Chapter 4C

Water Management Strategies for Entities with an Identified Need

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	0	132
Recommended Strategy ADC-1: Increase Supply from Queen City						100
Recommended Strategy ADC-2: Increase Supply from Carrizo-Wilcox						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 FR1: Increase Supply from Carrizo-Wilcox			121	121	121	121
Recommended Strategy FR-2: Water Conservation			6	7	8	9

Strategy	Amount (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
FR1: 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)	0	19	45	70	95	119
Recommended Strategy ADN-1: Increase Supply from Carrizo-Wilcox		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 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		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	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	-16	-133	-347	-657
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	1200	$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**	**$3,274,191**			

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)	-2,509	-10,006	-12,523	-15,070	-17,365	-19,827
ANM-1: Obtain water from City of Lufkin	6,800	15,800	15,800	15,800	15,800	15,800
ANM-2: Obtain raw water from Lake Columbia via contract with ANRA		8,551	8,551	8,551	8,551	8,551

Strategy	Amount (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	15,800	$15,609,700[1]	$7,716,000	$488	$1.50
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 4,500 ac-ft peryear would be raw water and 3,000 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	-18	-53	-90
Recommended Strategy ANL-1 (ac-ft per year): Increase local surface water supplies (stock ponds)				90	90	90

Strategy	Amount (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	Amount (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				

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			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)	-153	-263	-284	-305	-358	-431
Recommended Strategy HAC-1A (ac-ft/year): Use additional water from Gulf Coast Aquifer (Phases I-III).	153	306	306	306	459	459

Strategy	Firm 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)	153	$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	Firm 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	Firm 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)	-21	-36	-56	-77	-107	-147
AT-1: Conservation	1	6	12	17	22	30
AT-2: Purchase water from Athens MWA	20	30	44	60	85	117

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

Strategy	Amount (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: Water from Athens MWA(1)	117	$0	$95,300	$814	$2.50

(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	Firm 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)	-3	-4	-5	-5	-6	-6
Recommended Strategy HEI-1 (ac-ft/year): Obtain water from Lake Athens	152	158	164	169	175	181

Strategy	Firm 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)	-466	-601	-729	-843	-959	-1,066
Recommended Strategy HEL-1 (ac-ft/year) Fish Hatchery Reuse	0	2,872	2,872	2,872	2,872	2,872

Strategy	Firm 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)	0	-2	-5	-8	-11	-15
Recommended Strategy HOMa-1 (ac-ft/year): Obtain water from Houston County WCID	0	2	5	8	11	15

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)	-382	-667	-986	-1,334	-1,720	-2,146
HOI-1: Increase Supply from Carrizo-Wilcox – Phase I-VI	383	766	1,149	1,532	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	383	$534,260	$79,154	$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)	-35	-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)	-309	-405	-423	-365	-338	-338
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	Firm 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	-4	-9
Recommended Strategy JEM-1 (ac-ft/year): Use additional supply from Gulf Coast Aquifer					9	9

Strategy	Firm 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		25,591	25,591	25,591	25,591	25,591

Strategy	Firm 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)	-78	-162	-235	-325	-498	-688
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	$	$	$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	$4,392,350	$505,765	$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	Amount (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	Firm 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 Manufacturing	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	Firm 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)	-88	-2	0	0	0	0
Recommended Strategy ORC-1 (ac-ft/year): Use additional supply from Gulf Coast Aquifer	140	140	140	140	140	140

Strategy	Firm 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	-38	-82	-97	-159	-203
Recommended Strategy ORMa-1 : New well in Jasper County in Gulf Coast Aquifer		203	203	203	203	203

Strategy	Firm 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)	-1,519	-8,356	-14,334	-20,294	-25,585	-31,536
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	Firm 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	Amount (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	Firm 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	-65	-165	-270	-366	-450
Recommended Strategy POM-1 (ac-ft/year): Expand existing supplies (Phases I and II)		225	225	450	450	450

Strategy	Firm 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	-3	-83	-158
Recommended Strategy RUL-1 (ac-ft/year): Increase supply from Carrizo-Wilcox	0	0	0	158	158	158

Strategy	Firm 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	-1,494	-9,905
Recommended Strategy RUSE-1 (ac-ft/year): Supply from SRA	0	0	0	0	1,500	1,500
Strategy RUSE-2: Supply from Lake Columbia					0	8,500

Strategy	Firm 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)	-11	-23	-30	-38	-47	-62
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	64	64	64	64	64	64

Strategy	Firm 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	200	$ 809,000	$ 177,000	$ 885	$ 2.71

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)	-38	-81	-130	-187	-253	-325
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	50	100	200	300

Strategy	Firm 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)	-90	-90	-90	-90	-90	-90
Recommended Strategy SAI-1 (ac-ft/year): Obtain water from Carrizo-Wilcox aquifer	90	90	90	90	90	90

Strategy	Firm Yield (ac-ft per year)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
SAI-1: Carrizo-Wilcox aquifer	90	$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	Firm 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	Amount (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)	0	-82	-157	-177	-226	-304
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	Firm 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	Firm 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	Firm 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	Amount (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	Firm 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	Amount (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 is 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	Firm 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	-74
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	Firm 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	Firm 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	Firm 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	-5	-101	-183	-294
Strategy SMMa-1 (ac-ft/year): Purchase water from City of Tyler	0	0	5	101	183	294

Strategy	Firm 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	294	$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	Firm 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.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.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	150	251	251	251	251

Strategy	Firm 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

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 in Table 4C.A with the current participation percentage.

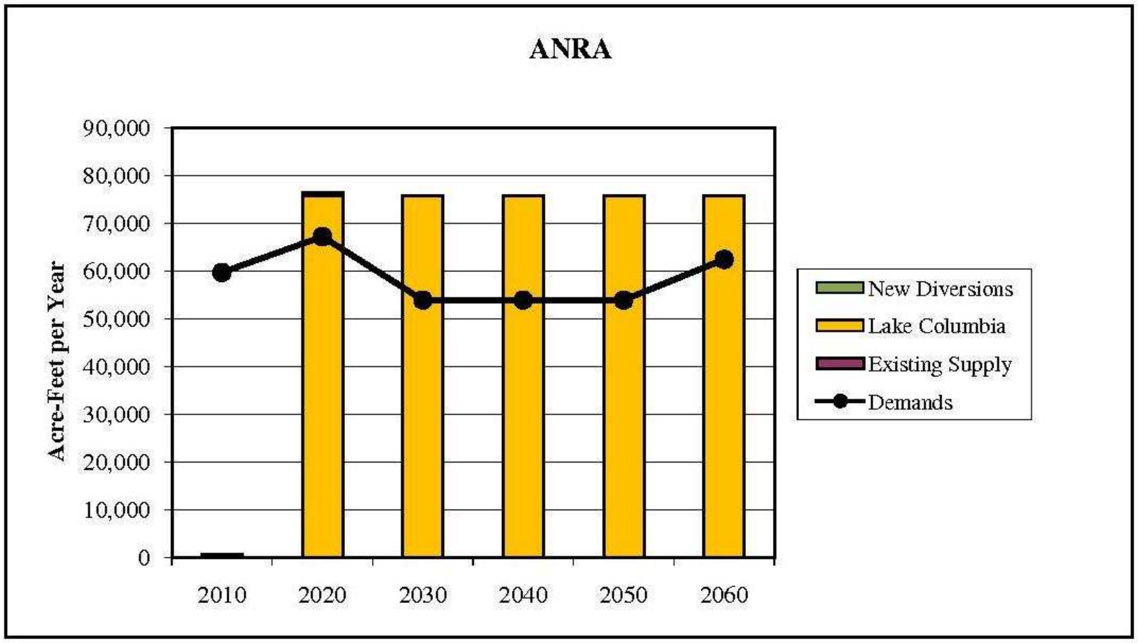
Current Participants in Lake Columbia

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.

Table 4C.2 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	Quantity (ac-ft per year)	Capital cost	Annual Cost	Unit Cost ($/AF)	Unit Cost ($/1000 gal)
New River Diversions	750	$200,000	$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
- 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:

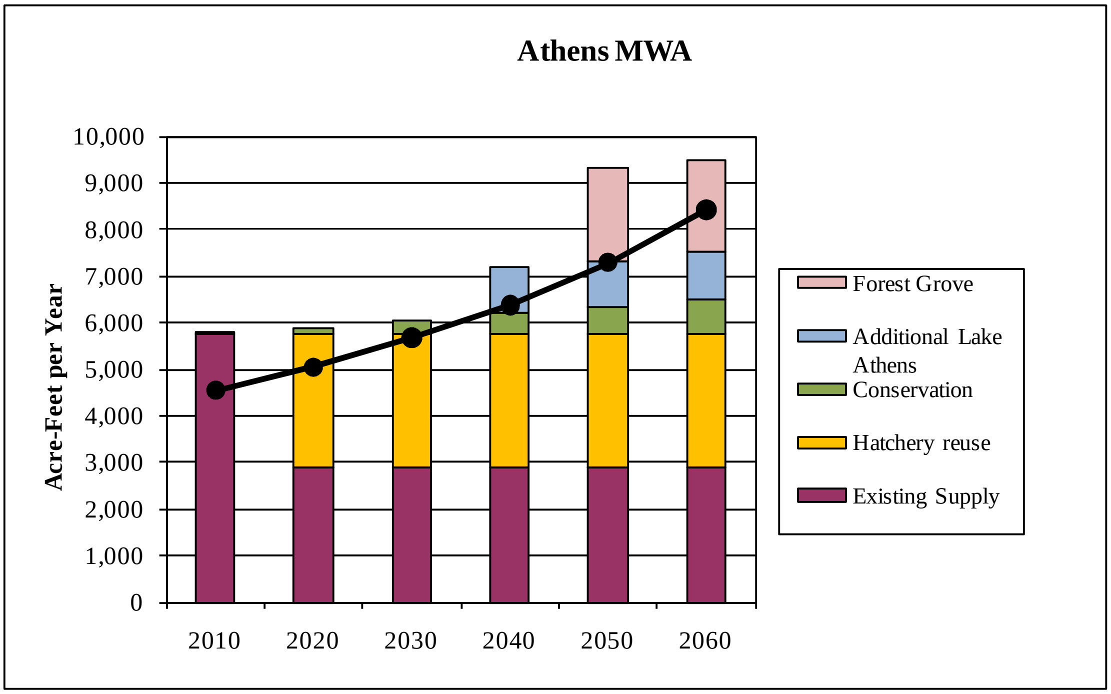
- Indirect reuse to Lake Athens from fish hatchery
- Water from Forest Grove Reservoir
- Construct new 4 MGD treatment plant near City of Athens, with a 4 MGD expansion in 2060.

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.

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)	46	209	344	452	589	761
Fish Hatchery Reuse	0	2,872	2,872	2,872	2,872	2,872
Forest Grove w/ WTP at City				2,240	2,240	2,240
WTP Expansion						2,240
Total Supplies from Strategies	46	3,081	3,216	5,564	5,701	8,113
Total Supplies	5,818	5,981	6,116	8,464	8,601	11,013
Total from Conservation and Reuse	46	3,081	3,216	3,324	3,461	3,633
Percent of Strategy Supplies from Conservation and Reuse	100%	100%	100%	60%	61%	45%
Demands (ac-ft per year)	4,536	5,054	5,672	6,373	7,289	8,421
Surplus or (Shortage)	**1,282**	**823**	**383**	**829**	**2,045**	**1,081**



Strategy	Quantity	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Fish Hatchery Reuse	2,872	$ 0	$ 0	$ 0	$ 0
Additional Lake Athens with 1.5 MGD Expansion at Lake	1,000	$5,943,300	$643,150	$ 643	$ 1.97
Forest Grove water with 3.5 MGD New WTP at City	2,000	$16,575,556	$1,651,300	$ 843	$ 2.59

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	Quantity (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.

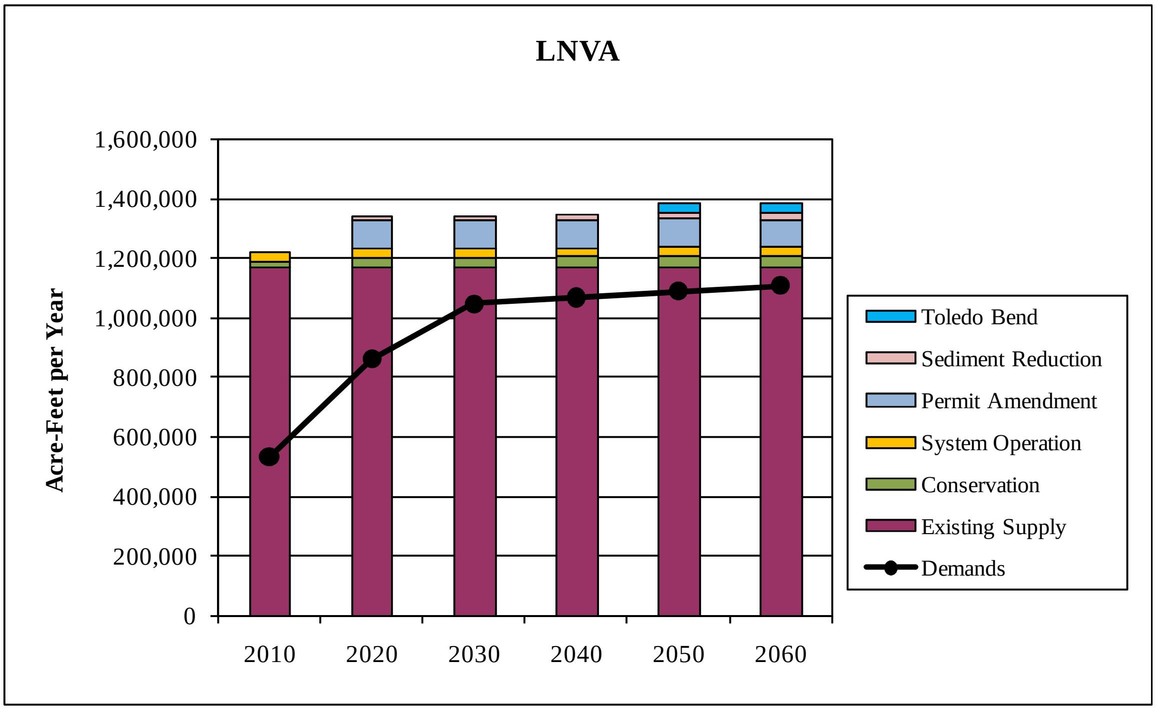
Sediment Reduction. The LNVA is pursuing a study on the feasibility of recapturing storage in Lake B.A. Steinhagen. The recent sediment survey of Lake B.A. Steinhagen shows a loss of nearly one third of its original capacity due to sediment. An additional loss of nearly one third (30,000 acre-feet) is 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.) This strategy, in conjunction with systems operation and the permit amendments for additional yield in Sam Rayburn Reservoir, can maintain the reliable supply associated with these strategies. For purposes of this plan, it is assumed that this strategy has a firm supply of 0.5 ac-ft per year per ac-ft of sediment removed.

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	55,500	55,500	55,500	55,500	55,500
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
Sediment reduction - Steinhagen	0	0	0	0	5,000	5,000
Purchase from SRA (Toledo Bend)					36,000	36,000
Total Supplies from Strategies	20,000	113,500	116,500	118,500	286,500	286,500
Total Supplies	**1,193,876**	**1,287,376**	**1,290,376**	**1,292,376**	**1,460,376**	**1,460,376**
Total from Conservation and Reuse	20,000	85,500	88,500	90,500	95,500	95,500
Percent of Strategy Supplies from Conservation and Reuse	100%	75%	76%	76%	33%	33%
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**	**395,999**	**210,257**	**188,707**	**331,103**	**312,131**



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	$15,000,000	$1,807,800[2]	$16.29	$0.05
LNVA-3: Permit amendment for Sam Rayburn (28,000)	28,000	$200,000[3]	$0	$0	$0
LNVA-4:Reallocation of Flood storage	122,000	$31,736,500[4]	$3,089,700	$25.33	$0.08
LNVA-5: Sediment Reduction	5,000	$161,333,000[5]	$14,066,000	$2,813	$8.63
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. Includes debt service on salt water barrier. Annual O&M is $500,000.
3. Capital costs are for water rights application. No costs for storage or O&M.
4. Costs are based on $163 per ac-ft of storage purchase from the Corps of Engineers
5. Costs are based on $10 per CY of dredged sediment.

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 Carizzo-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.

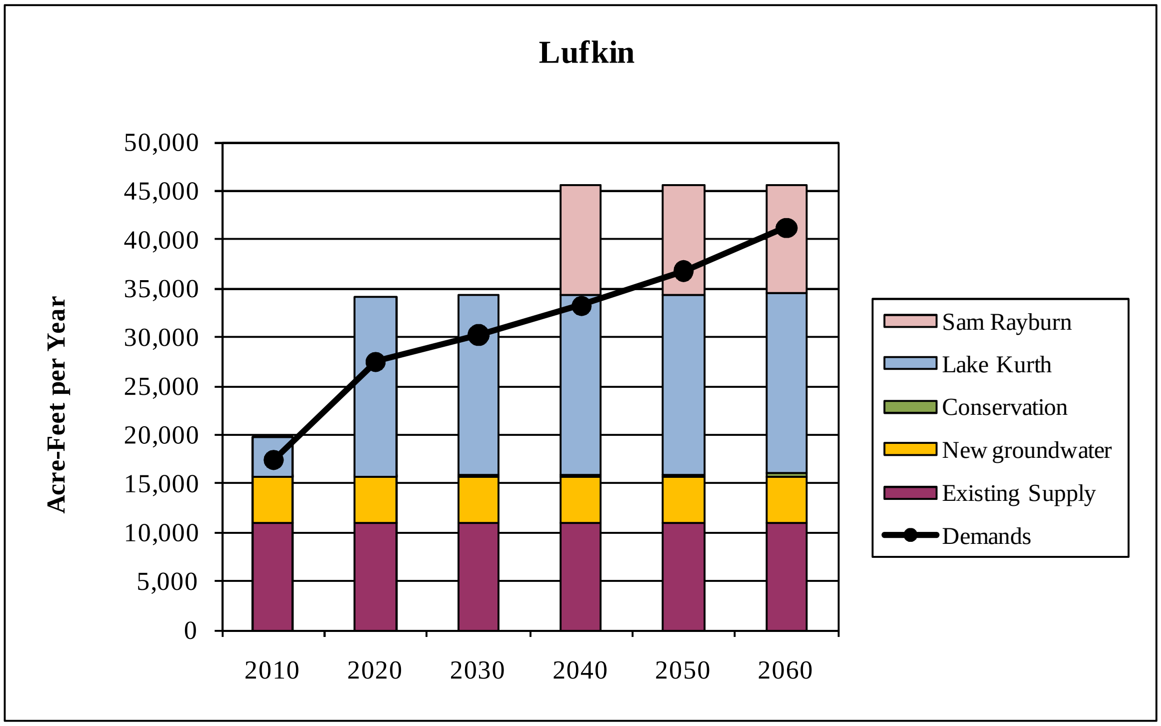
Develop Lake Kurth Surface Water. The water rights associated with Lake Kurth include the right to divert up to 19,100 acre-feet per year from the Angelina River for industrial purposes and to impound 16,200 acre-feet of water in Lake Kurth. To utilize these rights, Lufkin plans to construct a surface 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**



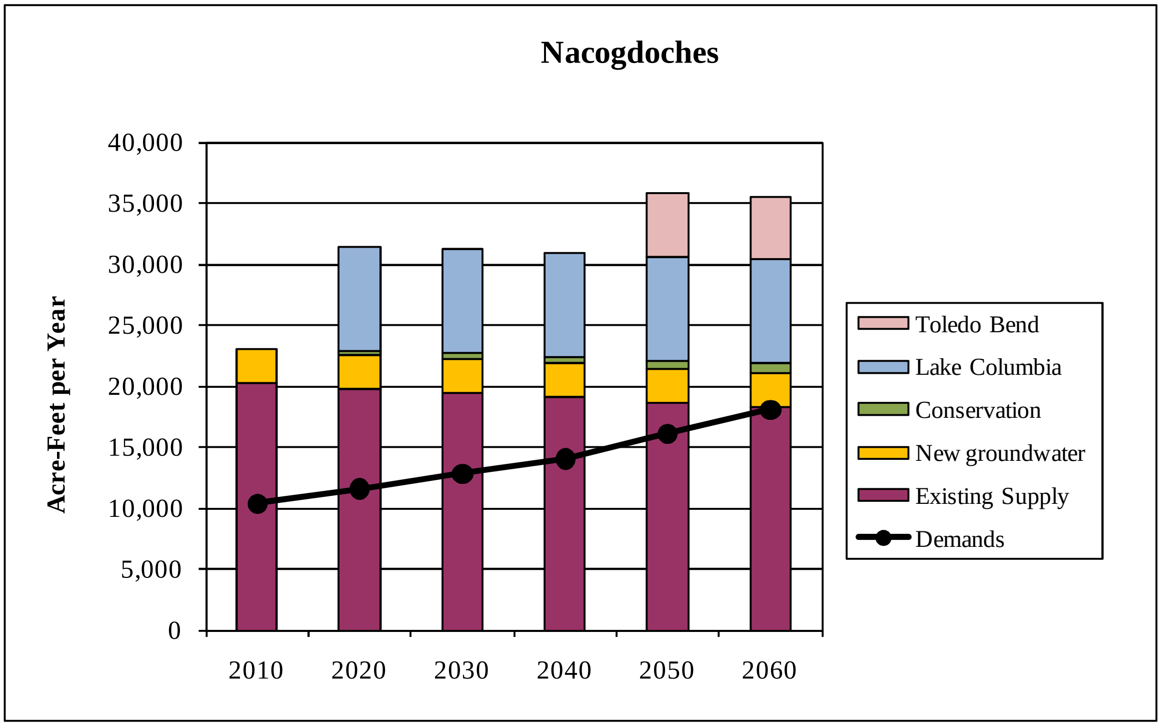
Estimates of capital costs for the Lufkin groundwater facilities are based on planning information provided by the City of Lufkin.

Strategy	Quantity (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 planning to transmit and treat water from the Toledo Bend Reservoir.

	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
Toledo Bend (Alternate)					5,175	5,175
Total Supplies from Strategies	2,800	11,580	11,776	11,865	17,180	17,313
Total Supplies	22,967	31,363	31,176	30,882	35,813	35,563
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%	3.8%	4.5%
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**	**19,717**	**17,501**



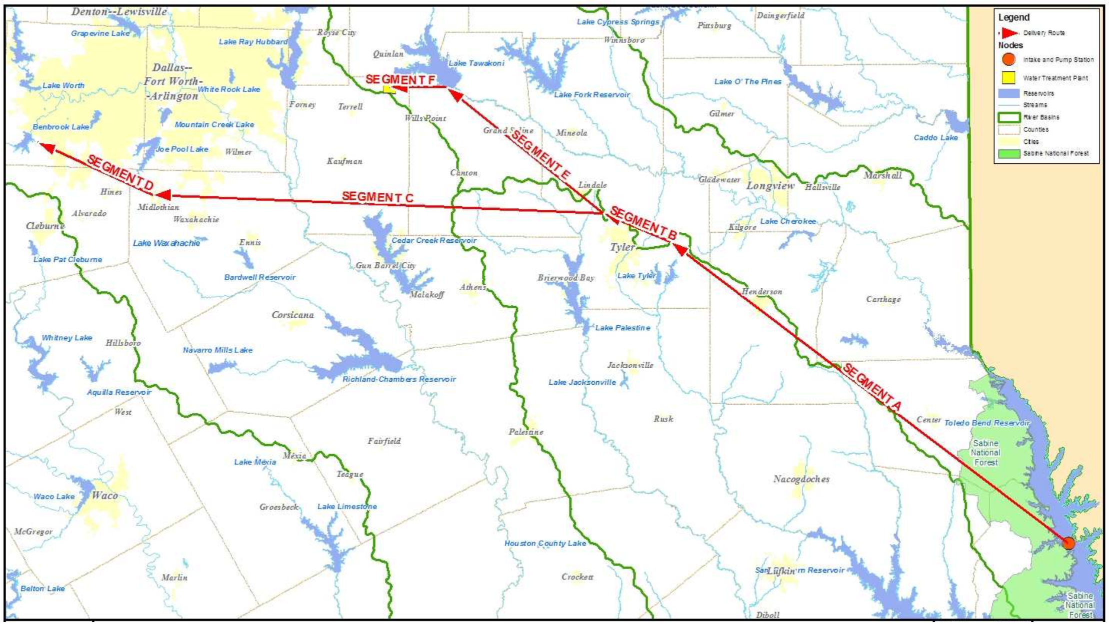
Strategy	Quantity	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Conservation	787		$40,000	$51	$0.16
New Groundwater	2,800	$2,727,000	$724,600	$259	$0.79
Lake Columbia	8,551	$37,282,000	$7,287,000	$852	$2.61
Toledo Bend (Alt)	5,175	$114,419,000	$10,602,000	$2,049	$6.29

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.

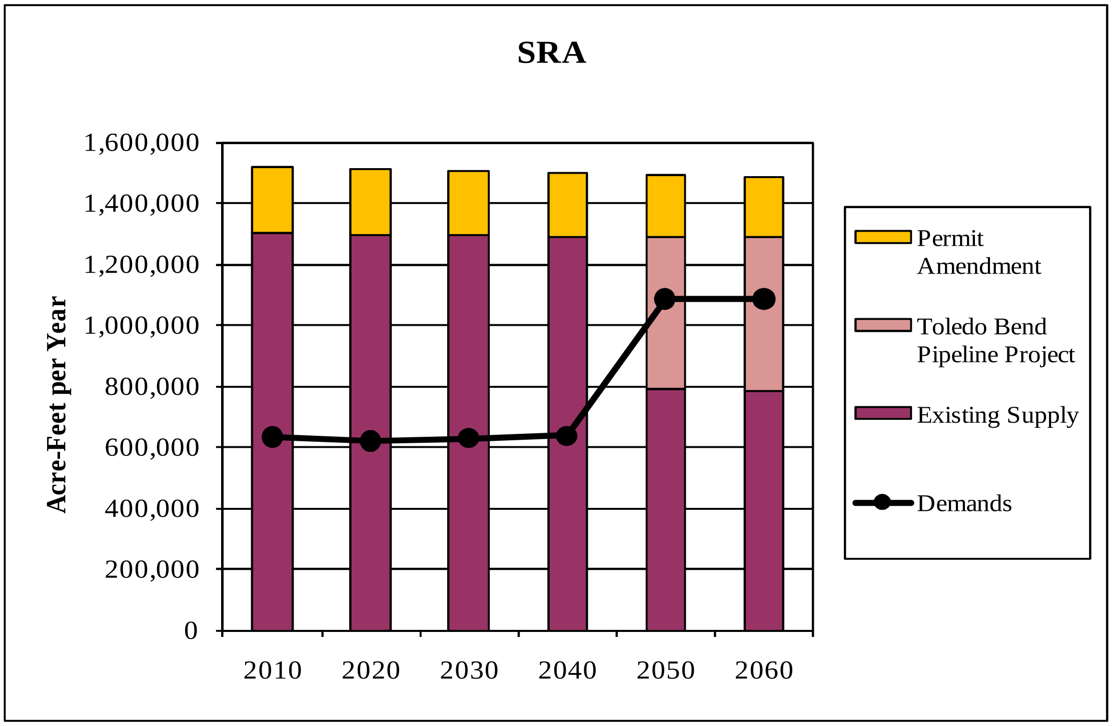
To support the increased use of water from Toledo Bend reservoir, the SRA has submitted a permit amendment to TCEQ to fully utilize Texas' share of the reservoir's firm yield. The application requested an additional 293,300 ac-ft per year of supply based on the TCEQ-approved Sabine River Basin WAM. The 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	Quantity (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

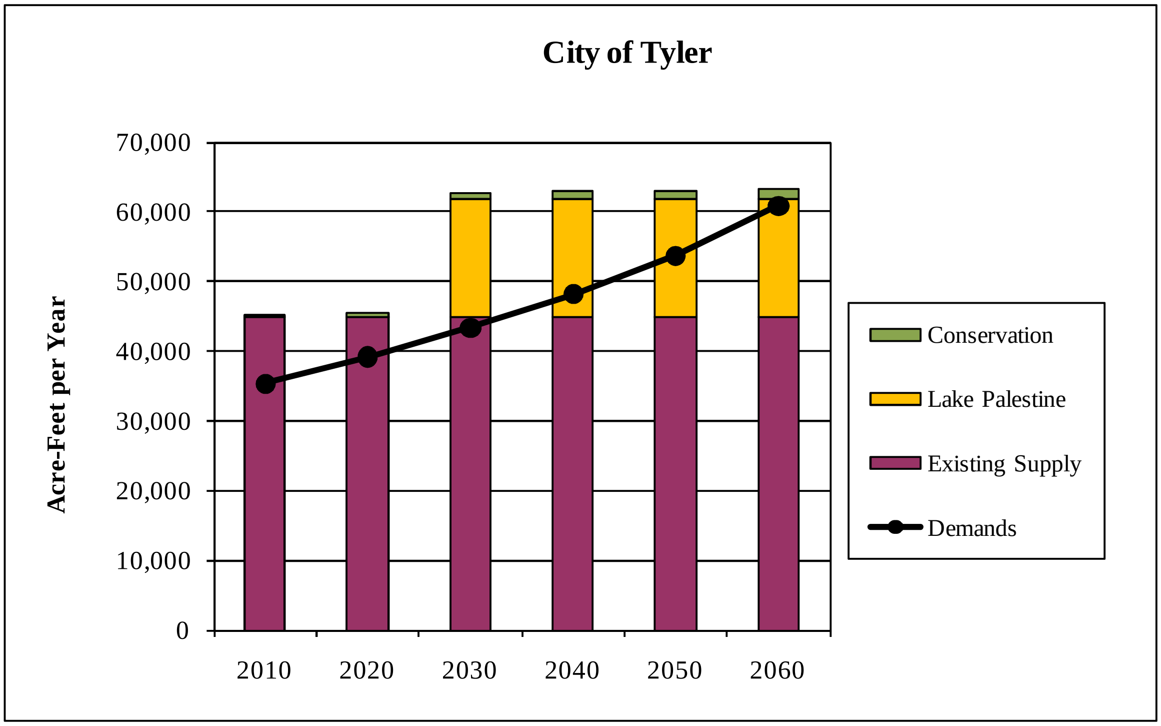
Quantity shown is the amount for SRA.

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	100.0 %	100.0 %	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	Quantity (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

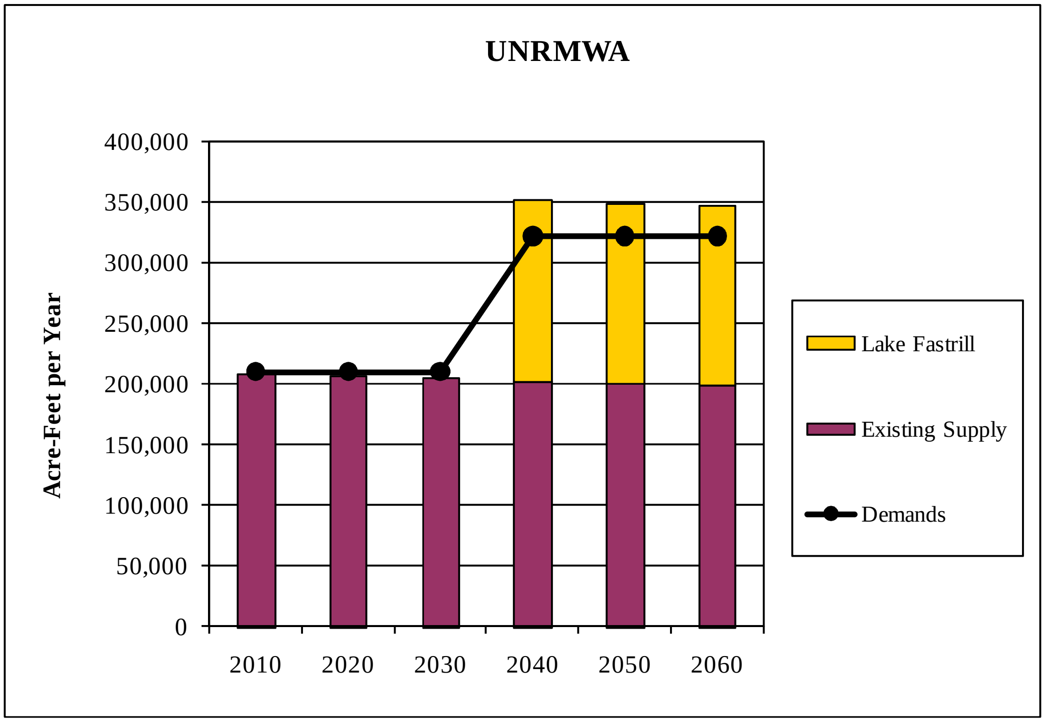
4C.2.10 Upper Neches River Municipal Authority. The Upper Neches River Municipal Water Authority (UNRMWA) owns and operates the Lake Palestine system in the Neches River Basin. Based on current contracts, the UNRMWA shows a small shortage during the planning period. This shortage is primarily associated with the reduced firm yield of Lake Palestine due to projected sediment accumulation in the lake.

The UNRMWA plans to sponsor the proposed Lake Fastrill and sell water to Dallas Water Utilities. Using the Neches River Water Availability Model, the estimated firm yield of Lake Fastrill is 148,780 ac-ft per year, assuming system operations with Lake Palestine subject to senior water rights and Consensus Criteria for Environmental

Flow Needs. Of this amount, Dallas Water Utilities plans to purchase 112,100 ac-ft per year, and the remaining 36,680 ac-ft per year would be available for users in the ETRWPA. Lake Fastrill is a recommended water management strategy for Region C to provide 112,100 Ac-Ft of water to Dallas Water Utilities. Details of the development of Lake Fastrill and the strategy to supply Dallas Water Utilities are discussed in the *2011 Region C Water Plan*. Further discussion of Fastrill is also contained in Chapter 8 of this report.

	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	0	0	0	148,780	148,780	148,780
Total Supplies from Strategies	0	0	0	148,780	148,780	148,780
Total Supplies	207,458	205,417	203,375	350,113	348,072	346,030
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	112,000	112,000	112,000
Potential Demand (Total)	210,135	210,124	210,115	322,106	322,099	322,093
Surplus or (Shortage)	**-2,677**	**-4,708**	**-6,740**	**28,007**	**25,972**	**23,937**

Strategy	Quantity (ac-ft per year)	Capital cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Lake Fastrill	148,780				



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.

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