes	Chapters 4, 6, and 7	§358.3(b)(4), §357.5 (a); §357.7 (a)(9); §357.5(e)(1); § 357.7(a)(10)
(b)(2)	Open and accountable decision-making based on accurate, objective information	Yes	Regular public meetings of the RWPG; Public Hearings scheduled throughout the region.	§357.5 (e)(6)
(b)(3)	Consideration of effects of plan on the public interest, and on entities providing water supply	Yes	Chapters 4, 5, and 7	
(b)(4)	Consideration and approval of cost-effective strategies that meet needs and respond to drought, and are consistent with long-term protection of resources	Yes	Chapters 4, 6, and 7	§358.3(b)(1), §357.5 (e)(4) and §357.5 (e)(6); §357.7(a)(9)
(b)(5)	Consideration of opportunities that encourage the voluntary transfer of water resources	Yes	Chapter 4	
(b)(6)	Consideration and approval of a balance of economic, social, aesthetic, and ecological viability	Yes	Chapters 4 and 7	
(b)(7)	The use of information from the adopted SWP for regions without a RWP	NA		
(b)(8)	The orderly development, management, and conservation of water resources	Yes	Chapters 4 and 6	§357.5(a)
(b)(9)	Surface waters are held in trust by the State, and governed by doctrine of prior appropriation	Yes	Chapters 3 and 4	
(b)(10)	Existing water rights, contracts, and option agreements are protected	Yes	Chapter 4	§357.5(e)(3)

Table 7.1 Checklist for Comparison of the Regional Water Plan to Applicable Water Planning Regulations (Cont.)

(Column 1) Regulatory Citation	(Column 2) Summary of Requirement	(Column 3) 2011 Plan Complies? (Yes/No/ NA)	(Column 4) Location(s) in Regional Plan and/or Other Commentary	(Column 5) Regulatory Cross References
(b)(11)	Groundwater is governed by the right of capture unless under local control of a groundwater conservation district	Yes	Chapter 1 and Chapter 4	
(b)(12)	Consideration of recommendation of stream segments of unique ecological value	Yes	Chapter 8. The RWPG decided to not recommend any of the Region's stream segments for designation as a segment of unique ecological value	§357.8
(b)(13)	Consideration of recommendation of sites of unique value for the construction of reservoirs	Yes	Chapter 8. The RWPG decided to not recommend any location as a site of unique value for construction of a reservoir.	§357.9
(b)(14)	Local, regional, state, and federal agency water planning coordination	Yes	The regional water planning process has included all levels of coordination, as necessary.	
(b)(15)	Improvement or maintenance of water quality and related uses as designated by the State Water Quality Plan	Yes	Chapters 4 and 5	
(b)(16)	Cooperation between neighboring water planning regions to identify common needs and issues	Yes	The regional planning process has included coordination with neighboring regions, as needed.	
(b)(17)	WMS described sufficiently to allow a state agency making financial or regulatory decisions to determine consistency of the WMS with the RWP	Yes	Chapter 4	§357.7(a)(9)
(b)(18)	Environmental evaluations are based on site-specific information or state environmental planning criteria	Yes	Chapter 4. To the extent that such information is available.	§357.5(e)(1); §357.5 (e)(6); §357.5(k)(1)(H)
(b)(19)	Consideration of environmental water needs, including instream flows and bay and estuary inflows	Yes	Chapters 3 and 4	§357.5(e)(1); §357.5(l); §357.7 (a)(8)(A)(ii)
(b)(20)	Planning is consistent with all laws applicable to water use for state and regional water planning	Yes	The regional water planning process has considered applicable water laws.	§357.5(f)

Table 7.1 Checklist for Comparison of the Regional Water Plan to Applicable Water Planning Regulations (Cont.)

(Column 1) Regulatory Citation	(Column 2) Summary of Requirement	(Column 3) 2011 Plan Complies? (Yes/No/ NA)	(Column 4) Location(s) in Regional Plan and/or Other Commentary	(Column 5) Regulatory Cross References
(b)(21)	Ongoing permitted water development projects are included	Yes	Chapters 1, 3, and 4	
31 TAC §357.5				
(a)	The RWP: provides for the orderly development, management, and conservation of water resources; prepares for drought conditions; and protects agricultural, natural, and water resources	Yes	Chapters 4, 6, and 7	§358.3(b)(1); §358.3(b)(1); §357.7(a)(10)
(b)	The RWP submitted by January 5, 2011	NA	To be submitted	
(c)	The RWP is consistent with 31 TAC §358 and 31 TAC §357, and guided by state and local water plans	Yes		
(d)(1) & (2)	The RWP uses state population and water demand projections from the SWP; or revised population or water demand projections that are adopted by the State	Yes	Chapter 2. Population of the ETRWPA did not change in this round, per TWDB. Water demands changes were approved by TWDB in January 2010	
(e)(1)	The RWP provides WMS adjusted for appropriate environmental water needs; environmental evaluations are based on site-specific information or state environmental planning criteria	Yes	Chapter 4; to the extent that site-specific information was available.	§358.3(b)(1); §358.3(b)(18); §357.7 (a)(8)(A)(ii), §358.3(b)(19)
(e)(2)	The RWP provides WMS that may be used during a drought of record	Yes	Chapter 4	
(e)(3)	The RWP protects existing water rights, contracts, and option agreements	Yes	Chapter 4	§358.3(b)(10)

Table 7.1 Checklist for Comparison of the Regional Water Plan to Applicable Water Planning Regulations (Cont.)

(Column 1) Regulatory Citation	(Column 2) Summary of Requirement	(Column 3) 2011 Plan Complies? (Yes/No/ NA)	(Column 4) Location(s) in Regional Plan and/or Other Commentary	(Column 5) Regulatory Cross References
(e)(4)	The RWP provides cost-effective and environmentally sensitive WMS based on comparisons of all potentially feasible WMS; The process is documented and presented to the public for comment.	Yes	Chapter 4. WMS have been presented to the public and adopted by the RWPG.	§358.3(b)(4)
(e)(5)	The RWP incorporates water conservation planning and drought contingency planning	Yes	Chapters 4 and 6	§357.5(k)(1)(A)&(B); §357.7(a)(7)(B)
(e)(6)	The RWP achieves efficient use of existing supplies and promotes regional water supplies or regional management of existing supplies; Public involvement is included in the decision-making process	Yes	Chapter 4. Regular public meetings held to discuss WMS and conservation issues.	§358.3(b)(2); §358.3(b)(4); §358.3(b)(18)
(e)(7)(A)&(B)	The RWP identifies (A) drought triggers, and (B) drought responses for designated water supplies	Yes	Chapter 6	§357.5(e)(5); §357.5(k)(1)(A)&(B)
(e)(8)	The RWP considers the effect of the plan on navigation	Yes		
(f)	Planning is consistent with all laws applicable to water use in the Region	Yes	The regional planning process has considered applicable water laws.	§358.3(b)(20)
(g)	The following characteristics of a candidate special water resource are considered:			
(g)(1)	The surface water rights are owned by an entity headquartered in another region.	Yes	Chapter 1	
(g)(2)	A water supply contract commits water to an entity headquartered in another region.	Yes	Chapter 1	
(g)(3)	An option agreement may result in water being supplied to an entity headquartered in another region.	Yes	Chapter 1	

Table 7.1 Checklist for Comparison of the Regional Water Plan to Applicable Water Planning Regulations (Cont.)

(Column 1) Regulatory Citation	(Column 2) Summary of Requirement	(Column 3) 2011 Plan Complies? (Yes/No/ NA)	(Column 4) Location(s) in Regional Plan and/or Other Commentary	(Column 5) Regulatory Cross References
(h)	Water rights, contracts, and option agreements of special water resources are protected in the RWP	NA		
(i)	The RWP considers emergency transfers of surface water rights	Yes	No emergency transfers of water are anticipated in this plan update.	
(j)(1)-(3)	Simplified planning is used in the RWP in accordance with TWDB rules	NA		
(k) (1)&(2)	The RWP shall consider existing plans and information, and existing programs and goals related to local or regional water planning	Yes	Chapters 1 through 6	§358.3(b)(18); §357.5(e)(5); §357.5(e)(7); §357.7(a)(1)(A)(M)
(l)	The RWP considers environmental water needs including instream flows and bays and estuary flows	Yes	Chapters 3 and 4	§358.3(b)(19); §357.7 (a)(8)(A)(ii)
31 TAC §357.7				
(a)(1)(A)-(M)	The RWP shall describe the region, including specific requirements of paragraphs A through M of this section of the regulations	Yes	Chapter 1	§357.7(a)(8)(A)(iii); §357.7(a)(8)(D); §357.5(k)(1)(C); §357.7(a)(7)(A)(iv)
(a)(2)(A)-(C)	The RWP includes a presentation of current and projected population and water demands, reported in accordance with paragraphs A through C of this section of the regulations	Yes	Chapter 2	

Table 7.1 Checklist for Comparison of the Regional Water Plan to Applicable Water Planning Regulations (Cont.)

(Column 1) Regulatory Citation	(Column 2) Summary of Requirement	(Column 3) 2011 Plan Complies? (Yes/No/ NA)	(Column 4) Location(s) in Regional Plan and/or Other Commentary	(Column 5) Regulatory Cross References
(a)(3)(A)&(B)	The RWP includes the evaluation of current water supplies available (including a presentation of reservoir firm yields) to the Region for use during drought of record conditions, reported by the type of entity and wholesale providers	Yes	Chapter 3	
(a)(4) (A)&(B)	The RWP includes water supply and demand analysis, comparing the type of entity and wholesale providers	Yes	Chapter 4	
(a)(5)(A)-(C)	The RWP provides sufficient water supply to meet the identified needs, in accordance with requirements of paragraphs A through C of this section of the regulations	Yes	Chapter 4	
(a)(6)	The RWP presents data required in paragraphs (2) - (5) of this subsection in subdivisions of the reporting units required, if desired by the RWPG	Yes	Chapters 2 through 4	
(a)(7)(A)-(G)	The RWP evaluates all WMS determined to be potentially feasible, in accordance with paragraphs A through G of this section of the regulations	Yes	Chapter 1	§357.5(k)(1)(C); §357.7(a)(1)(M); §357.5(e)(5); §357.5(k)(1)(B)
(a)(8)(A)-(H)	The RWP evaluates all WMS determined to be potentially feasible, by considering the requirements of paragraphs A through H of this section of the regulations	Yes	Chapter 4	§358.3(b)(19); §357.5(e)(1); §357.5(l); §357.7(a)(1)(L); §357.7(a)(8)(D); §357.7(a)(8)(A)(iii);
(a)(9)	The RWP makes specific recommendations of WMS in sufficient detail to allow state agencies to make financial or regulatory decisions to determine the consistency of the proposed action with an approved RWP	Yes	Chapter 4	§358.3(b)(1); §358.3(b)(4); §358.3(b)(17)

Table 7.1 Checklist for Comparison of the Regional Water Plan to Applicable Water Planning Regulations (Cont.)

(Column 1) Regulatory Citation	(Column 2) Summary of Requirement	(Column 3) 2011 Plan Complies? (Yes/No/ NA)	(Column 4) Location(s) in Regional Plan and/or Other Commentary	(Column 5) Regulatory Cross References
(a)(10)	The RWP includes regulatory, administrative, or legislative recommendations to facilitate the orderly development, management, and conservation of water resources; prepares for drought conditions; and protects agricultural, natural, and water resources	Yes	Chapters 4, 6, and 7	§358.3(b)(1) §357.5(a)
(a)(11)	The RWP includes a chapter consolidating the water conservation and drought management recommendations	Yes	Chapter 6	
(a)(12)	The RWP includes a chapter describing the major impacts of recommended WMS on key parameters of water quality	Yes	Chapter 5	
(a)(13)	The RWP includes a chapter describing how it is consistent with long-term protection of the state's water, agricultural, and natural resources	Yes	Chapter 7	
(a)(14)	The RWP includes a chapter describing the financing needed to implement the water management strategies recommended	Yes	Will be provided as Chapter 9	
(b)	The RWP excludes WMS for political subdivisions that object to inclusion and provide reasons for objection	NA		
(c)	The RWP includes model water conservation plan(s)	Yes	Chapter 6 of the 2006 Plan. Referenced in the 2011 Plan.	
(d)	The RWP includes model drought contingency plan(s)	Yes	Chapter 6 of the 2006 Plan. Referenced in the 2011 Plan.	
(e)	The RWP includes provisions for assistance of the TWDB in performing regional water planning activities and/or resolving conflicts within the Region	NA	No known conflicts within the region.	

Table 7.1 Checklist for Comparison of the Regional Water Plan to Applicable Water Planning Regulations (Cont.)

(Column 1) Regulatory Citation	(Column 2) Summary of Requirement	(Column 3) 2011 Plan Complies? (Yes/No/ NA)	(Column 4) Location(s) in Regional Plan and/or Other Commentary	(Column 5) Regulatory Cross References
31 TAC §357.8				
(a)	The RWP considers the inclusion of recommendations for the designation of river and stream segments of unique ecological value within the Region	Yes	Chapter 8. The RWPG decided to not recommend any of the Region's stream segments for designation as a segment of unique ecological value.	§358.3(b)(12)
(b)	If river or stream segments of unique ecological value are recommended, such recommendations are made in the plan on the basis of the criteria established in this section of the regulations	NA	No river or stream segments of unique ecological value have been recommended in this update.	
(c)	If the RWP recommends designation of river or stream segments of unique ecological value, the impact of the regional water plan on these segments is assessed	NA	No river or stream segments of unique ecological value have been recommended in this update.	
31 TAC §357.9				
(1)	The RWP considers the inclusion of recommendations for the designation of sites of unique value for construction of reservoirs	Yes	The RWPG decided to not recommend any location as a site of unique value for construction of a reservoir.	§358.3(b)(13)
(2)	If sites of unique value for construction of reservoirs are recommended, such recommendations are made in the plan on the basis of criteria established in this section of the regulations	NA	No sites have been recommended for designation as having unique value for construction of a reservoir in this update.	

Chapter 8

Ecologically Unique Stream Segments, Unique Reservoir Sites, and Legislative Recommendations

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This chapter of the 2011 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 ETRWPG and the group voted on each issue. Following is a discussion of each issue.

8.1 Unique Stream Segments

Designation of a river or stream segment as ecologically unique is defined by §16.051(f) of the Texas Water Code to mean "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." Based on this legislation, the ETRWPG is obligated to consider potential river or stream segments as being of unique ecological value based upon the following criteria:

(1) **Biological function** – stream segments which 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 which 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 which are fringed by significant areas in public ownership including state and federal refuges,

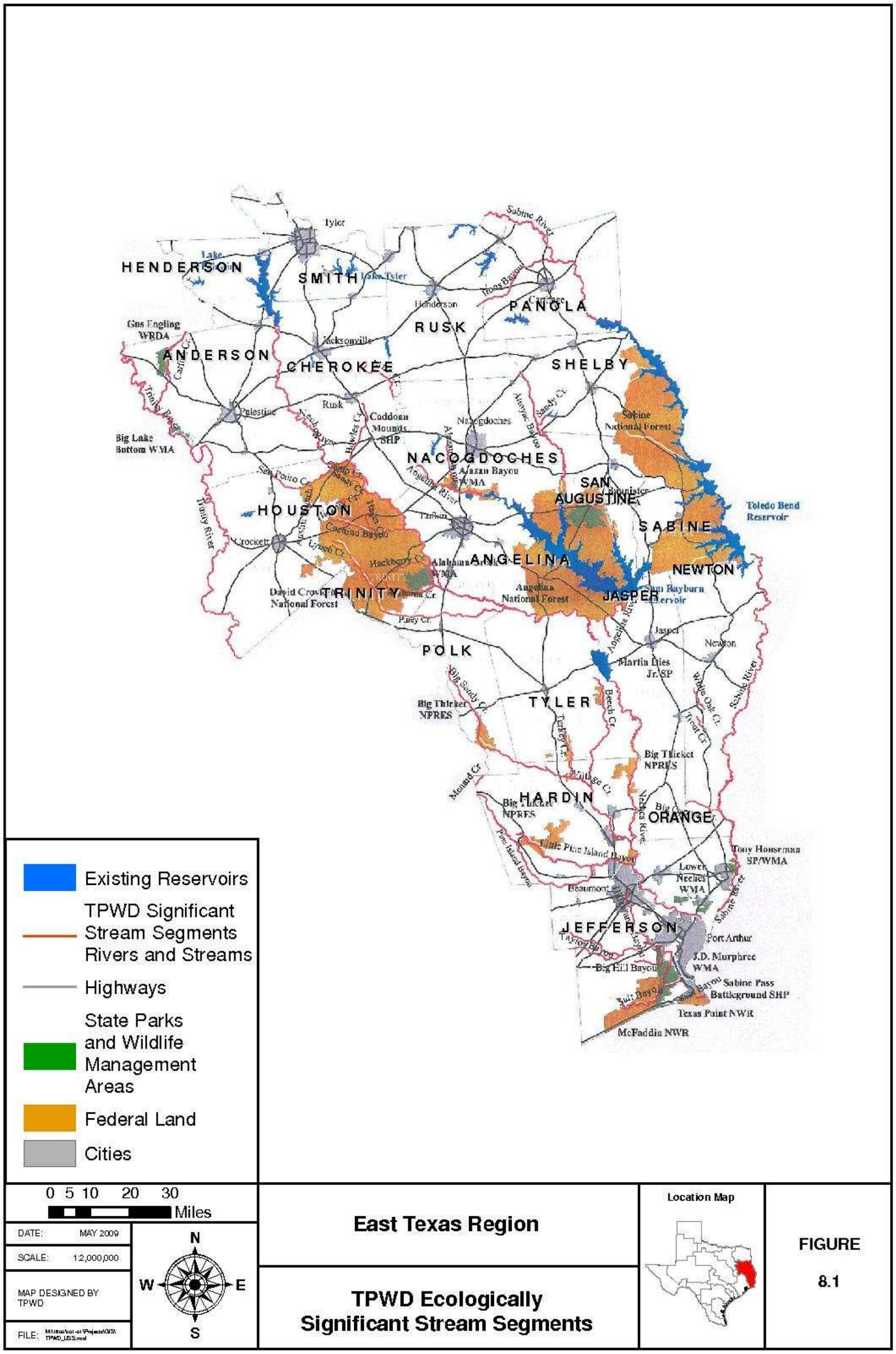
wildlife management areas, preserves, parks, mitigation areas, or other areas held by governmental organizations for conservation purposes, or stream segments which are fringed by other areas managed for conservation purposes under a governmentally approved conservation plan;

(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 TPWD developed a draft report[1] of ecologically significant river and stream segments in the ETRWPA. The TPWD draft 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 draft report has not been finalized and no action has been taken as of yet.

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.


HENDERSON
SMITH
RUSK
PANOLA
ANDERSON
CHEROKEE
SHELBY
NACOGDOCHES
SAN AUGUSTINE
HOUSTON
SABINE
ANGELINA
NEWTON
TRINITY
JASPER
POLK
TYLER
HARDIN
ORANGE
JEFFERSON
Toledo Bend Reservoir
Sam Rayburn Reservoir
Sabine National Forest
Angelina National Forest
Davy Crockett National Forest
Existing Reservoirs
TPWD Significant Stream Segments
Rivers and Streams
Highways
State Parks and Wildlife Management Areas
Federal Land
Cities
0 5 10 20 30
Miles
DATE: MAY 2009
SCALE: 12,000,000
MAP DESIGNED BY TPWD
N
W
E
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East Texas Region
TPWD Ecologically Significant Stream Segments
Location Map
FIGURE
8.1

Only nine of the 41 segments have three or more applicable criteria. Table 8.1 presents a summary of the 41 segments identified by TPWD and 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.

When the first regional water plans were prepared (2001), the RWPGs requested clarification of the intent of unique stream segment designations. The legislature addressed that issue in the 77th Legislative Session. The results are reflected in Section 16.051(f) of the Texas Water Code, which states:

> *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.*

This implies that it would be irrelevant to consider recommending a segment for designation if it does not have potential to be a reservoir site. Despite the above clarification, there continues to be concern among many regional water planning groups (including the ETRWPG) that designation of a stream segment might lead to additional unwarranted restrictions on the use of the segment, including water diversions and discharges of treated effluent. During the current round of regional water planning, representatives of Region C met with TCEQ, TWDB, and TPWD to discuss potential issues related to restrictions associated with unique stream segment designation. As a result of this meeting, the TWDB has determined that a stakeholder committee should be formed to address the potential concerns. The committee has not yet been formed. However, it is understood that recommendations of the committee should be developed before the next round of water planning is complete.

Table 8.1 TPWD Ecologically Significant River and Stream Segments

River/Stream Segment	Biological Function	Hydrologic Function	Riparian Conservation Areas	High Water Quality/ Exceptional Aquatic Life/High Aesthetic Value	Threatened or Endangered Species/Unique Communities
Alabama Creek			•		
Alazan Bayou	•		•		
Upper Angelina River	•		•		•
Lower Angeline River			•		•
Attoyac Bayou					•
Austin Branch			•		
Beech Creek			•	•	
Big Cypress Creek			•	•	
Big Hill Bayou	•		•		
Big Sandy Creek	•		•	•	
Bowles Creek			•		
Camp Creek			•		•
Catfish Creek			•	•	•
Cochino Bayou			•		
Hackberry Creek			•		•
Hager Creek			•		
Hickory Creek			•		
Hillebrandt Creek			•		
Irons Bayou				•	
Little Pine Island Bayou			•		
Lynch Creek			•		•
Menard Creek	•		•		
Mud Creek	•				•
Upper Neches River	•		•	•	•
Lower Neches River	•		•	•	•
Pine Island Bayou			•		
Piney Creek			•	•	•
Upper Sabine River	•			•	
Middle Sabine River	•		•		
Lower Sabine River	•			•	•
Salt Bayou	•		•		
San Pedro Creek			•		
Sandy Creek (Trinity County)					•
Sandy Creek (Shelby County)			•		•
Taylor Bayou	•		•		
Texas Bayou	•		•		
Trinity River	•		•		•
Trout Creek			•		
Turkey Creek			•		
Village Creek	•		•	•	•
White Oak Creek				•	

Table 8.2 TPWD 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		•							•

Six of the nine 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:

- Angelina River (Segment 0611; Nacogdoches County)
- Big Sandy Creek (0608B)
- Catfish Creek (Segment 0804G)
- Neches River (Segments 0601/0602)
- Trinity River (Segment 0803/0804)
- Village Creek (Segment 0608)

Three segments include reaches that have been identified as potentially suitable for a reservoir site.

- Neches River (Segment 0604) – Rockland Reservoir and Fastrill Reservoir
- Piney Creek (Segment 0604D) – Rockland Reservoir

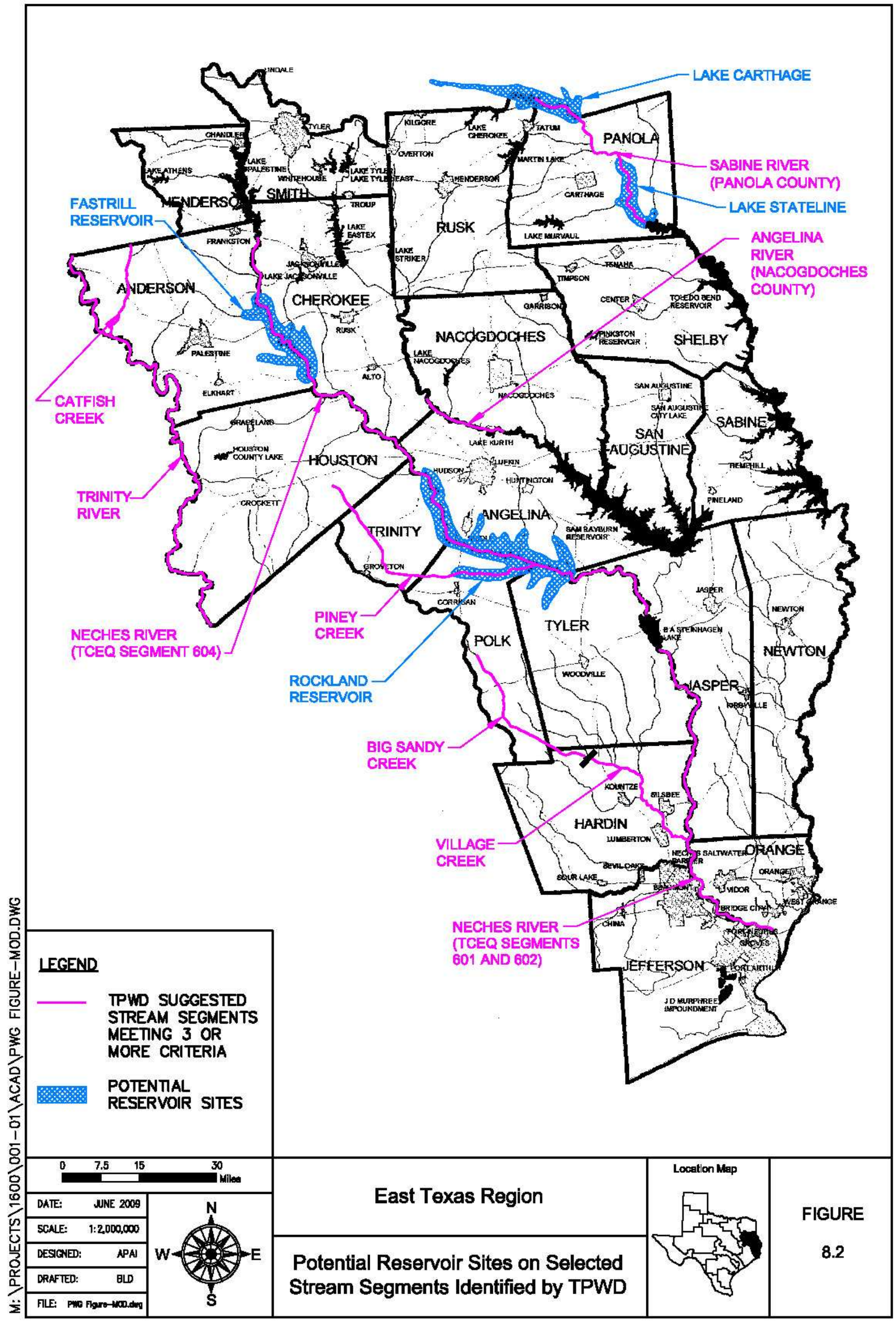
- Sabine River (Segment 0505; Panola County) – Lake Stateline and Lake Carthage

Figure 8.2 provides locations of the four proposed reservoirs with respect to potential unique stream segments.

Very little information currently 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. There are three national forests (Davy Crockett National Forest, Angelina National Forest, and Sabine National Forest) that encompass 475,000 acres. The Big Thicket National Preserve covers 97,000 acres. The McFaddin National Wildlife Refuge, Neches National Wildlife Refuge, Texas Point National Wildlife Refuge, J.D. Murphree Wildlife Management Area, Tony Houseman Wildlife Management Area, Engling Wildlife Management Area, Alabama Creek Wildlife Management Area, Alazan Bayou Wildlife Management Area, Lower Neches River Wildlife Management Area, Big Lake Bottom Wildlife Management Area, and E.O. Siecke State Forest encompass 138,000 acres. In addition, there are a number of state parks, state historic sites, and the Alabama and Coushatta Indian Reservation.


LAKE CARTHAGE
PANOLA
SABINE RIVER (PANOLA COUNTY)
LAKE STATELINE
ANGELINA RIVER (NACOGDOCHES COUNTY)
FASTRILL RESERVOIR
HENDERSON
SMITH
RUSK
ANDERSON
CHEROKEE
NACOGDOCHES
SHELBY
CATFISH CREEK
HOUSTON
SAN AUGUSTINE
SABINE
TRINITY RIVER
TRINITY
ANGELINA
NECHES RIVER (TCEQ SEGMENT 604)
PINEY CREEK
POLK
TYLER
NEWTON
ROCKLAND RESERVOIR
JASPER
BIG SANDY CREEK
HARDIN
VILLAGE CREEK
ORANGE
NECHES RIVER (TCEQ SEGMENTS 601 AND 602)
JEFFERSON
LEGEND
TPWD SUGGESTED STREAM SEGMENTS MEETING 3 OR MORE CRITERIA
POTENTIAL RESERVOIR SITES
0 7.5 15 30 Miles
DATE: JUNE 2009
SCALE: 1:2,000,000
DESIGNED: APAI
DRAFTED: BLD
N W E S
East Texas Region
Potential Reservoir Sites on Selected Stream Segments Identified by TPWD
Location Map
FIGURE 8.2
M:\PROJECTS\1600\001-01\ACAD\PWG FIGURE-MOD.DWG

Areas of the ETRWPA that are not part of a state or federal preserve are also protected by various regulatory programs. These activities include state and federal permitting activities, requirements for environmental assessments for certain activities that could adversely affect the environment.

At its regularly scheduled meeting in July 2009, the ETRWPG considered the above information and voted to not 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.

8.2 Unique Reservoir Sites

Regional water planning guidelines allow regional water planning groups to recommend sites of unique value for construction of new reservoirs. Considerations include physical characteristics (location, hydrology, geology, and topography), environmental factors, water availability and other pertinent features that make the site uniquely suited for water supply. The ETRWPA has a long history of water supply planning and reservoir development. There are numerous sites that 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 SB 3. Lake Columbia received its unique designation by the State Legislature, SB1362. Lake Columbia is currently being pursued for development. Other sites have been considered for water supply development in the past and may be considered again for future supplies.

The ETRWPG considered potential reservoir sites for possible designation as unique but did not designate any additional unique reservoir sites. The considered sites are described below.

Lake Columbia is identified as a recommended strategy to meet water shortages in the current planning cycle. Rockland Reservoir is identified as an alternative water management strategy for LNVA to meet its future water demands if reallocation of water in the Rayburn-Steinhagen system, or access to water from Toledo Bend Reservoir proves not to be viable.

There are several reservoir sites in the ETRWPA that have long been discussed as potential sources of water. 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 which is more thorough than the regional water planning effort. The ETRWPG is not recommending these sites 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.

At its regularly scheduled meeting in December 2009, the ETRWPG voted to not recommend any proposed reservoir sites as unique during this planning cycle. Proposed sites, including the two sites already designated as unique, are included in Table 8.3, following.

Table 8.3 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 (Alternate WMS)
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	Fastrill Reservoir (Already Unique Site)

In addition to the above sites, Lake Naconiche, located in northeast Nacogdoches County may also be a potential water supply. Lake Naconiche has a main purpose of flood control. The dam for Lake Naconiche has been completed and the lake is now impounding water. At normal pool elevation (348 ft. msl) the lake will impound 9,074 acre-feet. 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 Rockland Reservoir. The Rockland Reservoir site is located on the Neches River at River Mile 160.4. Appendix 8-A, Figure 8-A.1 indicates the proposed location. 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.

8.2.2 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.2 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.

8.2.3 Bon Weir Reservoir. The Bon Weir 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.2 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 Weir 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 impact numerous archeological and historical sites in both Texas and Louisiana. The Clean Rivers Program Water Quality data reported possible concerns for elevated TDS 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.

8.2.4 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.3 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 USFWS 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 (SRA, 1996a) 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.

8.2.5 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.3 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.

8.2.6 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.3 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 is 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 is 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.

8.2.7 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.3 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 SRA. 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 impact 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.

8.2.8 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.3 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.

8.2.9 Lake Columbia. The reservoir is a project of ANRA located predominantly in Cherokee County but extends into the southern portion of Smith County. Figure 8-A.4 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 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 (EIS) for Lake Columbia. The EIS underwent public comment in the first half of 2010. ANRA is currently responding to comments of state and federal review agencies, including the TPWD and EPA. Support for Lake Columbia also came from TPWD in its comments on the 2011 IPP, recognizing "the value of Lake Columbia in meeting certain local water supply needs[...]" The complete text of their comments may be found in Appendix 10-C.

8.2.10 Fastrill Reservoir. The Fastrill Reservoir has long been a project of the City of Dallas and UNRMWD. The site was designated as unique by the Texas Legislature in 2007. It 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.4 indicates the proposed location. Normal pool elevation would be at an elevation of 275 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.

The development of Fastrill Reservoir is unlikely at this time due to the designation of a portion of the site as a national wildlife refuge by the USFWS. The following discussion of Fastrill Reservoir's status is found in the Region C 2011 Plan:

> *Lake Fastrill was a recommended water management strategy in the approved 2006 Region C Water Plan and the 2007 State Water Plan and was designated by the Texas Legislature as a unique site for reservoir development. The lake was intended to meet projected water supply needs for Dallas and water user groups in Anderson, Cherokee, Henderson, and Smith Counties in Region I. A decision of the United States Supreme Court on February 22, 2010 not to hear the appeals of the State of Texas and Dallas has effectively supported the creation of the Neches River National Wildlife Refuge (NRNWR) and rendered the development of Lake Fastrill extremely unlikely.*

As the Texas Legislature has designated Fastrill Reservoir as a unique reservoir site, the ETRWPG will not eliminate it from the list of proposed reservoirs in the ETRWPA at this time. In accordance with a request of the City of Dallas, however, Fastrill Reservoir has been removed as a WMS in the 2011 Plan.

8.2.11 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.4 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.

8.2.12 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.5 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 SRA 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.

8.2.13 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.5 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.

8.3 Legislative Recommendations

Rules in 31 TAC 357.7(a)(10) 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 facilitate the orderly development, management and conservation of water resources and preparation for and response to drought conditions to ensure sufficient water will be available at a reasonable cost. For this update of the regional water plan, the Executive Committee of the ETRWPG reviewed previous recommendations made pursuant to this rule and evaluated new potential recommendations. Proposed recommendations were brought to the ETRWPG for consideration. Legislative recommendations adopted by the ETRWPG are discussed following.

8.3.1. Junior Water Rights. The ETRWPG supports legislation allowing exemptions to junior water rights by contracts that reserve sufficient surface water to meet 125% of the total projected demand of the basin of origin for the next 50 years. Such contracts shall require the receiving basin to pay for development of future water supplies needed to maintain the 125% reserve for renewal of the water supply contract.

8.3.2. Flexibility in Determining Water Plan Consistency. The ETRWPG is 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 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.

8.3.3 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.

8.3.4. Groundwater Conservation Districts. The ETRWPG recognizes the critical importance of groundwater conservation and proper management of this resource in the ETRWPA. Therefore, as an important component of regional planning, the ETWRPG encourages those portions of the ETRWPA not presently participating in a groundwater conservation district to carefully review groundwater management practices in their area and to consider whether creating or joining a groundwater conservation district would be appropriate.

8.3.5. Unique Reservoir Designation. The 79th Texas Legislature designated 19 sites as having unique value for the construction of a reservoir. One of these sites, Fastrill Reservoir, is located in the ETRWPA. As part of this designation, efforts to develop the site as a water supply reservoir must be taken by 2015 or the designation becomes null. Many of these sites are identified for potential water supply way beyond the 2015 time frame. Loss of this designation could allow others to permanently limit the ability of developing a reservoir on the site. The ETRWPG recommends that the designation of unique reservoir for the sites currently designated be extended to 2060, which would be through the current planning period.

In order to properly plan for mitigation banks in relationship to unique reservoir sites or potential reservoir sites, the ETRWPG recommends that the USACE Mitigation Bank Review Teams have TWDB and appropriate regional water planning agencies be added to the review teams.

8.3.6 Wastewater Reuse. The ETRWPG recommends that current regulations as they pertain to wastewater reuse should be reviewed and amended, as necessary, to encourage the reuse of wastewater effluent.

8.3.7 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 (WIF). 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 WIF 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.

8.3.8 Environmental Flows. Texas is currently in a process of identifying and recommending instream flows for the 23 river basins in Texas. The Neches and Sabine River Basins are two of the first basins to begin this process. The ETRWPG acknowledges the importance of these studies for the future of its water resources and supports the efforts of the various advisory teams and stakeholders in this endeavor. The ETRWPG also recognizes the need for water for growth and economic development. There is concern among local water rights holders that a significant portion of their water supply could be reallocated to meet instream flow demands. The ETRWPG recognizes that future flow conditions in Texas' rivers and streams must be sufficient to support a sound ecological environment that is appropriate for the area. However, the ETRWPG believes it is imperative that existing water rights are protected. In addition, SB 2 and SB 3 processes that relate to environmental flows should be closely coordinated with the SB 1 planning effort, involving regional water planning.

8.3.9 Uncommitted 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 shorter term "interruptible" water contracts as a way to meet short term needs before long-term water rights are fully utilized.

Chapter 9

Infrastructure Financing Report

The purpose of the infrastructure financing report (IFR) is to identify funding needed to implement the WMSs recommended in the 2011 Plan. The primary objectives of the report are:

- To determine the number of political subdivisions with identified needs for additional water supplies that will be unable to pay for their water infrastructure needs without some form of outside financial assistance;
- To determine how much of the infrastructure costs in the regional water plans cannot be paid for solely using local utility revenue sources;
- To determine the financing options proposed by political subdivisions to meet future water infrastructure needs (including the identification of any State funding sources considered); and,
- To determine what role(s) the RWPGs propose for the State in financing the recommended water supply projects.

A survey of WUGs with identified infrastructure needs was conducted by the ETRWPG and the TWDB. The survey form was designed by the TWDB and distributed after the IPP was approved by the ETRWPG.

9.1 Summary of Survey Results

Surveys were sent to seventeen municipal WUGs and seven WWPs with projected water shortages. Surveys were completed and returned for eight of the municipal WUGs and six of the WWPs. There were 31 WUGs with needs identified in the 2011 Plan which were not surveyed. These WUGs were in the manufacturing, power generation, irrigation, livestock, and mining categories. The results of the survey are included in Appendix 9-A.

In the IFR study, $1,348,737,330 of water supply and infrastructure needs were identified. Of that, $1,236,774,491 was the estimated cost of new surface water supply projects and major transmission systems. The remaining $111,962,839 was in development of new wells, local infrastructure, and public/private partnership projects. A summary of the projected financing required to meet the needs in the East Texas Region and a listing of the projects considered are provided in Appendix 9-A.

9.1.1 Municipal Water User Groups. A separate accounting was made for cost of project, by decade, to meet water needs for municipal WUGs, and is summarized in Table 9-1. Not included in this group are the costs of projects being undertaken by WWPs to meet the needs of municipal users. Projects for WWPs are discussed separately.

Table 9-1: Infrastructure Improvement Cost by Decade for Municipal Use

	2010	2020	2030	2040	2050	2060
Cost	$43,337,189	$17,569,450	0	0	0	0

Maintenance and replacement of existing treatment and transmission systems are not addressed in the 2011 Plan cost estimates. However, these are significant and on-going costs, and will impact communities' ability to fund additional infrastructure. These maintenance costs are expected to increase as a percentage of water system budgets as facilities constructed in the mid-20th century reach the end of their design life.

In the 14 survey responses received, four respondents (40%) anticipated fully funding the infrastructure costs through utility revenues supplemented in part with bank loans. The ten remaining respondents anticipated utilizing State or Federal programs to cover some or all of the estimated infrastructure costs.

9.1.2 Non-Municipal Water User Groups. Non-municipal WUGs were not surveyed. Water demands were aggregated at the county level. It is expected that within the non-municipal water use categories, any local infrastructure will be funded using a combination of the methods outlined below.

Manufacturing. It is anticipated that companies with projected shortages will coordinate directly with surface water providers identified for any infrastructure needed to bring water to their sites. The funding of this construction may occur in a number of ways. The typical method is for the water provider to construct the distribution system supplying the customers, and pass through the cost in the water rate. State assistance may be requested through the State Loan Program for some projects. A second funding option is for the manufacturer to directly construct the required infrastructure, which would be a site-specific consideration. In areas not currently served by a surface water provider, a private developer may choose to establish a distribution utility, or a public-private partnership may be formed between the water supplier and end user to develop a new system.

Steam Electric Power. It is expected that power plant owners, as a part of facility construction, will include any required water supply intakes and pipelines or contract directly with existing major water providers to obtain the needed additional water.

Mining. Mining is projected to experience water shortages in four counties. It is anticipated that those companies with projected shortages will either provide new supplies for themselves by drilling new wells or coordinate directly with surface water providers in their area for any infrastructure needed to bring water to their sites. It is expected that private companies will pay the cost of required infrastructure.

Irrigation. Anticipated infrastructure costs for irrigation are related to increased water needs due to business expansion. The needs are expected to be met by irrigators drilling wells or by contractual arrangement for increased supplies with surface water providers local to the point of need.

Livestock. Shortages in meeting livestock water demands are expected in seven counties. It is anticipated that those individuals and private companies with projected shortages will either provide new supplies for themselves by drilling new wells or coordinate directly with surface water providers in their area for any infrastructure needed to bring water to their sites. It is expected that payment of the cost for infrastructure will be made by the individuals or private companies needing the water.

9.1.3 Wholesale Water Providers.

All six WWP respondents indicated they would be implementing the recommended strategy in the 2011 Plan. Five of the respondents indicated that all or most of the funding source would be through TWDB programs. One respondent indicated funding would be from cash reserves as the strategy involved agreement with downstream water right holders. The estimated cost, by decade and TWDB Funding program is shown in Table 9-2.

Table 9-2: Infrastructure Improvement Cost for Wholesale Water Provider

Decade of Improvement	TWDB Funding Source Amount	
	State Participation	Drinking Water SRF
		$336,428,550
2020	$85,790,050	$266,992,250
2030		$79,389,250
2040		$79,783,000
2050		$475,648,000
2060		$12,387,000
Total	**$85,790,050**	**$1,164,838,000**

9.2 Infrastructure Finance Policy Statements

The Legislature has directed each regional water planning group to propose ways for the State to finance a portion of the water supply projects recommended by the State Water Plan. The ETRWPG has reviewed the needs of the region, and offers the following recommendations. Recommendations are grouped by the following categories: Policy Recommendations, Financial Assistance Programs, and New Funding Sources.

9.2.1 Policy Recommendations. Several general policy recommendations are provided, as follows:

- Water users should pay for the required infrastructure.
  - From local funds including those borrowed locally
  - From state revolving fund loan programs
  - From federal loan programs
  - From existing state and/or federal grant programs
- The State of Texas should participate in constructing new water supplies to make development of large water supplies feasible. State money to be recouped at the earliest possible date through sale of state portion of the project to water user.
- If water users are unable to pay for the required infrastructure, merging with another local entity to improve financial capacity must be considered.
- If merger is not an option, the State must provide some safety net type funds to provide safe water supply for small water users (less than 200 connections) that cannot afford the required infrastructure as determined by EPA affordability calculation.

9.2.2 Financial Assistance Programs. Recommendations regarding financial assistance programs include the following:

- The State Participation Program will be one of the most important financing programs for water supply projects sized to meet projected long-term demands. Increase the funding of this program as needed to allow development of these water supply projects (Lake Columbia).
- The State Revolving Fund Programs will remain important to assist some systems in meeting minimum water quality standards. As infrastructure ages and water quality standards increase, the demand for this assistance will grow. Increase the funding of this program in future decades, and

expand the program to include coverage for system capacity increases to meet projected growth for communities.

- The State Loan Program for political subdivisions and water supply corporations offers loans at a cost advantage over many commercial and many public funding options. Increase funding of this program to allow financing of near-term infrastructure cost projections.
- The USDA Rural Utilities Service offers Water and Waste Disposal Loans and Grants to rural areas and towns of up to 10,000 people. Disadvantaged communities within Texas are specifically targeted for these loans. Support continued and increased funding of this program at the Federal level, and fund the state Rural Water Assistance Fund.
- The Regional Water Supply and Wastewater Facilities Planning Program assists political subdivisions with planning grants, allowing small communities to pursue cost-efficient regional solutions. Increase funding of this program in anticipation of upcoming development throughout the state, and expand the program to include the costs for preliminary engineering design and development of detailed engineering cost estimates of recommended facilities.
- The USACE constructs civil works projects for flood control, hydropower, and navigation and ecosystem restoration. USACE participation in water supply projects is limited by current regulations. The ETRWPG supports legislative or regulatory changes that will:
  - Increase USACE's flexibility regarding increasing water supply storage in the reservoirs that they manage, and investigate other alternatives for increased involvement of USACE in funding water supply projects.
  - Allow the USACE to construct reservoirs with water supply as a primary purpose.

9.2.3 New Funding Sources. The ETRPWG believes that revenue generated by imposing a tax on bottled beverages, including bottled water, could be an important new source of income for financing water projects in Texas in the future. The legislative budget board has estimated that a 5 cent tax on bottled water only could raise in excess of $65.2 million dollars (2006 estimate).

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Chapter 10

Public Participation and Adoption of Plan

Regional water planning in Texas is a public process, requiring strategy for ensuring that the region's citizens are able to participate in the process. Rules in 31 TAC Chapter 357.12 define the notice and public participation requirements of the process. These rules include the following requirements:

- A public meeting prior to preparation of the regional water plan.
- Ongoing opportunities for public input during preparation of the plan.
- A Public Hearing 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.
- Agendas, meeting notices, IPP, and final regional water plan published on the internet.
- Copies of the IPP made available for public viewing.

This chapter addresses the ETRWPG's strategy for public involvement and participation in the development and adoption of the final 2011 Plan. The strategy included regular meetings of the ETRWPG, consultation with representatives of the major water user groups, publication of a region newsletter, distribution of regular press releases, and maintenance of a website for the ETRWPA. In addition, the regional planning process requires holding a Public Hearing to introduce the 2011 IPP and accept public comment. A description of the ETRWPG and the process follows.

10.1 East Texas Regional Water Planning Group Members

Original legislation for SB1 and the TWDB planning guidelines establish regional water planning groups to manage the planning process in their respective regions. The regional water planning groups include representatives of eleven 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 and Group Representation

Member	Interest
David Alders	Agriculture
Jeff Branick	Counties
David Brock	Municipalities
George P. Campbell	Other
Jerry Clark	River Authorities
Josh David	Other
Judge Chris Davis	Counties
Mark Dunn	Small Businesses
Michael Harbordt	Industries
Scott Hall	River Authorities
William Heugel	Public
Kelley Holcomb	Water Utilities
Dr. Joseph Holcomb	Small Businesses

Member	Interest
Bill Kimbrough	Other
Glenda Kindle	Public
Duke Lyons	Municipalities
Dale R. Peddy	Electric Power
Judge Hermon Reed	Agriculture
Monty D. Shank	River Authorities
Darla Smith	Industries
Worth Whitehead	Water Districts
Dr. J. Leon Young	Environmental

The ETRWPG appointed a Technical Committee comprised of individuals within the planning group. The charge to the Technical Committee was to work with the East Texas Region consulting team to develop recommended population and water demand projections, review work product of the consulting team, and provide technical advice to the planning group. Members of the Technical Committee during this round of planning included:

- Michael Harbordt
- David Brock
- George Campbell
- Chris Davis
- Glenda Kindle
- Monty Shank
- Scott Hall

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 final 2011 Plan.

10.2 Preplanning for the Final 2011 Plan

Rules in 31 TAC Chapter 357.6 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.
- Designate a political subdivision as a representative of the regional water planning group.

The ETRWPG held a public meeting on June 4, 2008, to discuss issues and provisions important to the ETRWPA that should be included in the regional water 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.

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 final 2011 Plan, including the following:

- Water user group involvement
- Press releases
- Newsletters
- 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. Chapters 1 through 4 of the final 2011 Plan cite specific instances of contact with WUGs.

10.3.2 Public Media and Press Releases. Press releases were sent to approximately 105 media entities within one week of each regularly scheduled RWPG meeting. Releases were frequently published in area newspapers, and more in-depth stories were occasionally written by newspaper staff. Copies of news releases and newspaper articles concerning water planning in the ETRWPA are included in Appendix 10-A.

10.3.3 Newsletters. The ETRWPG published newsletters to periodically inform the public of the progress of the planning process and to provide other relevant news. Newsletters were posted on the ETRWPA website http://www.etexwaterplan.org, and digitally and/or physically mailed to the following:

- Members of the ETRWPG
- Elected officials in the region
- Cities in the region
- Counties in the region
- Individuals who requested to be on the mailing list

Copies of newsletters produced since February 2009 are provided in Appendix 10-A.

10.3.4 East Texas Regional Water Planning Area Website. The ETRWPA website, www.etexwaterplan.org was regularly updated to inform the public of scheduled meetings and to provide minutes, agenda, press releases, newsletters, presentations, and memoranda.

10.3.5 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 final 2011 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 and the Texas Open Meetings Act. Regular meetings were held on the following dates:

- January 23, 2008
- April 9, 2008
- June 4, 2008
- August 13, 2008
- November 5, 2008
- February 11, 2009
- April 8, 2009
- July 8, 2009
- October 14, 2009
- December 9, 2009
- February 17, 2010

- June 30, 2010
- August 11, 2010

The 2011 IPP was adopted by the ETRWPG at its regularly scheduled meeting on February 17, 2010. The 2011 Plan was adopted by the ETRWPG on August 11, 2010.

10.3.6 Public Hearings for the Initially Prepared Plan. Following adoption of the IPP, hard-copies of the 2011 IPP were provided to at least one public library and county clerk's office in each county within the ETRWPA for public review. In addition, electronic copies were available for review on the ETRWPG website at www.etexwaterplan.org and at the Office of the City Secretary for the City of Nacogdoches.

According to rules in 30 TAC § 357.12(a)(3), a Public Hearing must be held in a central location within the ETRWPA following the adoption of an IPP. Appropriate public notice was provided for the Public Hearing, held in Jacksonville, Nacogdoches, and Beaumont on three consecutive evenings on April 20, 21, and 22, 2010. The purpose of the Public Hearing was to receive comments from the public on the 2011 IPP. Oral and written comments were received from two individuals at the Beaumont portion of the Public Hearing and are summarized in Section 10.5. Transcripts, presentations, and minutes from the Public Hearing are included in Appendix 10-B.

10.4 Comments from the Public and Agencies

As a public planning process, the ETRWPG must accept comments by the public and federal and state agencies regarding the development of the regional water 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. These comments are considered by the ETRWPG during the development of the 2011 IPP. After publication of the 2011 IPP, there is an official comment period during which public and federal and state agencies may submit formal comments on the IPP.

Comments received through the end of the comment period were reviewed and evaluated by the ETRWPG and consulting team. The ETRWPG modified the 2011 IPP as necessary, in response to comments.

Following are responses to the comments received from individuals, entities, and agencies regarding the IPP for the 2011 update of the ETRWPA regional water plan. In all, comments were received from eight persons on behalf of various agencies or groups. These included one oral comment provided at the Public Hearing for the 2011 IPP, one hand-written response provided at the Public Hearing, and six letters received during the comment period. In four cases, the comments received related to a single issue of the commenter. The other comments received addressed multiple issues. Appendix 10-C contains a transcript of the one oral comment and copies of all other comments received during the public comment period.

Responses to the comments are separated by commenter and provided in the order in which they were received. Where practical to do so, comments are first restated verbatim. Otherwise, a summary of the comment is provided. Some comments appeared to be, essentially, observations about the 2011 IPP instead of comments for which a response was intended. In such cases, the observation is summarized and acknowledged. In cases where the comment has resulted in modifications to the 2011 IPP, the locations within the plan are identified within this response to comments.

10.4.1 Comment of Richard Harrel on Behalf of Clean Air And Water, Inc.

Dr. Richard Harrel attended the Public Hearing held in Beaumont on April 22, 2010, and offered one oral comment, restated as follows:

> *My name is Richard Harrel, and I am the president of the citizen's environmental organization, Clean Air & Water, Inc. And Clean Air & Water, Inc., has been active since 1966. And Clean Air & Water, Inc., the*

Board of Directors, is opposed to construction of any new reservoirs in either of the drainage basins concerned. We think that construction of reservoirs, which would include – especially Fastrill reservoir but also the old Rockland reservoir, would have untold environmental effects that would all be harmful. And so, we want to go down on the record that we are opposed to taking water from our upper basins and moving it to Houston, Dallas or the Fort Worth area. We need the water. There are shortages in this region; and we will need the water, especially during those times. That's all.

Response: The ETRWPG acknowledges the comment. No changes have been made to the 2011 IPP as a result of the comment.

10.4.2 Comment of Bruce Drury on Behalf of the Big Thicket Association. Dr. Bruce Drury attended the Public Hearing held in Beaumont on April 22, 2010, and offered one written comment on the Public Comment Request Form, restated as follows:

Strike the provisions for Fastrill and Rockland. Impoundment of the Neches will do great harm to the floodplain – the core of the Big Thicket.

Response: The ETRWPG acknowledges the comment. Fastrill Reservoir is no longer a recommended strategy for the City of Dallas (see comment and response in Section 10.4.7). Fastrill Reservoir remains a unique reservoir site. No changes have been made to Chapter 8 in the 2011 IPP as a result of the comment.

10.4.3 Comment of Fred Manhart on Behalf of Entergy Texas, Inc. Fred Manhart, manager of environmental support with Entergy Texas, Inc., offered one comment in a letter to the ETRWPG dated June 17, 2010. Mr. Manhart's comment is summarized as follows:

The comment referenced the 2011 IPP Executive Summary, Section 8.3, first bullet of the section, in which the ETRWPG encourages all areas in the region not presently in a groundwater management area to create or join one. Mr. Manhart expressed concern about this "one size fits all" approach and that individual areas within the region should be responsible for selecting the methods by which protection of future uses and natural resources would be accomplished.

Response: The referenced location in the 2011 IPP is the Executive Summary, which is a summary of language found in Chapter 8 of the 2011 IPP (Section 8.3.4). The ETRWPG's intent was to point out that conservation of groundwater resources is important to the future of water supply within the region. At the June 30, 2010, meeting of the ETRWPG, it was noted by some members that a groundwater conservation district had prevented over-drafting of the aquifer. Had the district not already been in place, it would have been too late to prevent potential loss of resource. Nevertheless, it was not the intent of the ETRWPG to imply that management of groundwater be addressed in only one manner. As a result of this comment, the applicable section within Chapter 8 (Section 8.3.4) and the referenced section within the Executive Summary of the 2011 IPP have been modified.

10.4.4 Comments of Billy Sims on Behalf of the City of Woodville. Billy Sims offered two comments in a letter to Rex Hunt, dated June 21, 2010. The comments are discussed following:

Comment 1. Mr. Sims noted that the City of Woodville is in need of a new water well to supplement its supply. He indicated that the population and water demands shown for the City in the 2011 IPP are too low, not showing the presence of two prison facilities and the commensurate water demand for these facilities. Mr. Sims requested that the plan be changed to more accurately reflect the City's demand, and to add a new well to their water management strategies.

Response: The ETRWPG responds that the population and water demands contained within the 2011 IPP have previously been approved by the ETRWPG and the

TWDB and cannot be changed at this time in the water planning process. Such changes will be evaluated in the next update of the water plan. However, the 2011 IPP will be modified to note this issue. A footnote to Table 2.1: Distribution of Population by County/Entity in Chapter 2 has been added. In addition, the 2011 IPP has been modified to add the new well as a water management strategy for the City. This addition is found in Chapter 4C, Section 4C.20.

Comment 2. Mr. Sims noted that the East Texas Electric Cooperative is planning to construct a bio-mass power plant in Tyler County, south of the City of Woodville, but that the 2011 IPP does not include any demand for power production in Tyler County. He requested that the 2011 IPP be modified to include power production demands in Tyler County.

Response: The ETRWPG responds that steam-electric water demands contained within the 2011 IPP have previously been approved by the ETRWPG and the TWDB, and cannot be changed at this time. The proposed power facility in Tyler County was not identified by the TWDB previously. It is still in the planning stages. The ETRWPG will consider this potential new demand in the next round of planning. No changes to the 2011 IPP were made regarding this comment.

10.4.5 Comments of Ross Meinchuk on Behalf of the Texas Parks and Wildlife Department.

Ross Meinchuk offered several general observations and five comments on the 2011 IPP in a letter to Kelley Holcomb dated June 21, 2010. The comments are discussed following:

Comment 1. Mr. Meinchuk noted that the following listed Species of Special Concern listed in Appendix 1-A, Table 1-A.1, should be denoted in the plan as "State Threatened" species:

- Texas pigtoe
- Louisiana pigtoe

- Texas heelsplitter
- Triangle pigtoe
- Sandbank pocketbook
- Southern hickorynut

Mr. Meinchuk also requested that these species be included in Chapter 1, Table 1.13 of the 2011 IPP.

Response: Table 1-A.1 has been modified to add the designation of State Threatened for the above listed species. In addition, these species have been added to Table 1.13.

Comment 2. Mr. Meinchuk noted that fish consumption advisories due to mercury contamination have been issued by the Texas Department of State Health Services for a number water bodies within the ETRWPA.

Response: The ETRWPG acknowledges that fish consumption advisories resulting from mercury contamination have been issued for water bodies in the region. No changes to the 2011 IPP have been made as a result of this comment.

Comment 3. Mr. Meinchuk noted the following in regard to the water management strategy, Lake Columbia:

> *TPWD recognizes the value of Lake Columbia in meeting certain local water supply needs and is committed to assisting the Angelina-Neches River Authority (ANRA) in attenuating impacts to fish and wildlife from reservoir constructions, as well as working with ANRA to develop compatible recreational and natural resources plans for the reservoir once constructed.*

Response: The ETRWPG appreciates TPWD's support of the appropriate development of water resources and protection of environmental resources in the

ETRWPA. Discussion of this statement of support has been added to the description of the Lake Columbia project found in Chapter 8, Section 8.2.9 of the final 2011 Plan.

Comment 4. Mr. Meinchuk noted that the TPWD wonders whether the Fastrill Reservoir project should continue to be recommended as a viable water management strategy.

Response. Based on comments from the City of Dallas (see Section 10.4.7), Fastrill Reservoir has been removed as a water management strategy for the City of Dallas. There are no other entities proposing the reservoir as a water management strategy. Therefore, the final 2011 Plan for the ETRWPA has been modified to remove Fastrill Reservoir as a water management strategy. However, Fastrill Reservoir is a Unique Reservoir Site, so designated by the Texas Legislature in 2007. Therefore, a discussion of the Fastrill Reservoir project remains in the final 2011 Plan in Chapter 8, Section 8.2.10. This section has been updated from the 2011 IPP to reflect the current status of the site.

Comment 5. Mr. Meinchuk also made the following comment:

> *TPWD does wish to reiterate its perspective that there are other conservation alternatives that are favorable to wildlife and the environment, such as water conservation, wastewater reuse, full use of existing supplies, and good land stewardship, to name a few. Construction of off-channel reservoirs can also help to minimize wildlife impacts if reservoirs are located to minimize inundation of habitats and diversions are modified to avoid impacts to environmental flows.*

Response: The context of this comment is unclear; however, the ETRWPG believes that the conservation alternatives listed in the comment are at least not harmful to wildlife and the environment, and may be considered favorable in many instances. The ETRWPG currently does not have an opinion regarding off-channel reservoirs. No changes to the plan have been made as a result of this comment.

10.4.6 Comment of Jim Jeffers on Behalf of the City of Nacogdoches. Nacogdoches City Manager, Jim Jeffers, provided two comments on the 2011 IPP in a letter to Rex Hunt dated June 22, 2010. The comments are discussed following:

Comment 1. Mr. Jeffers related the City's desire to replace their alternate water management strategy for water from Toledo Bend with an alternate water management strategy for water from Sam Rayburn Reservoir. The comment provided reasons for the requested change and suggested modifications to the 2011 IPP to address the requested change.

The ETRWPG discussed the City's comment with Mr. Jeffers during a regularly scheduled ETRWPG meeting on June 30, 2010. At that time, it was suggested that the City need not delete the Toledo Bend alternate water management strategy in order to add another alternate water management strategy. Mr. Jeffers agreed and indicated that it would be acceptable to leave the Toledo Bend alternate water management strategy in the plan for now. In addition, the ETRWPG stated that the proposed new Sam Rayburn strategy could not be incorporated into the plan as an alternate water management strategy at this time due to time and resource limitations. However, the ETRWPG agreed that the proposed new alternate water management strategy could be described in the plan with the intent of finalizing it in the next round of regional water planning. This would mean the alternate water management strategy could be in the 2016 update of the regional water plan. Mr. Jeffers agreed that this would be acceptable to the City.

Response: Based on the discussions held during the June 30 meeting, the ETRWPG has modified Chapter 4C, Section 4C.2.7, of the 2011 IPP to incorporate a discussion of the proposed future alternate water management strategy.

Comment 2. Mr. Jeffers expressed the City's concern that the water demand projections for the City in the 2011 IPP are too low, and that the City is not in agreement with the projections.

Response: The ETRWPG appreciates the City's concern about water demand projections, but cannot modify the demands further in this round of planning. Water demands will be evaluated more closely in the next round of regional water planning where the 2010 Census population data can be used to better support water demand projections for all of the ETRWPA. Section 4C.2.7 acknowledges that the City's current planning efforts indicate greater population growth and higher demands by the commercial and manufacturing sectors.

10.4.7 Comments of Jody Puckett on Behalf of Dallas Water Utilities.

Jody Puckett offered seven comments on the 2011 IPP in a letter to Kelley Holcomb dated June 28, 2010. The comments are discussed following:

Comment 1. Ms. Puckett provided an updated description of Lake Palestine for Chapter 1 of the plan, for consideration of the ETRWPG.

Response: The updated description provided has been added to the final 2011 Plan.

Comment 2. Ms. Puckett noted changes in the status of Lake Fastrill resulting from the recent decision of the United States Supreme Court to not hear appeals of the TWDB and City of Dallas, stating that the decision "rendered the development of Lake Fastrill extremely unlikely." Excerpts from the Region C Plan outlining the plans for replacements to the Lake Fastrill water management strategy were provided for consideration of the ETRWPG.

Response: The ETRWPG agrees that the Region C plan and the ETRWPA plan should be consistent with regard to Lake Fastrill. The final 2011 Plan has been revised to incorporate the Neches Run-of-the-River Project or Fastrill Replacement Project in place of Fastrill Reservoir.

Comment 3. Ms. Puckett noted that Lake Fastrill has been designated by the Texas Legislature as a Unique Reservoir Site and likewise identified in the 2007 State Water Plan. As such, Ms. Puckett suggested that Lake Fastrill should remain in the final 2011

Plan "in the event conditions change and it becomes favorable to proceed with Lake Fastrill."

Response: The ETRWPG agrees that it would be inappropriate to remove Lake Fastrill from the final 2011 Plan as long as the proposed lake is designated as a Unique Reservoir Site. While the description of Lake Fastrill in Chapter 8 (Section 8.2.10) has been modified to reflect the changes suggested in the Region C plan, Lake Fastrill will remain as an Unique Reservoir Site in the final 2011 Plan.

Comment 4. Ms. Puckett noted that demand by Lake Fastrill, in the amount of 112,100 ac-ft per year beginning in 2040, was left blank in Table 4.B.18. The comment indicated that this demand will be met through UNRMWA.

Response: Table 4B.18 was titled, "Demands Supplied by Lake Fastrill." With the removal of Lake Fastrill as a water management strategy, the title of this table will be modified to reflect the change in source of supply. In addition, the demand for the City of Dallas will be included in the table in the amount of 112,100 ac-ft per year beginning in 2040.

Comment 5. Ms. Puckett noted that the volume of "future potential" demand shown in the UNRMWA demand table on page 4C-90 was inconsistent with the volume provided in the text above the table for water to Dallas Water Utilities.

Response: The table has been corrected.

Comment 6. This comment is in reference to a discussion in Chapter 1, Section 1.16.4 regarding Lake Murvaul. The comment provides updated information regarding the contract between the City of Dallas and Luminant.

Response: The final 2011 Plan has been updated to reflect the updated information.

Comment 7. The comment refers to the Tables and Figures in Chapter 4C not being identified with names or numbers.

Response: The ETRWPG acknowledges the comment. No changes have been made to the final 2011 Plan relevant to this comment.

10.5 Comments of Carolyn Brittin on Behalf of the Texas Water Development Board

Carolyn Brittin offered comments to the 2011 IPP in a letter to Kelley Holcomb dated June 28, 2010. The comments were divided between "Level 1" and "Level 2" comments. Level 1 includes comments, questions, and online planning database revisions that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements. Level 2 includes comments and suggestions for consideration that may improve the readability and overall understanding of the regional plan. Each comment is addressed following.

10.5.1 Level 1 Comments. There were 21 Level 1 comments offered by Ms. Brittin.

Comment 1. Please describe the plan's impact to navigation. [Title 31 Texas Administrative Code (TAC) §357.5(e)(8)]

Response: A new section with a description of the plan's impact to navigation has been added to Chapter 1, Section 1.2.3.

Comment 2. Please describe how the plan considered existing regional water plans, existing recommendations in state water plan and existing local water plans. [31 TAC 31§357.7(a)(1)(I), (J), and (K)]

Response: A new section with a discussion of how the plan considered existing regional water plans, existing recommendations in the state water plan, and existing local water plans has been added to Chapter 1, Section 1.15.

Comment 3. Provide a list of potentially feasible water management strategies that were considered and evaluated by the planning group. [Contract Exhibit "C" Section 11.1]

Response: A list has been included in Appendix 4C-B of the final 2011 Plan. The potentially feasible strategies are also listed on page 4B-1 of the 2011 IPP.

Comment 4. Page 1-24, Figure 1.12; Page 3-15, Figure 3.5: Complete outcrop areas of minor aquifers in the region are not displayed and sub-crop areas overlap and cover the outcrop areas of younger units. Please review plan text to reflect the accurate locations. For example: In chapter 1, page 1-26, although the Yegua-Jackson aquifer is located in the southern portion of Houston county it is not shown on the map (Figure 1.12) or discussed in text. [31 TAC §357.7(a)(1)(D)]

Response: Figures and text have been revised to appropriately demonstrate minor aquifer locations.

Comment 5. Water demand projections are not split out by river basins. Please present water demand projections by river basin for each county. [31 TAC §357.7(a)(2)(A)(iv)]

Response: Water demand projections have been split out by river basin in the plan, in Appendix 2-B of the final 2011 Plan.

Comment 6. The plan does not include categories of water demands for wholesale water providers by river basins. Please present water demands for wholesale water providers by river basin. [31 TAC §357.7(a)(2)(B)]

Response: Water demands for wholesale water providers have been split out by river basin in the plan, in Appendix 2-B of the final 2011 Plan.

Comment 7. Page 3-10, Table 3.4: It appears that the Trinity County-Neches Basin-Irrigation water supply is mislabeled as "mining." Please revise if appropriate.

Response: The use type was changed to irrigation and supply summaries were updated.

Comment 8. Page 3-17, Table 3.5: Water supply sources are not summarized by county and river basin. Please revise to summarize by county and river basin. [31 TAC § 357.7(a)(4)(B) ; Contract Exhibit "D" Section 3.0]

Response: Water supply sources have been summarized by county and river basin in Appendix 3-B of the final 2011 Plan.

Comment 9. Page 3-28, second paragraph: A reference is made to "Appendix 3-B." The referenced appendix was not included in plan. Please include appendix or revise text.

Response: Appendix 3-B has been included in the final 2011 Plan.

Comment 10. Pages 3-29 and 3-30, Tables 3.9 and 3-10: Please revise tables to summarize water supplies by county and river basin. [31 TAC § 357.7(a)(4)(B)]

Response: The available supplies to water users are shown by county and basin in Appendix 3-B of the final 2011 Plan. No changes were made to table 3-9 and 3-10.

Comment 11. Page 4A-5, Table 4A.3: It appears that total county surplus and shortage (water need) volumes were calculated incorrectly by subtracting total [county-wide] supply from total [county-wide] demand. Please revise to reflect total county water needs as the sum of the individual needs of each water user group in the county; needs that are calculated based on each water user group's own demands and supplies. Please also delete region totals at bottom of table as this further mis-aggregates water needs (shortages) region-wide.

Response: These tables reflect a supply and demand comparison by county. The projected shortages by water user group are shown in Table 4A.5. The projected surplus or shortage for each water user group by county and river basin is included in the DB12 tables in Appendix 4C-B of the final 2011 Plan. A footnote was added to Table 4A.3 noting that the sum of individual shortages may differ from the surplus or shortage shown in this table. A reference to Table 4A.5 with the WUG shortages was added.

Comment 12. Please include a table with recommended and, if applicable, alternative water management strategies with project capital costs and water supply by decade. [31 TAC §357.7(a)(7)(H); Contract Exhibit "C" Sections 4.3, 11.1]

Response: The requested table has been included in Appendix 4C-B of the final 2011 Plan.

Comment 13. Please explain how the region considered emergency transfers of non-municipal use surface water without causing unreasonable damage to the property of the non-municipal water rights holder pursuant to Texas Water Code §11.139. [TAC 31 §357.5(i)]

Response: Only water management strategies to meet long-term needs were identified in the East Texas Regional Water Plan. Emergency transfers are strategies implemented on a short term basis and were not considered in this update.

Comment 14. Please describe how alternative water management strategies were evaluated using environmental criteria. [31 TAC §358.3(b)(180]

Response: Alternative strategies were evaluated in the same manner as all strategies discussed in the plan. Details of the strategy evaluation process are outlined in Appendix 4B-A.

Comment 15. Please confirm that capital costs are based on September 2008 dollars as required, or revise as appropriate. [Contract Exhibit "C" Section 4.1.2]

Response: The assumptions used for cost estimates have been included in Appendix 4C-A. This was inadvertently omitted from the 2011 IPP.

Comment 16. In instances when conservation was considered but not recommended as a water management strategy, please indicate why conservation was not recommended. [31 TAC §357.7(a)(4)]

Response: The screening of conservation strategies is outlined in Appendix 4B-A.

Comment 17. Please include a summary of information regarding water loss audits specific to Region I. [31 TAC § 357.7 (a)(1)(M)]

Response: A summary of information regarding water loss audits for the ETRWPA has been added to Section 1.14.3 of the final 2011 Plan.

Comment 18. Page 6-3, paragraph 3: Plan does not include a model water conservation/drought contingency plan. Please include a model water conservation/drought contingency plan. [31 TAC §357.7(c)]

Response: The final 2011 Plan is an update of the 2006 Plan only. Model water conservation and drought contingency plans were included in the 2006 Plan and have been referenced in the final 2011 Plan. To further aid water user groups in development of water conservation and drought contingency plans, a hyperlink to model plans on the Texas Commission on Environmental Quality website was provided.

Comment 19. Page 6-8, first paragraph: Plan does not include a model drought contingency plan from an affected water user group. Please include a model drought contingency plan for an affected water user group. [31 TAC §357.7(d)]

Response: The final 2011 Plan is an update of the 2006 Plan only. Model water conservation and drought contingency plans were included in the 2006 Plan and have been referenced in the final 2011 Plan. To further aid water user groups in development of water conservation and drought contingency plans, a hyperlink to model plans on the Texas Commission on Environmental Quality website was provided.

Comment 20. (Attachment B) Comments on the online planning database (i.e. DB12) are herein being provided in spreadsheet format. These Level 1 comments are based on a direct comparison of the online planning database against the Initially Prepared Regional Water Plan document as submitted. The table only includes numbers that do not reconcile between the plan (left side of spreadsheet) and online database (right side of spreadsheet). An electronic version of this spreadsheet will be provided upon request.

Response: The planning data base (DB12) and the final 2011 Plan have been reconciled. Responses to specific comments are documented on the spreadsheet provided by the TWDB in Appendix 10-D.

Comment 21. (Attachment C) Based on the information provided to date by the regional water planning groups, TWDB has also attached a summary, in spreadsheet format, of apparent unmet water needs that were identified during the review of the online planning database and Initially Prepared Regional Water Plan. [Additional TWDB comments regarding the general conformance of the online planning database (DB12) format and content to the Guidelines for Regional Water Planning Data Deliverables (Contract Exhibit D) are being provided by TWDB staff under separate cover as 'Exception Reports']

Response: Shortages for Cherokee and Hardin Mining demands and Nacogdoches Steam Electric Power are correct. Discussions of the needs for these entities are included in Chapter 4C. The ETRWPG did not develop water management strategies for needs less than 5 ac-ft per year. No changes were made to the ETRWP.

10.5.2 Level 2 Comments. There were six Level 2 comments offered by Ms. Brittin.

Comment 1. Page 1-27, Section 1.6.1: "Springs" appears to incorrectly refer to Section 1.9.8. Please consider revising reference as appropriate (i.e., to "Section 1.9.7")

Response: The reference to springs has been corrected in the final 2011 Plan.

Comment 2. Page 1-42, Section 1.9: Please consider including assessment of the importance of recreational uses of natural resources (fishing, boating, etc.).

Response: The ETRWPG agrees that recreational uses of natural resources are important. However, such uses will not be assessed at this time and no change will be made to the final 2011 Plan.

Comment 3. Page 3-7: A reference is made in the "Reservoirs" paragraph to a summary of "firm yields" in Table 3.2. The Table is titled "Currently Available Supplies from Permitted Reservoirs…" Please consider clarifying in Table 3.2 that it presents firm yields, if applicable.

Response: The last sentence under paragraph "Reservoirs" was modified to reflect available supplies. The definition of available supply is defined earlier in the paragraph.

Comment 4. Page 3-17, Table 3.5: Please consider revising two of the table headings from "Yegua" to "Yegua-Jackson" and from "Carrizo" to "Carrizo-Wilcox."

Response: The requested revisions were made.

Comment 5. Page 4C-62, table: Table is referenced in the text as "4C.A". Please consider adding the missing table number "4C.A" to the table title to be consistent with other tables.

Response: The requested revisions were made.

Comment 6. Appendix 4C-A: Project cost estimates are presented in two different formats (e.g., Anderson County Other, page 4C-A-3 format vs. Hardin County-Other, page 4C-A-28 format). Please consider using a consistent format for presenting "Cost Estimate" worksheets.

Response: The requested revisions were not made.

10.6 Adoption of the Final 2011 Plan

The ETRWPG met in August 2010, to review comments and propose modifications to the 2011 IPP. The final 2011 Plan was adopted by the ETRWPG on August 11, 2010, and published on the Internet for public viewing. The final 2011 Plan was submitted to the TWDB by September 1, 2010.

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