Chapter 5B
Evaluation of Potentially Feasible, Recommended, and Alternative Water Management Strategies

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

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

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

5B.1 Water Management Strategy Evaluation

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

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

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

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

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

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

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

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

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

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

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

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

5B.2 Water User Groups with Water Management Strategies

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

5B.2.1 Anderson County

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

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

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

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

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

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

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

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

5B.2.2 Angelina County

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5B.2.3 Cherokee County

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

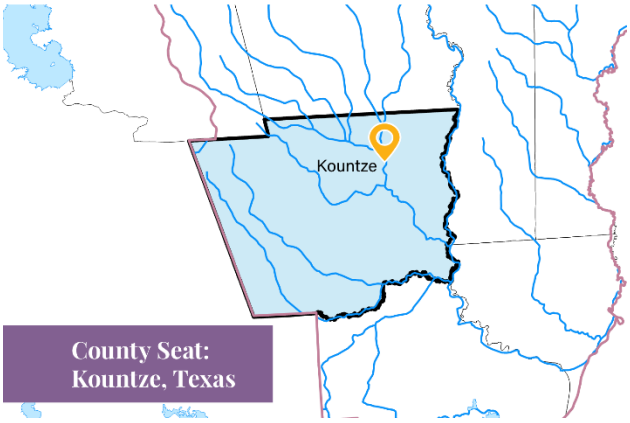
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Alto	4	6	7	7	9	10
Blackjack WSC	2	3	4	5	5	6
Jacksonville	50	85	110	129	152	178
Wells	2	0	0	0	0	0

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

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

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

5B.2.4 Hardin County



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

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

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

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

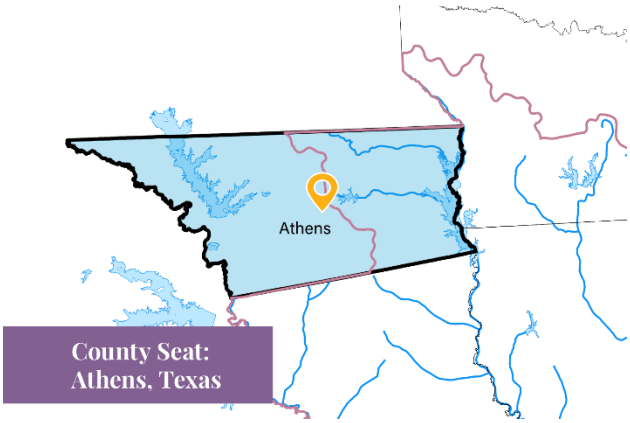
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Wildwood POA	4	6	7	7	8	8

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

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

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

5B.2.5 Henderson County



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

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

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

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

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

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

**Region C strategy. For additional strategy information, see Region C plan.*

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	27	$786,000	$25,000	$1,156	$3.55

Irrigation. Irrigation users in Henderson County receive water from various sources, including surface water, groundwater, and purchased water from Athens MWA. Irrigation in Henderson County are shown to have shortages in Region I and C; however, these shortages will be met through Athens MWA's recommended strategies, which include reuse of fish hatchery return flows and development of additional

groundwater wells in the Carrizo-Wilcox aquifer. These WMS are discussed in further detail under the Athens MWA major water provider (MWP) section of Chapter 5B and in the 2021 Region C Water Plan.

Henderson Irrigation	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	30	50
Recommended Strategy HEND-ATH: AMWA Athens Fish Hatchery Reuse (ac-ft/yr)*	0	0	0	0	10	16
Recommended Strategy HEND-ATH: AMWA New Wells (Carrizo-Wilcox) (ac-ft/yr)*	0	0	0	0	20	34

**Region C strategy. For additional strategy information, see Region C plan.*

Chandler. The City of Chandler is supplied entirely by groundwater from the Carrizo-Wilcox aquifer. Beginning in the 2070 decade, the City is projected to have an unmet need of approximately 118 ac-ft/yr. In order to meet this need, one recommended strategy for the City of Chandler is to develop additional wells in the Carrizo-Wilcox aquifer. In addition, municipal conservation is also a recommended strategy for the City of Chandler. Municipal conservation is discussed further in Chapter 5C.

Chandler	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	0	118
Recommended Strategy: Conservation (ac-ft/yr)	9	17	21	26	32	36
Recommended Strategy HEND-CHN: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	0	0	0	101

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	36	$0	$11,000	$362	$1.11
Recommended Strategy HEND-CHN: New Wells (Carrizo-Wilcox)	101	$1,397,000	$113,000	$1,119	$3.43

Moore Station WSC. Moore Station WSC is shown to have an unmet need of 38 ac-ft/yr in the 2060 decade, which then grows to 111 ac-ft/yr by the 2070 decade. Similar to other WUGs in the county, Moore Station WSC receives its supply from groundwater in the Carrizo-Wilcox aquifer. Therefore, a recommended strategy for this WUG is to develop additional wells in the Carrizo-Wilcox aquifer to meet future unmet needs.

Moore Station WSC	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	38	111
Recommended Strategy HEND-MSW: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	0	0	38	111

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy HEND-MSW: New Wells (Carrizo-Wilcox)	111	$1,417,000	$116,000	$1,045	$3.21

Mining. Mining users in Henderson County primarily use groundwater from the Carrizo-Wilcox aquifer or other undifferentiated aquifers for their supply. Due to larger mining demands in the earlier decades, there are needs for mining in Henderson County ranging from 10 to 21 ac-ft/yr from 2020 through 2040. A recommended strategy to meet these needs is to develop additional wells in the Carrizo-Wilcox aquifer. Since the unmet needs are relatively small, mining users might consider increasing the pumping rates from their current wells to meet their demands, rather than develop additional wells.

Henderson Mining	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	10	21	10	0	0	0
Recommended Strategy HEND-MIN: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	19	10	0	0	0
Recommended Strategy: Integrated Pipeline* (ac-ft/yr)	0	2	0	0	0	0

*Region C strategy. For additional strategy information, see Region C plan.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy HEND-MIN: New Wells (Carrizo-Wilcox)	19	$201,000	$15,000	$789	$2.42

Edom WSC. The water management strategy for Edom WSC was developed by Region D. ETRWPA supports and approves the strategy developed to meet the shortages in both regions. Edom WSC provides water service in Van Zandt and Henderson Counties. The WUG population is projected to be 1,395 by 2020 and increases to 2,025 by 2070. Edom WSC supplies its customers with groundwater from the Carrizo-Wilcox aquifer with water wells in Van Zandt County. Edom WSC is projected to have a total deficit of 13 ac-ft/yr in 2020 and increasing to a deficit of 64 ac-ft/yr by 2070; the shortage projected to occur in Van Zandt County is 11 ac-ft/yr in 2020 increasing to 55 ac-ft/yr by 2070. The shortage in Henderson County is 2 ac-ft/yr in 2020, increasing to 9 ac-ft/yr in 2070.

Edom WSC	2020	2030	2040	2050	2060	2070
Population	1,395	1,526	1,631	1,740	1,878	2,025
Projected Water Demand	152	160	166	176	188	203
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	139	139	139	139	139	139
Projected Supply Surplus (+) / Deficit (-)	-13	-21	-27	-37	-49	-64

Projected Supply Surplus (+) / Deficit (-) by County	2020	2030	2040	2050	2060	2070
Van Zandt (ac-ft/yr)*	-11	-18	-23	-32	-42	-55
Henderson (ac-ft/yr)	-2	-3	-4	-5	-7	-9
Total (ac-ft/yr)	**-13**	**-21**	**-27**	**-37**	**-49**	**-64**

*Region C

Evaluation of Potentially Feasible Water Management Strategies:

Four alternative strategies were considered to meet the WSC's water supply shortages as summarized in the following table. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Water reuse was not considered because the WSC does not have a demand for non-potable water. Surface water was not considered because the

WSC does not currently have surface water treatment. Groundwater has been identified as a potential strategy for Edom WSC. The recommended strategy for Edom WSC to meet their projected deficit of 2 ac-ft/yr in 2020 up to 9 ac-ft/yr in 2070 would be to construct three additional water wells similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo-Wilcox Aquifer in the Neches Basin in Van Zandt County. One well with rated capacity of 50 gpm each, pumping at an approximately depth of 560 ft., would provide approximately 27 acre-feet each.

Edom WSC	2020	2030	2040	2050	2060	2070
Recommended Strategy HSDN-EDOM: New Wells (Carrizo-Wilcox) (ac-ft/yr)	2	3	4	5	7	9

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy HSDN-EDOM: New Wells (Carrizo-Wilcox)	9	$1,088,000	$136,000	$2,125	$6.52

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

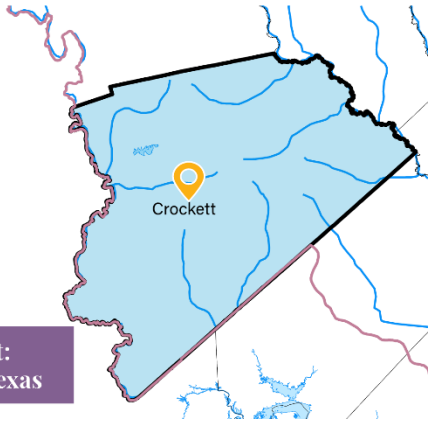
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Brownsboro	3	0	0	0	0	0

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Brownsboro	3	$0	$2,000	$667	$2.05

County Summary. Below is a summary of WUGs in the ETRWPA in Henderson County, current water supply sources, and recommended WMSs (if any).

Water User Group Henderson County	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Athens	Carrizo-Wilcox, Lake Athens	40	Conservation, Athens MWA strategies (discussed under Athens MWA MWP section)
Berryville	Carrizo-Wilcox	0	None
Bethel Ash WSC	Carrizo-Wilcox	0	None
Brownsboro	Carrizo-Wilcox	0	Conservation
Brushy Creek WSC	Carrizo-Wilcox	0	None
Chandler	Carrizo-Wilcox	118	New Wells (Carrizo-Wilcox), Municipal Conservation
County Other	Carrizo-Wilcox, Other Undifferentiated Aquifer	0	None
Edom WSC	Carrizo-Wilcox	9	New Wells (Carrizo Wilcox)
Frankston	Carrizo-Wilcox	0	None
Moore Station WSC	Carrizo-Wilcox	111	New Wells (Carrizo-Wilcox)
Murchison	Carrizo-Wilcox	0	None
Leagueville WSC	Carrizo-Wilcox	0	None
R P M WSC	Carrizo-Wilcox	48	See Smith County for WUG discussion
Virginia Hill WSC	Carrizo-Wilcox	0	None
Manufacturing	Carrizo-Wilcox	0	None
Mining	Carrizo-Wilcox, Other Undifferentiated Aquifer	21	New Wells (Carrizo-Wilcox)
Livestock	Carrizo-Wilcox, Local Supply, Lake Athens	0	None
Irrigation	Carrizo-Wilcox, Lake Athens, Lake Palestine, Run-of-River	50	Athens MWA strategies (discussed under Athens MWA MWP section)
Steam Electric Power	None	0	None

5B.2.6 Houston County



County Seat:
Crockett, Texas

Water supplies in Houston County include surface water from Houston County Lake (through Houston County WCID #1), run-of-river supplies for irrigation, and groundwater from the Carrizo-Wilcox, Yegua-Jackson, Sparta, Queen City and Other-Undifferentiated aquifers. There are projected water shortages in Houston County for irrigation use. The Carrizo-Wilcox and Yegua-Jackson aquifers have adequate capacity for expanded development in this county.

Livestock. The demand for Livestock is met from local supply, groundwater supplies from Carrizo Wilcox aquifer, Sparta aquifer, Queen City aquifer, and Other-Undifferentiated aquifer. The shortages are met by developing a groundwater supply strategy in the Yegua-Jackson aquifer.

Houston Livestock	2020	2030	2040	2050	2060	2070
Need (ac-ft/ yr)	0	0	0	0	0	201
Recommended Strategy HOUS-LTK: New Wells (Yegua-Jackson) (ac-ft/yr)	0	0	0	0	0	201

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy HOUS-LTK: New Wells (Yegua-Jackson)	201	$399,000	$39,000	$194	$0.60

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

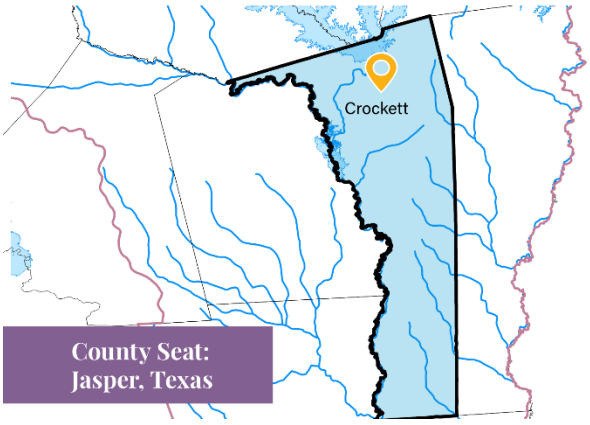
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Crockett	19	29	30	32	34	36
Lovelady	2	3	3	3	4	4
TDCJ Eastham Unit	15	25	27	29	30	32
County-Other	2	3	3	4	4	4

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Crockett	36	$0	$11,000	$367	$1.13
Lovelady	4	$0	$1,000	$316	$0.97
TDCJ Eastham Unit	32	$0	$4,000	$152	$0.47
County-Other	4	$0	$1,000	$300	$0.92

County Summary. Below is a summary of WUGs in Houston County, current sources of supply, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
County Other	All Aquifers	0	Conservation
Crockett	Carrizo-Wilcox, Houston County Lake	0	Conservation
Grapeland	Carrizo-Wilcox, Houston County Lake	0	None
Lovelady	Yegua-Jackson, Houston County Lake	0	Conservation
Pennington WSC	Yegua-Jackson	0	None
TDCJ Eastham Unit	Sparta	0	Conservation
The Consolidated WSC	Carrizo-Wilcox, Houston County Lake	0	None
Manufacturing	Carrizo-Wilcox, Houston County Lake	0	None
Mining	Other Undifferentiated	0	None
Irrigation	All Aquifers, Run-of-River	0	None
Livestock	All Aquifers, Local Supply	201	New Wells (Yegua-Jackson)
Steam Electric Power	None	0	None

5B.2.7 Jasper County



WUGs in Jasper County utilize surface water from local supplies, Sam Rayburn Reservoir, or the Neches River. Water demands are also met with groundwater from the Gulf Coast aquifer. The Gulf Coast aquifer has adequate capacity for expanded development in this county. The only WUG with a projected need in Jasper County during the planning period is livestock.

Livestock. Due to large projected demands and limited development of groundwater supplies in Jasper County, livestock is shown to have a shortage of nearly 9,000 ac-ft per year for each decade. Current supplies for livestock users in Jasper County include groundwater from the Gulf Coast aquifer and other local supplies. It is recommended that any large-scale user should obtain surface water from the Sam Rayburn Reservoir through a contract with LNVA.

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

Jasper Livestock	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	8,932	8,932	8,932	8,932	8,932	8,932
Recommended Strategy JASP-LTK: Purchase from LNVA (Sam Rayburn) (ac-ft/yr)	8,932	8,932	8,932	8,932	8,932	8,932

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy JASP-LTK: Purchase from LNVA (Sam Rayburn)	8,932	$0	$2,911,000	$326	$1.00

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

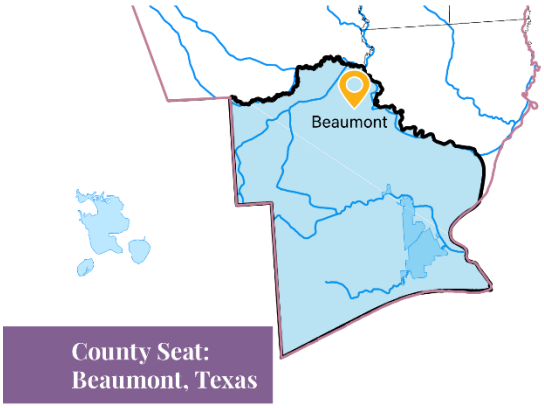
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Jasper	75	124	141	158	178	196
Kirbyville	6	9	10	11	11	12

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Jasper	196	$15,444,000	$532,000	$3,008	$9.23
Kirbyville	12	$0.00	$3,000	$305	$0.94

County Summary. Below is a summary of WUGs in Jasper County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Brookeland FWSD	Gulf Coast	0	None
County Other	Gulf Coast, Houston County Lake	0	None
Jasper	Gulf Coast	0	Conservation
Jasper County WCID 1	Gulf Coast	0	None
Kirbyville	Gulf Coast	0	Conservation
Mauriceville SUD	Gulf Coast	0	None
Rayburn Country MUD	Gulf Coast	0	None
Rural WSC	Gulf Coast	0	None
South Jasper County WSC	Gulf Coast	0	None
Upper Jasper County Water Authority	Gulf Coast	0	None
Irrigation	Local Supply	0	None
Livestock	Gulf Coast, Local Supply	8,932	Purchase from LNVA (Sam Rayburn)
Manufacturing	Gulf Coast, Run-of-River, Sam Rayburn	0	None
Mining	Gulf Coast Aquifer	0	None
Steam Electric Power	None	0	None

5B.2.8 Jefferson County



Water supply is Jefferson County is largely provided by LNVA with surface water from the Sam Rayburn/BA Steinhagen system and the Neches River. The exception to this is Beaumont, which has a supply from their own water rights on the Neches River in Jefferson County and Hardin County groundwater wells in the Gulf Coast aquifer. There are four WUGs with a projected need during the planning period. Beaumont should be able to meet its shortages with conservation, and LNVA has adequate supply to provide water to the remaining three WUGs.

Beaumont. The current supply sources for the City of Beaumont are the Neches River, Gulf Coast Aquifer, and Sam Rayburn/BA Steinhagen system (LNVA). Beaumont's supply is limited by their water treatment plant capacity of 64 MGD, and the City is projected to have a water shortage beginning in 2040. The City had an average per capita consumption of 219 gpcd in 2011. This value is well over the statewide goal of 140 gpcd. The City has begun a meter replacement program, which may help reduce the per capita use rate somewhat. In addition, after performing a conservation cost analysis, the ETRWPG believes a water conservation strategy for the City is economically achievable and is therefore recommended. This strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce Beaumont's demand; therefore, municipal conservation is one recommended WMS for the City. Municipal conservation is further discussed in Chapter 5C.

After municipal conservation, the City of Beaumont is still shown to have a need in the 2060 and 2070 decades. Consequently, a recommended strategy is to add an amendment to their supplemental contract with LNVA to obtain additional supplies to meet the rest of their needs. This strategy is further discussed in Section 5B.3.4.

Beaumont	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	1,248	3,843	6,357	9,218
Recommended Strategy: Conservation (ac-ft/yr)	2,027	3,425	4,202	5,112	6,171	7,382
Recommended Strategy JEFF-BEA: Amendment to Supplemental Contract with LNVA (ac-ft/yr)	0	0	0	0	228	2,249

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	7,382	$60,175,000	$2,076,000	$371	$1.14
Recommended Strategy JEFF-BEA: Amendment to Supplemental Contract with LNVA	2,249	$0	$2,199,000	$977	$3.00

County-Other. Current supply is the Gulf Coast aquifer, Neches River (Beaumont), and Sam Rayburn/BA Steinhagen system (LNVA and Port Arthur) for Jefferson County-Other. Approximately 80 percent of County-Other demand is met by the City of Beaumont. In addition, LNVA has the water available to meet the County-Other water shortage and has expressed interest in providing more water Jefferson County-Other. Purchasing water from Sam Rayburn Reservoir (LNVA) is the only recommended WMS for County-Other.

County Other	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	855	1,950
Recommended Strategy: Conservation (ac-ft/yr)	34	0	0	0	0	0
Recommended Strategy JEFF-CTR: Purchase from LNVA (Sam Rayburn) (ac-ft/yr)	0	0	0	0	855	1,950

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

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	34	$0	$20,000	$588	$1.80
Recommended Strategy JEFF-CTR: Purchase from LNVA (Sam Rayburn)	1,950	$21,665,000	$2,402,000	$1,232	$3.78

Manufacturing. Current supply for manufacturing users in Jefferson County includes the Gulf Coast aquifer, Neches River (Beaumont and LNVA), Sabine River (SRA), and Sam Rayburn/BA Steinhagen system (Beaumont, LNVA, and Port Arthur). Manufacturing in Jefferson County is projected to have a water supply shortage beginning in 2020 that spans throughout the planning horizon. Much of the Manufacturing demand is currently met by LNVA. In addition, LNVA has the water available to meet the water shortage and has expressed interest in providing more water for Jefferson County Manufacturing. Therefore, purchasing water from Sam Rayburn/BA Steinhagen system (LNVA) is the only recommended WMS for manufacturing.

Jefferson Manufacturing	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	101,138	143,513	143,497	143,479	143,462	143,446
Recommended Strategy JEFF-MFG: Purchase from LNVA (Sam Rayburn) (ac-ft/yr)	0	143,513	143,497	143,479	143,462	143,446

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

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy JEFF-MFG: Purchase from LNVA (Sam Rayburn)	143,513	$279,210,000	$69,673,000	$485	$1.49

Steam Electric Power. This WUG is a proposed facility and does not currently have a supply. The projected demands are based on several proposed facilities in Jefferson County that have been delayed or cancelled since the development of water projections. It is anticipated that as the need for electric power increases, these facilities will be constructed. The proposed strategy to meet this need is to purchase water from LNVA. Sam Rayburn Reservoir (LNVA) has sufficient supplies to meet the projected steam electric power needs. The actual source of water will be negotiated once the facilities are constructed.

Jefferson Steam Electric Power	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	2,391	2,391	2,391	2,391	2,391	2,391
Recommended Strategy JEFF-SEP: Purchase from LNVA (Sam Rayburn) (ac-ft/yr)	0	2,391	2,391	2,391	2,391	2,391

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

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy JEFF-SEP: Purchase from LNVA (Sam Rayburn Reservoir)	2,391	$32,302,000	$3,464,000	$1,449	$4.45

There are no shortages for Port Arthur; however, a conservation strategy was proposed as a proactive water management strategy.

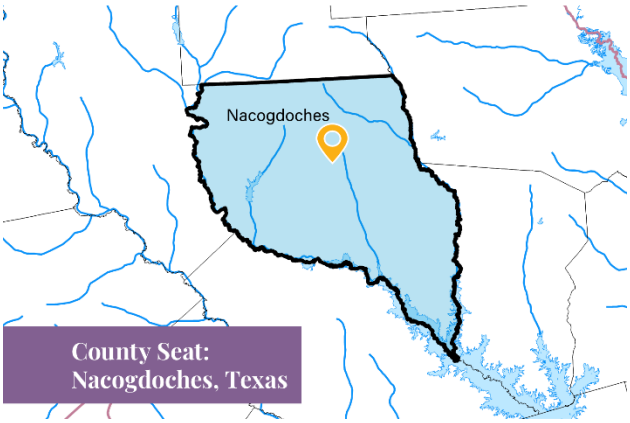
Conservation Strategy	2020	2030	2040	2050	2060	2070
Port Arthur (ac-ft/yr)	2,708	4,449	5,222	6,029	6,844	7,664

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Port Arthur	7,664	$51,618,000	$1,981,000	$295	$0.91

County Summary. Below is a summary of WUGs in Jefferson County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Beaumont	Gulf Coast, Run-of-River, Sam Rayburn	9,218	Conservation, Amendment to Supplemental Contract with LNVA
Bevil Oaks	Gulf Coast	0	None
China	Gulf Coast	0	None
County Other	Gulf Coast, Run-of-River, Sam Rayburn	1,950	Conservation, Purchase from LNVA (Sam Rayburn)
Groves	Sam Rayburn	0	None
Jefferson County WCID 10	Carrizo-Wilcox, Houston County Lake	0	None
Meeker MWD	Run-of-River, Gulf Coast	0	None
Nederland	Sam Rayburn	0	None
Port Arthur	Sam Rayburn	0	Conservation
Port Neches	Sam Rayburn	0	None
West Jefferson County MWD	Sam Rayburn, Run-of-River	0	None
Irrigation	Gulf Coast, Run-of-River, Sam Rayburn	0	None
Livestock	Gulf Coast, Local Supply	0	None
Manufacturing	Sam Rayburn, Gulf Coast, Run-of-River, Toledo Bend	143,513	Purchase from LNVA (Sam Rayburn)
Mining	Gulf Coast, Local Supply, Run-of-River	0	None
Steam Electric Power	None	2,391	Purchase from LNVA (Sam Rayburn)

5B.2.9 Nacogdoches County



Surface water, groundwater and local livestock supplies provide water to users in Nacogdoches County. Lake Nacogdoches and Striker Lake provide the majority of surface water, while groundwater is the primary source for rural water supplies. Lake Naconiche has recently been completed. This lake was built by NRCS for flood storage and recreation, but there are plans to develop water supply from the lake for rural communities. A 1992 study evaluated a potential regional water system using water from Lake Naconiche. This regional system is a recommended strategy to provide water to Nacogdoches County-Other users and several rural WSCs. A brief description of the proposed strategy is presented below.

County Other – Lake Naconiche Regional Water Supply System. Lake Naconiche is located in northeast Nacogdoches County on Naconiche Creek. It is permitted to store 9,072 ac-ft of water. To use water from Lake Naconiche for water supply, the County must seek a permit amendment to allow diversions for municipal use. It is assumed that the regional water system would serve Appleby WSC, Lily Grove WSC, Swift WSC, and County-Other entities in Nacogdoches County (including Caro WSC, Lilbert-Looneyville WSC, Libby WSC, and others). Nacogdoches County is the current sponsor of this water management strategy.

The project is initially sized for 3.0 MGD. This includes a lake intake, new water treatment plant located near Lake Naconiche, pump station and a distribution system of pipelines in the northeast part of the county. Costs are summarized below. The costs for each participant are based on the unit cost of water for the strategy and capital costs are proportioned by strategy amounts. Actual costs would be negotiated as the project is developed.

County Other	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	0	0
Recommended Strategy NACN-LK: Lake Naconiche Regional Water System (ac-ft/yr)	0	1,700	1,700	1,700	1,700	1,700

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy NACN-LK: Lake Naconiche Regional Water System	1,700	$42,117,000	$5,363,000	$3,155	$9.68

D & M WSC. D & M WSC currently relies on groundwater from the Carrizo-Wilcox aquifer. The recommended strategy is to expand development of supplies from Carrizo-Wilcox. Municipal conservation was considered for this WUG but not recommended as D & M WSC's average per capita consumption of is below the statewide goal of 140 gpcd.

D & M WSC	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	32	135	251	374
Recommended Strategy NACW-DMW: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	32	135	251	374

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy NACW-DMW: New Wells (Carrizo-Wilcox)	374	$4,567,000	$373,000	$997	$3.06

Livestock. Local supply provides over half of current livestock needs for Nacogdoches County, with the remainder supplied from groundwater sources. Local supplies may not be adequate to cover the projected shortages and further expansion of groundwater from Carrizo Wilcox aquifer is proposed as the recommended strategy.

Nacogdoches Livestock	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	5,970	6,399	6,896	7,472	8,131	9,113
Recommended Strategy NACW-LTK: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	6,399	6,896	7,472	8,131	9,113

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy NACW-LTK: New Wells (Carrizo-Wilcox)	9,113	$26,677,000	$2,695,000	$296	$0.91

Mining. Current mining water needs in Nacogdoches County are met through local surface water supplies. As a result of increased interest in natural gas exploration in East Texas, there are projected water shortages for mining in Nacogdoches County. Nacogdoches has recently negotiated a contract with Angelina & Neches River Authority to provide water for the County's mining needs. The recommended water management strategy to meet these needs is run-of-the-river diversions from the Angelina River. It is assumed that Angelina & Neches River Authority would be the sponsor for this strategy.

Nacogdoches Mining	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	5,475	2,975	118	0	0	0
Recommended Strategy NACW-MIN: Purchase water from ANRA (Mud Creek) (ac-ft/yr)	0	2,975	118	0	0	0

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

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
NACW-MIN: Purchase water from ANRA (Mud Creek)	2,975	$14,557,000	$4,159,000	$1,398	$4.29

Cushing. Currently the demands for Cushing are met from groundwater supplies in the Carrizo Wilcox aquifer in Nacogdoches county. There are shortages in decades 2060 and 2070 and these shortages are met by means of implementation of conservation measures.

Cushing	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	8	30
Recommended Strategy: Conservation (ac-ft/yr)	10	19	24	30	37	45

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

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	45	$1,030,000	$42,000	$1,083	$3.32

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

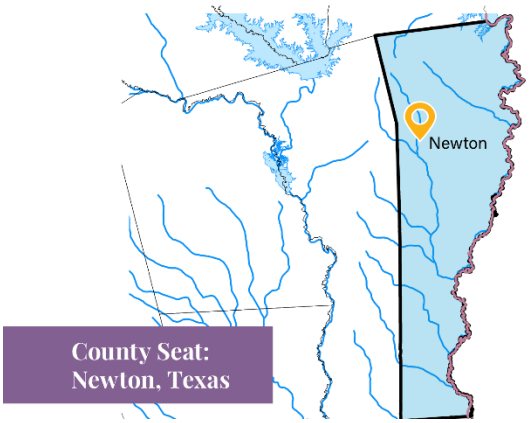
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Appleby WSC	9	17	20	23	27	32
Garrison	4	6	8	9	10	12
Nacogdoches	247	426	532	656	802	966

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Appleby WSC	32	$0.00	$9,000	$336	$1.03
Garrison	12	$0.00	$3,000	$286	$0.88
Nacogdoches	966	$27,720,000	$986,000	$1,349	$4.14

County Summary. Below is a summary of WUGs in Nacogdoches County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Appleby WSC	Carrizo-Wilcox, Lake Nacogdoches	0	Conservation
Caro WSC	Carrizo-Wilcox	0	None
County Other	All aquifers, Lake Nacogdoches	0	Lake Naconiche Regional Water System
Cushing	Carrizo-Wilcox	30	Conservation
D & M WSC	Carrizo-Wilcox, Lake Nacogdoches	374	Additional GW Wells in Carrizo Wilcox aquifer
Etoile WSC	Carrizo-Wilcox	0	None
Garrison	Carrizo-Wilcox	0	Conservation
Lily Grove SUD	Carrizo-Wilcox	0	None
Melrose WSC	Carrizo-Wilcox	0	None
Nacogdoches	Carrizo-Wilcox, Lake Nacogdoches	0	Lake Columbia Transmission System (Discussion Included in the MWP Summary for Nacogdoches), Conservation
Swift WSC	Carrizo-Wilcox	0	None
Woden WSC	Carrizo-Wilcox	0	None
Irrigation	Carrizo-Wilcox, Run-of-River	0	None
Manufacturing	Carrizo-Wilcox, Lake Nacogdoches	0	None
Livestock	All aquifers, Local Supply	9,113	New Wells (Carrizo-Wilcox)
Mining	Other Undifferentiated, Local Supply	5,475	Purchase from ANRA (Mud Creek)
Steam Electric Power	Lake Striker	0	None

5B.2.10 Newton County



Most of the WUGs in Newton County use groundwater from the Gulf Coast aquifer. According to the Groundwater Availability Model estimates for 2020, there are approximately 34,000 ac-ft/yr of groundwater available from the Gulf Coast aquifer in Newton County. As a part of this round of planning, approximately 3,000 ac-ft/yr has been allocated to WUGs in Newton County. There is also a significant amount of surface water available from the SRA system. Some of this water is contracted for steam electric power. Based on the available groundwater and proximity of surface water to users in Newton County, there is substantial water available for development to meet projected demands for mining and steam electric power. The only unmet need in Newton County is for mining.

Mining. Current supplies are from local surface water supplies and the Gulf Coast aquifer. The mining demand in Newton County is very low compared to the other demands in this county, but mining is projected to have a water shortage for 2020 and 2030. The recommended strategy to meet this demand is to purchase surface water from SRA. SRA currently provides water for existing mining demands in Newton County.

Newton Mining	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	115	59	0	0	0	0
Recommended Strategy NEWT-MIN: Purchase from SRA (Toledo Bend) (ac-ft/yr)	115	59	0	0	0	0

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

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy NEWT-MIN: Purchase from SRA (Toledo Bend)	115	$0	$111,000	$965	$2.96

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

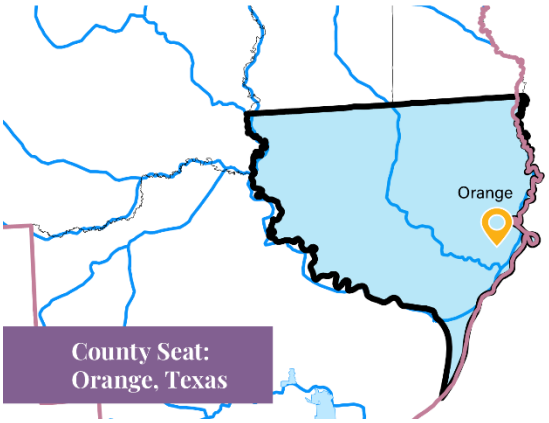
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Newton	6	10	10	11	12	12

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Newton	12	$0.00	$4,000	$393	$1.21

County Summary. Below is a summary of WUGs in Newton County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Brookeland FWSD	Gulf Coast	0	None
County Other	Gulf Coast	0	None
Mauriceville SUD	Gulf Coast	0	None
Newton	Gulf Coast	0	Conservation
South Newton WSC	Gulf Coast	0	None
Irrigation	Gulf Coast, Local Supply-Run-of-River	0	None
Manufacturing	Gulf Coast, Run-of-River	0	None
Livestock	Gulf Coast, Local Supplies	0	None
Mining	Gulf Coast, Run-of-River	115	Purchase from SRA (Toledo Bend)
Steam Electric Power	SRA Canal System	0	None

5B.2.11 Orange County



The majority of the water used in Orange County comes from the Gulf Coast Aquifer and the Sabine River, with a very small portion coming from the Neches River. The total long-term sustainable groundwater availability from the Gulf Coast Aquifer in Orange County is estimated at nearly 20,000 ac-ft/yr. Current groundwater use in Orange County is around 12,500 ac-ft/yr. It is recommended that any new large-scale water needs be met with surface water. Otherwise, it is recommended that entities currently using groundwater be allowed to remain on groundwater to meet their future growth, until such a time that a salt-water intrusion or subsidence problem is encountered.

There is a significant amount of surface water available in the Sabine River in Orange County. The SRA canal system, which is located in Orange County, has a conveyance capacity of 346,000 ac-ft/yr. SRA has water rights of 147,100 ac-ft/yr associated with the canal system (100,400 ac-ft/yr for municipal and industrial use and 46,700 ac-ft/yr for irrigation). There is a significant amount of supplies in the canal system for future demands. SRA also has a large amount of uncontracted water in Toledo Bend Reservoir that could potentially be released through the dam and carried by the Sabine River for downstream use from the canal.

Irrigation. This WUG has a shortage starting 2020, however this project will not be online prior to January 2023, so it has an online decade of 2030. The current supply comes from SRA's run-of-river canal system supplies. It is recommended that the irrigation users contract with SRA for additional supplies.

Orange Irrigation	2010	2020	2030	2040	2050	2060
Need (ac-ft/yr)	526	526	526	526	526	526
Recommended Strategy ORAN-IRR: Purchase from SRA (Sabine River) (ac-ft/yr)	0	526	526	526	526	526

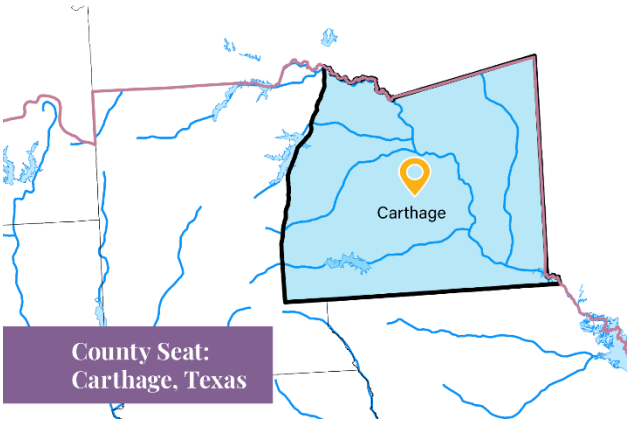
Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy ORAN-IRR: Purchase from SRA (Sabine River)	526	$14,624,000	$1,355,000	$2,576	$7.91

County Summary. Below is a summary of WUGs in Orange County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Bridge City	Gulf Coast	0	None
County Other	Gulf Coast	0	None
Kelly G Brewer	Gulf Coast	0	None
Mauriceville SUD	Gulf Coast	0	None
Orange	Gulf Coast	0	None
Orange County WCID 1	Gulf Coast	0	None
Orange County WCID 2	Gulf Coast	0	None
Orangefield WSC	Gulf Coast	0	None
Pinehurst	Gulf Coast	0	None
Port Arthur	Gulf Coast	0	None
South Newton WSC	Gulf Coast	0	None
Irrigation	Run-of-River, SRA Canal	526	Purchase from SRA (Run of River, Sabine)
Livestock	Local Supply, Gulf Coast	0	None
Manufacturing	Run-of-River, Gulf Coast	0	None
Mining	Local Supply, Gulf Coast	0	None
Steam Electric Power	SRA Canal, Gulf Coast	0	None

5B.2.12 Panola County



Panola County has only one entity with projected water shortages (livestock). Generally, demands in Panola County are expected to increase slightly and can be met through existing supplies. Both groundwater from the Carrizo-Wilcox aquifer and surface water supplies, mostly from Lake Murvaul, are used in Panola County. The Carrizo-Wilcox aquifer has a long-term availability of approximately 8,400 ac-ft/yr in Panola County. Based on historical use information and well capacities from entities in the county, the groundwater supply is fully developed. Because the long-term sustainable availability of the aquifer has been reached, it is recommended that any new (not currently identified) large-scale water needs be met with surface water. It is recommended that those entities currently on groundwater remain on groundwater to meet their future growth until such time as groundwater is no longer a reliable supply. Any entities that are willing to convert to surface water should be encouraged to do so.

Livestock. Livestock users in Panola County are shown to have a shortage of nearly 1,000 ac-ft throughout the planning horizon. Current supplies for livestock users in Jasper County include groundwater from the Carrizo-Wilcox aquifer and other local supplies. After allocations of groundwater supplies in Panola County, there is still around 3,400 ac-ft/yr of MAG. Therefore, the recommended strategy for livestock users to meet their needs is to develop additional groundwater in the Carrizo-Wilcox aquifer. Though a need is shown in the 2020 decade, this project will not be implemented prior to January 2023, due to time constraints. The strategy will come online in the 2030 decade.

Panola Livestock	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	982	982	982	982	982	982
Recommended Strategy PANL-LTK: New Wells (Carrizo-Wilcox) (ac-ft/yr):	0	982	982	982	982	982

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy PANL-LTK: New Wells (Carrizo-Wilcox)	982	$1,172,000	$122,000	$124	$0.38

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Carthage	23	39	41	44	47	50
Panola-Bethany WSC	0	0	0	0	1	2

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Carthage	50	$0.00	$11,000	$266	$0.82
Panola-Bethany WSC	2	$0.00	$0	$0.00	$0.00

County Summary. Below is a summary of WUGs in Panola County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Beckville	Carrizo-Wilcox	0	None
Carthage	Carrizo-Wilcox, Lake Murvaul	0	Conservation
County Other	Carrizo-Wilcox, Lake Murvaul	0	None
Gill WSC	Carrizo-Wilcox, Marshall	0	None
Minden Brachfield WSC	Carrizo-Wilcox	0	None
Panola-Bethany WSC	Carrizo-Wilcox	0	Conservation
Tatum	Carrizo-Wilcox	0	None
Irrigation	Carrizo-Wilcox, Run-of-River	0	None
Livestock	Local Supply, Carrizo-Wilcox	982	New Wells (Carrizo-Wilcox)
Manufacturing	Run-of-River, Lake Murvaul, Carrizo-Wilcox	0	None
Mining	Run-of-River, Lake Murvaul, Carrizo-Wilcox, Toledo Bend	0	None
Steam Electric Power	None	0	None

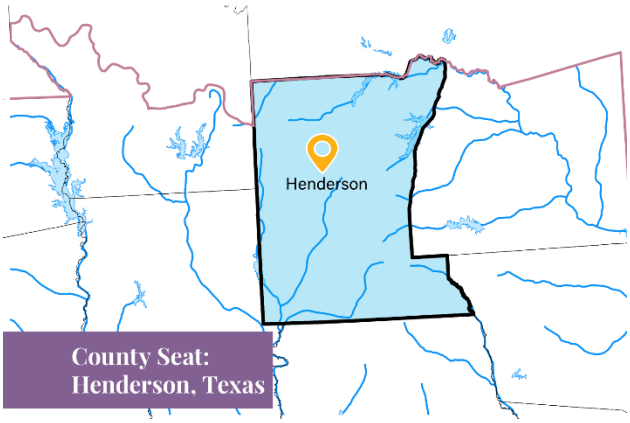
5B.2.13 Polk County

Polk County is partially located in the ETRWPA and partially in Region H. Every WUG in the county uses water from groundwater supplies. The groundwater supplies are from the Gulf Coast, Yegua-Jackson, and Other-Undifferentiated aquifers. Local surface water supplies are also used to meet demands in Polk County. There is no projected need for any WUG located within Polk County during the planning period. Based on the groundwater availability estimates included in this plan, the Gulf Coast aquifer is sufficient to provide water to future demands that are expected to develop in Polk County.

County Summary. Below is a summary of WUGs in Polk County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Chester WSC	Gulf Coast	0	None
Corrigan	Other Undifferentiated	0	None
County Other	All Aquifers	0	None
Damascus-Stryker WSC	Yegua-Jackson	0	None
Lake Livingston WSC	Other Undifferentiated	0	None
Moscow WSC	Gulf Coast	0	None
Soda WSC	Gulf Coast	0	None
Irrigation	Gulf Coast, Local Supply	0	None
Livestock	All Aquifers, Local Supply	0	None
Manufacturing	Gulf Coast, Other Undifferentiated	0	None
Mining	Local Supply, Gulf Coast, Other Undifferentiated	0	None
Steam Electric Power	None	0	None

5B.2.14 Rusk County



Surface water and groundwater are used for water supply in Rusk County. The water sources used by most WUGs in Ruck County include the Neches and Sabine Rivers, the Carrizo-Wilcox, Queen City, and Other-Undifferentiated aquifers, and local supplies. Otherwise, the City of Henderson receives water from Lake Fork (SRA), while steam electric power users have a permit in Martin Lake and receive water from the Toledo Bend Reservoir (SRA). During the duration of the planning horizon, there are projected water shortages for multiple WUGs in Rusk County, including Jacobs WSC, Wright City WSC, livestock, mining, and steam electric power; however, there are sufficient supplies available to meet these identified needs.

Rusk County Refinery is a potential manufacturing water user that has approached Angelina & Neches River Authority for a water supply contract. The contract amount for this entity is approximately 5,600 ac-ft/yr. It should be noted that the overall projections for manufacturing demand in Rusk County are at a maximum amount of 34 ac-ft/yr. It is believed that the Rusk County Refinery demands were not accounted for the regional water planning demand projections. WMSs for Rusk County Refinery are not discussed in this section because the demand is not included in the regional water planning demand projections. However, Angelina & Neches River Authority is identified as the seller to this entity and a WMS is discussed in the WMS discussion for major water providers.

Jacobs WSC. All water supplies in Jacobs WSC are from groundwater in the Carrizo-Wilcox aquifer. Beginning in 2070, there is a need of 22 ac-ft shown due to slightly increasing demands over the planning horizon. The recommended strategy for Jacobs WSC to meet their need is to develop additional groundwater in the Carrizo-Wilcox aquifer. Since the need is relatively minimal (less than 10 percent of demand), rather than drilling new wells, this WUG could also consider increasing the pumping rate of their current well system to meet their future demands if there are no infrastructure limitations

Jacobs WSC	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	0	22
Recommended Strategy RUSK-JAW: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	0	0	0	22

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy RUSK-JAW: New Wells (Carrizo-Wilcox)	22	$1,795,000	$140,000	$6,364	$19.53

Overton. The strategy to meet the shortages for Overton in Rusk County are discussed in the Smith County strategy summary section.

Wright City WSC. Wright City WSC is split across three counties in Region I (Cherokee, Rusk, Smith). All current supplies for this WUG are from wells in the Carrizo-Wilcox aquifer, most of which are located in

Smith County. All of Wright City WSC's demands in Smith County are met by their groundwater supplies, however, needs are shown in Cherokee and Rusk Counties. The recommended strategy for Wright City to meet these needs is to develop additional groundwater in the Carrizo-Wilcox aquifer. The strategy is discussed in the Cherokee County strategy summary section.

Wright City WSC	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	0	21
Recommended Strategy RUSK-WRC: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	0	0	0	22

Livestock. Current supplies for livestock users in Rusk County include groundwater from the Carrizo-Wilcox and Queen City aquifers, as well as other local supplies. There is an unmet need for livestock of 20 ac-ft beginning in 2040 that increases to 83 ac-ft by 2070. The recommended strategy for livestock users to meet this need is to develop additional groundwater in the Carrizo-Wilcox aquifer.

Rusk Livestock	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	20	51	83	83
Recommended Strategy RUSK-LTK: New Wells (Carrizo-Wilcox) (ac-ft/yr):	0	0	20	51	83	83

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy RUSK-LTK: New Wells (Carrizo-Wilcox)	83	$283,000	$24,000	$289	$0.89

Mining. Rusk County Mining is supplied by groundwater from the Carrizo-Wilcox and Other-Undifferentiated aquifers and surface water from local supplies. Several private industries have undergone negotiations with Angelina & Neches River Authority and are currently under contract to purchase water from Angelina & Neches River Authority to meet their projected demands. Therefore, the recommended strategy for meeting the mining needs for Rusk County 2020 is to purchase raw water from Angelina & Neches River Authority.

Rusk Mining	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	305	168	22	0	0
Recommended Strategy RUSK-MIN: Purchase from ANRA (Mud Creek) (ac-ft/yr)	0	305	168	22	0	0

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers. It is assumed that the mining customers will construct a raw water transmission system to transfer supplies from the Run-of-River diversion location. Cost estimates include capital cost for a pipeline, pump stations, and storage tanks.

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy RUSK-MIN: Purchase from ANRA (Mud Creek)	305	$14,808,000	$1,291,000	$4,233	$12.99

Steam Electric Power. The current supply for steam electric power users in Rusk County are the Carrizo-Wilcox aquifer, Martin Lake, and Toledo Bend Reservoir (SRA). The demands for steam electric power are based on projected demands for two existing power plants that have existing supplies: Luminant's Martin Lake plant and the Tenaska Gateway facilities. Martin Lake has a firm yield of 25,000 ac-ft/yr. The Tenaska Gateway facility uses water from Toledo Bend Reservoir and has a contract for 17,922 ac-ft/yr. Based on the projected demands for steam electric power in Rusk County, there is a projected shortage of approximately 1,100 ac-ft throughout the planning horizon. For planning purposes, it is assumed that this demand will be at the Tenaska facility and can be met through additional supplies from SRA with little to no infrastructure improvements. Because SRA has water supplies available to meet the projected water shortage from this WUG, it is recommended that a contract be implemented to secure water from Toledo Bend Reservoir (SRA). Since this project will not be completed prior to January 2023, due to time constraints, it will be pushed to come online in the 2030 decade to comply with TWDB planning requirements.

Rusk Steam Electric Power	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	1,103	1,103	1,103	1,103	1,103	1,103
Recommended Strategy RUSK-SEP: Purchase from SRA (Toledo Bend) (ac-ft/yr)	0	1,103	1,103	1,103	1,103	1,103

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

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy RUSK-SEP: Purchase from SRA (Toledo Bend Reservoir)	1,103	$30,008,000	$2,795,000	$2,534	$7.78

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

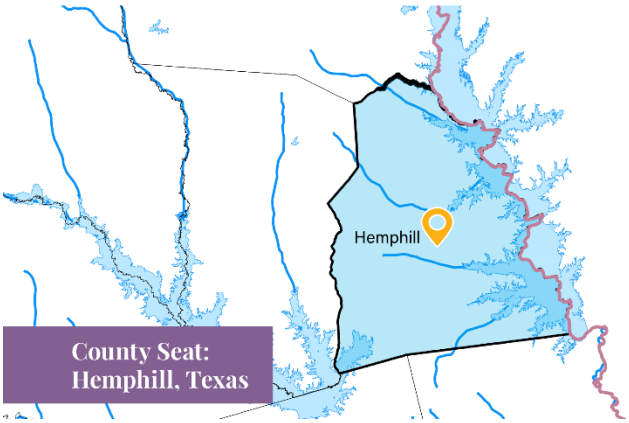
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Henderson	83	148	179	235	283	334
Kilgore	10	19	21	25	28	32
Mt. Enterprise WSC	4	8	0	0	0	0
New London	13	22	26	30	36	40
Tatum	4	8	9	10	12	14

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Henderson	334	$9,900,000	$370,000	$1,431	$4.39
Kilgore	32	$0.00	$8,000	$289	$0.89
Mt. Enterprise WSC	8	$0.00	$3,000	$500	$1.53
New London	40	$0.00	$6,000	$174	$0.53
Tatum	14	$0.00	$4,000	$316	$0.97

County Summary. Below is a summary of WUGs in Rusk County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Chalk Hill SUD	Carrizo-Wilcox	0	None
County Other	Carrizo-Wilcox, Other Undifferentiated	0	None
Cross Roads SUD	Carrizo-Wilcox, Lake Fork (Kilgore)	0	None
Crystal Farms WSC	Carrizo-Wilcox	0	None
Ebenezer WSC	Carrizo-Wilcox	0	None
Elderville WSC	Lake Cherokee, Lake Fork	0	None
Gaston WSC	Carrizo-Wilcox	0	None
Goodsprings WSC	Carrizo-Wilcox	0	None
Henderson	Lake Fork, Carrizo-Wilcox	0	Conservation
Jacobs WSC	Carrizo-Wilcox	22	New Wells (Carrizo-Wilcox)
Kilgore	Lake Fork, Carrizo-Wilcox	0	Conservation
Minden Brachfield WSC	Carrizo-Wilcox	0	None
MT Enterprise WSC	Carrizo-Wilcox	0	Conservation
New London	Carrizo-Wilcox	0	Conservation
New Prospect WSC	Carrizo-Wilcox	0	None
Overton	Carrizo-Wilcox	384	New Wells (Carrizo Aquifer) See Smith County for Discussion
South Rusk WSC	Carrizo-Wilcox	0	None
Southern Utilities Inc.	Carrizo-Wilcox, Tyler Carrizo, Lake Tyler, Lake Palestine	0	None
Tatum	Carrizo-Wilcox	0	Conservation
West Gregg SUD	Carrizo-Wilcox	0	None
Wright City WSC	Carrizo-Wilcox	21	New Wells (Carrizo-Wilcox)
Irrigation	Carrizo-Wilcox, Run-of-River, Other Undifferentiated	0	None
Manufacturing	Carrizo-Wilcox, Run-of-River	0	None
Livestock	Carrizo-Wilcox, Queen City, Local Supply	83	New Wells (Carrizo-Wilcox)
Mining	Carrizo-Wilcox, Run-of-River, Other Undifferentiated	305	Purchase from ANRA (Mud Creek)
Steam Electric Power	Carrizo-Wilcox, Martin Lake, Toledo Bend Reservoir	1,103	Purchase from SRA (Toledo Bend)

5B.2.15 Sabine County



Water supply sources currently used in Sabine County include the Carrizo-Wilcox, Yegua-Jackson and Other-Undifferentiated aquifers, Toledo Bend Reservoir, and local surface supplies. The total available supply from groundwater in Sabine County is 11,690 ac-ft/yr. Of this amount, about 1,500 ac-ft/yr is currently being used. This leaves considerable groundwater for future supplies. In addition, Toledo Bend Reservoir, which is located along the eastern border of Sabine County, has available supply (through contracts with SRA). Currently, there are no shortages for WUGs in Sabine County.

G-M WSC. G-M WSC is a WUG in Sabine County. Currently G-M WSC has sufficient supplies to meet the projected needs over the planning period. However, G-M WSC wanted the WMSs from their five-year water plan incorporated into the 2021 Plan. Below is a discussion on the supplies and WMSs based on the information provided by G-M WSC.

The current and future customers for G-M WSC are 1) G-M WSC, 2) Pendleton Harbor 3) El Camino 4) Dogwood Estates 5) Frontier Park 6) Cypress point. The existing sources of supply for G-M WSC are 1) groundwater wells 2) potable water from City of Hemphill 3) potable water from City of Pineland. G-M WSC would like to be independent of City of Hemphill purchases in five years. The WSC recently completed the construction of a WTP at a capacity of 1 MGD, and a 10-inch waterline from the WTP to FM 3121.

In terms of future projects, G-M WSC is planning some improvements and updates to distribution system infrastructure, expansion of the existing WTP to 2 MGD to potentially sell water to City of Hemphill, replacing water meters and constructing an elevated storage tank. Following is a summary of the list of water supply projects and the cost estimates provided by G-M WSC.

Strategy	Opinion of Probable Costs
Waterline Improvements	
Water Plant to Highway 83 Plant	$ 917,200
FM 3121 to City Limits	$ 535,800
North Bypass Loop around Hemphill	$ 454,200
South Bypass Loop around Hemphill	$ 773,200
Total	**$ 2,680,400**
Water System Expansion	
Pendleton Harbor and Frontier Park Areas	-
Dogwood Estates and Other Areas of FM 2928	$ 514,750
El Camino, Millionaire Point, and Apache Drive	$ 881,040
Unserved Areas of East FM 2928	$ 594,700
Total	**$ 1,990,490**
Surface Water Plant Improvements	$ 2,483,000
Highway 83 Plant – Elevated Tank	$ 745,500

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

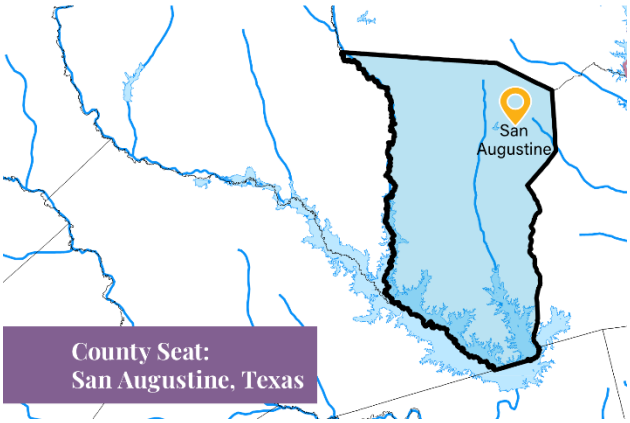
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Hemphill	4	8	7	7	8	8

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Hemphill	8	$0.00	$2,000	$286	$0.88

County Summary. Below is a summary of WUGs in Sabine County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Brookeland FWSD	Yegua-Jackson, Gulf Coast	0	None
County Other	All Aquifers, Toledo Bend Reservoir	0	None
G-M WSC	Carrizo-Wilcox, Toledo Bend Reservoir	0	Infrastructure Improvements
Hemphill	Toledo Bend Reservoir	0	Conservation
Pineland	Carrizo-Wilcox, Yegua-Jackson	0	None
Irrigation	None	0	None
Livestock	All Aquifers, Local Supply	0	None
Manufacturing	Yegua-Jackson, Reuse, Run-of-River Neches	0	None
Mining	Yegua-Jackson, Toledo Bend Reservoir, Other Undifferentiated	0	None
Steam Electric Power	None	0	None

5B.2.16 San Augustine County



San Augustine County is in the Neches and Sabine River Basins. Current water supplies for the county include groundwater from the Carrizo-Wilcox, Sparta, and Yegua-Jackson aquifers and surface water from San Augustine Lake and local supplies. Available supplies to meet projected shortages include nearly 2,700 ac-ft/yr of unallocated groundwater and a small amount of surface water from San Augustine.

San Augustine. Current supplies for San Augustine include surface water supplies from San Augustine Lake. There are shortages for this WUG owing to the limitations of supplies in the San Augustine Lake. The recommended strategy for San Augustine to meet future shortages is to install new wells in Carrizo Wilcox aquifer to meet any unmet needs. Though San Augustine has a need in 2020, the new wells will not be completed prior to January 2023 due to time constraints, so the strategy must have an online decade of 2030 according to TWDB planning requirements.

San Augustine	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	120	105	92	89	89	89
Recommended Strategy SAUG-SAG: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	105	92	89	89	89
Recommended Strategy: Conservation (ac-ft/yr)	10	17	18	20	22	23

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SAUG-SAG: New Wells (Carrizo-Wilcox)	105	$1,045,000	$88,000	$838	$2.57
Recommended Strategy: Conservation	23	$2,297,000	$79,000	$3,661	$11.23

Livestock. Current supplies for livestock users in San Augustine County include groundwater from the Carrizo-Wilcox, Sparta, and other undifferentiated aquifers, as well as other local surface water supplies. Due to high demands and limitations of developed groundwater supplies for livestock users, increasing needs above 1,000 ac-ft are shown throughout the planning horizon. The recommended strategy for livestock users is to purchase additional water from SRA to meet any unmet needs. Though there is a need in 2020, this project will not be completed prior to January 2023 due to time constraints, so the online decade for this project will be 2030 because of TWDB planning requirements.

San Augustine Livestock	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	1,333	1,539	1,774	2,048	2,349	2,349
Recommended Strategy SAUG-LTK: Purchase from SRA (Toledo Bend) (ac-ft/yr)	0	1,539	1,774	2,048	2,349	2,349

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

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SAUG-LTK: Purchase from SRA (Toledo Bend)	2,349	$41,302,000	$4,121,000	$1,754	$5.38

Mining. There is a shortage in mining needs in San Augustine County for decades 2020 through 2030. San Augustine mining users have negotiated a contract with Angelina & Neches River Authority of purchase of water from Angelina & Neches River Authority's run-of-river supplies on Angelina River. Though there is a need in 2020, this project will not be completed prior to January 2023 due to time constraints, so the online decade for this project will be 2030 because of TWDB planning requirements.

San Augustine Mining	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	2,102	1,102	0	0	0	0
Recommended Strategy SAUG-MIN: Purchase from ANRA (Mud Creek) (ac-ft/yr)	0	1,102	0	0	0	0

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

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SAUG-MIN: Purchase from ANRA (Mud Creek)	1,102	$35,769,000	$3,911,000	$3,549	$10.89

County Summary. Below is a summary of WUGs in San Augustine County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
County Other	All Aquifers, San Augustine Lake	0	None
G-M WSC	Carrizo-Wilcox, Toledo Bend Reservoir	0	None
San Augustine	Carrizo-Wilcox, San Augustine Lake	120	New Wells (Carrizo-Wilcox), Conservation
San Augustine Rural WSC	Carrizo-Wilcox, Sales from City of San Augustine	0	None
Irrigation	Carrizo-Wilcox	0	None
Livestock	Carrizo-Wilcox	2,349	Purchase from SRA (Toledo Bend)
Manufacturing	Carrizo-Wilcox	0	None
Mining	All Aquifers, Local Supply	2,102	Purchase from ANRA (Mud Creek)
Steam Electric Power	None	0	None

5B.2.17 Shelby County

Shelby County, which is located in the northeastern part of the region, uses groundwater from the Carrizo-Wilcox aquifer and surface water from Toledo Bend Reservoir, Lake Pinkston, and Center Lake. The largest water user in the county is livestock, and this demand is expected to nearly triple by 2070. The other major demand center is the City of Center and its customers. The total projected shortage for the county is 8,215 ac-ft/yr. The Carrizo-Wilcox aquifer has a long-term availability of 6,000 ac-ft/yr, and its estimated current use is approximately 4,500 ac-ft/yr. There is some groundwater available for development and considerable supply available from Toledo Bend Reservoir. However, a Toledo Bend Reservoir strategy would require infrastructure development to treat and deliver the water to areas with needs. A long-term shift of water supply to surface water may be needed to address future water needs.

Livestock. Livestock water demands are projected to increase significantly in Shelby County, partially due to the growing poultry industry. Current supply is from Carrizo-Wilcox aquifer and local surface water supplies. It is recommended that any large-scale user should obtain surface water from Toledo Bend Reservoir through a contract with SRA.

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

Shelby Livestock	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	6,491	8,761	11,524	14,896	19,006	19,006
Recommended Strategy SHEL-LTK: Purchase from SRA (Toledo Bend) (ac-ft/yr)	6,491	8,761	11,524	14,896	19,006	19,006

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SHEL-LTK: Purchase from SRA (Toledo Bend)	19,006	-	$18,582,000	$978	$3.00

Sand Hills WSC. The current supplies for Sand Hills WSC are taken from Carrizo Wilcox aquifer, Lake Center and Lake Pinkston. The shortages for future decades are met by means of two strategies. One recommended is to purchase additional supplies from Sabine River Authority. The other recommended strategy is to implement conservation measures.

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

Sand Hills WSC	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	65	76	85	95	107	117
Recommended Strategy SHEL-SHW: Purchase from Center (ac-ft/yr)	61	68	77	87	97	105
Recommended Strategy: Conservation (ac-ft/yr)	4	8	8	9	10	12

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SHEL-SHW: Purchase from Center	117	-	$102,000	$971	$2.98
Recommended Strategy: Conservation	12	-	$3,000	$353	$1.08

There are no shortages but a strategy to implement conservation measures was proposed for the following WUGs.

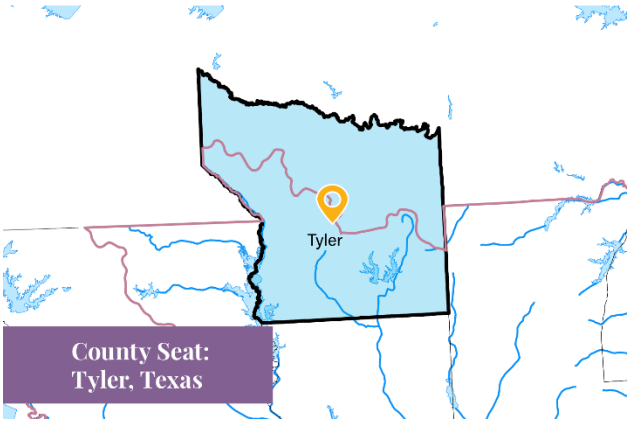
Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Center	26	45	52	57	64	70
Tenaha	4	6	6	7	8	8

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Center	70	$0.00	$11,000	$188	$0.58
Tenaha	8	$0.00	$2,000	$308	$0.94

County Summary. Below is a summary of WUGs in Shelby County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Center	Carrizo-Wilcox, Lake Pinkston, Lake Center	0	Reuse Pipeline to Center Lake, Toledo Bend Pipeline to Center Lake (Discussion included in the MWP Summary), Conservation
Choice WSC	Carrizo-Wilcox	0	None
County-Other	Carrizo-Wilcox, Lake Pinkston, Lake Center, Toledo Bend (LA)	0	None
East Lamar WSC	Carrizo-Wilcox	0	None
Five Way WSC	Carrizo-Wilcox	0	None
Flat Fork WSC	Carrizo-Wilcox	0	None
Huxley	Toledo Bend Reservoir	0	None
Joaquin	Toledo Bend (LA)	0	None
McClelland WSC	Carrizo-Wilcox	0	None
Sand Hills WSC	Carrizo-Wilcox, Lake Center, Pinkston Reservoir	117	Purchase from Center, Conservation
Tenaha	Carrizo-Wilcox	0	Conservation
Timpson	Carrizo-Wilcox	0	None
Irrigation	Carrizo-Wilcox, Reuse	0	None
Livestock	Carrizo-Wilcox, Local Supply	19,006	Purchase from SRA (Toledo Bend)
Manufacturing	Carrizo-Wilcox, Lake Pinkston, Lake Center	0	None
Mining	Carrizo-Wilcox, Toledo Bend	0	None
Steam Electric Power	None	0	None

5B.2.18 Smith County



Smith County is located partially in the ETRWPA and partially in Region D. Almost all of the supplies in Smith County in the ETRWPA come from City of Tyler sources and from groundwater supplies. A small amount of water is supplied from Lake Jacksonville through the Cherokee WSC. The City of Tyler currently utilizes surface water from Lakes Tyler and Tyler East, Bellwood Lake and Lake Palestine. About 10 percent of Tyler's current supply is from the Carrizo-Wilcox aquifer.

The groundwater in Smith County is heavily used for water supply. Current use from the Carrizo-Wilcox aquifer, the county's largest groundwater supply, exceeds the Modeled Available Groundwater. Allocation of the current supplies resulted in an over-allocation of the Modeled Available Groundwater capacity. Therefore, current supplies in Smith County were reduced to cut back uniformly for all water users in Smith County to avoid over-allocation. In the allocation process, it was assumed that there is no additional Carrizo-Wilcox water available at this time. There is water available from the Queen City aquifer, but water quality concerns limit its potential use. The most likely sources for municipal water needs include surface water supplies from the City of Tyler and voluntary transfers from other users. The City of Tyler has indicated that it could provide potable water to most of the municipal WUGs with needs, with limited infrastructure in most cases. Irrigation and mining needs are shown to be supplied by the Queen City aquifer.

Bullard. Bullard's current supply is from the Carrizo-Wilcox aquifer. Due to competition for water from this source, the City is projected to have a shortage of nearly 1,128 ac-ft/yr by 2070. It is recommended that Bullard purchase water from City of Tyler. Municipal conservation is another recommended strategy for Bullard. A potentially feasible strategy is to purchase water from North Cherokee WSC, which would be supplied from the WSC's participation in Lake Columbia project.

Another potentially feasible strategy for Bullard is to drill additional wells in the Carrizo Wilcox aquifer. A groundwater strategy was not proposed as a recommended strategy because the Carrizo Wilcox aquifer in Smith County is over-allocated based on the Modeled Available Groundwater (MAG) supplies projected. When the MAG values are updated to address the over-allocation issues, Bullard can consider a strategy to drill additional wells in the Carrizo Wilcox aquifer.

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers. It is assumed that the Bullard will construct a raw water transmission system to transfer supplies from the City of Tyler supply sources. Cost estimates include capital cost for a pipeline, pump stations, and storage tanks. Though there is a need in 2020, this project will not be completed prior to January 2023 due to time constraints, so the online decade for this project will be 2030 because of TWDB planning requirements.

Bullard	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	141	332	526	739	956	1,182
Recommended Strategy SMTH-BLD: Purchase from City of Tyler (ac-ft/yr)	0	322	511	718	928	1,145
Recommended Strategy: Conservation (ac-ft/yr)	11	22	28	36	44	54

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SMTH-BLD: Purchase from City of Tyler	1,145	$14,264,00	$1,615,000	$1,410	$4.33
Recommended Strategy: Conservation	54	$0	$14,000	$297	$0.91

Crystal Systems Texas. Crystal Systems Texas serves multiple counties in Regions C and D and Smith County in the ETRWPA. Water supplies to Crystal Systems in Smith County are from the Carrizo-Wilcox aquifer. The Crystal Systems Texas, Inc. system is located in northwestern Smith County and serves the un-incorporated area surrounding Hideaway Lake. In 2018, the system had 2050 residential connections. The population is projected to increase from 4,343 persons in 2020 to 8,881 persons in 2070. The System is included as a WUG in Smith County. The system's current water supply consists of five water wells from the Carrizo-Wilcox Aquifer. The total rated capacity of these wells is 3,560 GPM, or 1,914 ac-ft/yr. The system is bounded on the north and southeast by the Lindale Rural WSC and on the east by the City of Lindale. The System does have a water conservation plan. The System is projected to have a water supply surplus of 169 ac-ft/yr in 2020 decreasing to a deficit of 291 ac-ft/yr in 2070. Region D is the primary region for managing the water strategy evaluation for Crystal Systems Texas. The strategies to address shortages for Crystal Systems Texas were developed by Region D for meeting shortages in all regions. ETRWPA approves and supports the strategies developed by Region D for this WUG.

Crystal Systems Texas	2020	2030	2040	2050	2060	2070
Population	4,343	5,041	5,812	6,696	7,708	8,881
Projected Water Demand (ac-ft/yr)	1,356	1,557	1,791	2,061	2,370	2,730
Current Water Supply (ac-ft/yr)	1,525	1,674	1,833	2,009	2,206	2,439
Projected Supply Surplus (+)/Deficit(-) (ac-ft/yr)	169	117	42	-52	-164	-291

Four alternative strategies were considered to meet the Crystal System's water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcd threshold set by the planning group. Water reuse was not considered because the system does not have a sewer collection system. Surface water alternatives were omitted since there is not a supply source within close proximity to the system and surface water treatment is not economically feasible for a system of this size. Wells in the Carrizo-Wilcox Aquifer (Sabine and Neches River Basins) were identified as a potentially feasible strategy for the WUG.

The recommended strategy for Crystal Systems to meet their projected deficit of 78 ac-ft/yr in 2040 and 816 ac-ft/yr in 2070 would be to construct four additional water wells similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo Wilcox Aquifer in Smith County. Four wells with rated capacity of 500 gpm each would provide approximately 269 acre-feet each. The Carrizo Wilcox Aquifer in Smith County is projected to have a more than ample supply availability to meet the needs of Crystal Systems for the planning period. During the planning period two

wells will be drilled in the Carrizo Wilcox formation of the Sabine River Basin while two wells will be drilled into the Carrizo Wilcox formation of the Neches River Basin.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

In addition to this, conservation was also proposed as a strategy for the WUG. Below the details of the conservation strategy.

Crystal Systems Texas	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	52	164	291
Recommended Strategy: Conservation (ac-ft/yr)	18	38	52	71	92	118
New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	0	78	192	310	538

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	118	$953,000	$39,000	$471	$1.45
Drill New Wells (Carrizo-Wilcox)	538	$2,531,000	$231,000	$ 429	$1.32

Lindale. Lindale is a WUG in both Region D and ETRWPA. Lindale has shortages both in ETRWPA and Region D. ETRWPA approves and supports the strategies developed in Region D to meet the shortages for Lindale in both regions. Below is a description of the WUG needs and strategies to meet shortages for Lindale.

The City of Lindale is located in northern Smith County and serves the incorporated city limits and an area immediately northwest of the City of Lindale. The population is projected to increase from 5,806 persons in 2020 to 13,985 persons in 2070. The City is included as a WUG in Smith County. The system's current water supply consists of four water wells from the Carrizo-Wilcox Aquifer. The total rated capacity of these wells is 2,320 gpm, or 1,247 ac-ft/yr. The system is bounded on the west, north, and east by the Lindale Rural WSC and on the south by the City of Tyler. The City does have a water conservation plan. The City of Lindale is projected to have a water supply deficit of 70 ac-ft/yr in 2020 increasing to a deficit of 1,833 ac-ft/yr in 2070.

Lindale (Sabine River Basin)	2020	2030	2040	2050	2060	2070
Population	3,707	4,499	5,396	6,107	7,280	8,674
Projected Water Demand	841	1,005	1,195	1,347	1,607	1,910
Current Water Supply	796	779	773	756	762	773
Projected Supply Surplus (+)/Deficit(-)	-45	-226	-422	-591	-842	-1,137

Lindale (Neches River Basin)	2020	2030	2040	2050	2060	2070
Population	2,099	2,704	3,311	3,964	4,629	5,311
Projected Water Demand	476	604	733	875	1,020	1,170
Current Water Supply	451	468	474	491	485	474
Projected Supply Surplus (+)/Deficit(-)	-25	-136	-259	-384	-535	-696

Four alternative strategies were considered to meet the City of Lindale's water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcd threshold set by the planning group. Water reuse was not considered because the City does not have a demand for non-potable water. Surface water alternatives were omitted since there is not a supply source within close proximity to the City and surface water treatment is not economically feasible for a system of this size. Groundwater wells in the Carrizo-Wilcox Aquifer in the Neches Basin were identified as a potentially feasible strategy for the City.

The recommended strategy for the City of Lindale to meet their projected deficit of 70 ac-ft/yr in 2020 and 1,833 ac-ft/yr in 2070 would be to construct six additional water wells similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo Wilcox Aquifer in Smith County. Six wells with rated capacity of 600 gpm each would provide approximately 322 acre-feet each. The Carrizo Wilcox Aquifer in Smith County (Neches River Basin) is projected to have a more than ample supply availability to meet the needs of the City of Lindale for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Lindale	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	25	136	259	384	535	696
Recommended Strategy SMTH-LIN (ac-ft/yr): Drill New Wells (Carrizo-Wilcox) (ac-ft/yr)	25	136	259	384	535	696

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
New Wells (Carrizo-Wilcox)	696	$ 7,592,000	$ 714,000	$ 370	$1.13

In addition to this conservation was also proposed as a strategy for the WUG. Below the details of the conservation strategy.

Lindale	2020	2030	2040	2050	2060	2070
Recommended Strategy: Conservation (ac-ft/yr)	7	14	18	23	29	36

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	36	$0.00	$8,000	$259	$0.80

Manufacturing. Manufacturing is expected to have shortages beginning in 2030 at 84 ac-ft/yr and increasing to 84 ac-ft/yr by 2070. It is recommended that the manufacturing shortage be met through the purchase of additional supplies from the City of Tyler. This strategy will address the shortages for the manufacturing WUG both in ETRWPA.

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

negotiations between provider and prospective buyers. It is assumed that the potential manufacturing customers will construct a raw water transmission system to transfer supplies from the City of Tyler supply sources. Cost estimates include capital cost for a pipeline, pump stations, and storage tanks.

Smith Manufacturing	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	84	84	84	84	84
Recommended Strategy SMTH-MFG: Purchase from City of Tyler (ac-ft/yr)	0	84	84	84	84	84

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SMTH-MFG: Purchase from City of Tyler	84	$6,198,000	$545,000	$6,488	$19.91

Overton. The current supply for the City of Overton is the Carrizo-Wilcox aquifer. The City's supply is limited by well capacities and water shortages are projected beginning in 2050. The City had an average per capita consumption of 200 gpcd in 2011. This value is well over the statewide goal of 140 gpcd. After performing a conservation cost analysis, the ETRWPG believes a water conservation strategy for the City is economically achievable and is therefore recommended. This strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce Overton's demand by more than their projected need; therefore, municipal conservation is the only recommended WMS for the City. It should be noted that this WMS will address the shortage for City of Overton WUG in ETRWPA.

Overton	2020	2030	2040	2050	2060	2070
(Rusk) Need (ac-ft/yr)	66	122	177	241	310	384
(Smith) Need (ac-ft/yr)	4	7	12	18	25	32
Recommended Strategy: Conservation (ac-ft/yr)	8	15	18	21	25	28
(Rusk) Recommended Strategy SMTH-OVN: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	122	177	241	310	384
(Smith) Recommended Strategy SMTH-OVN: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	7	12	18	25	32

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	28	$0	$7,000	$289	$0.89
Recommended Strategy SMTH-OVN: New Wells (Carrizo-Wilcox)	416	$8,914,000	$846,000	$2,034	$6.24

Southern Utilities. The current supply for the Southern Utilities is the Carrizo-Wilcox aquifer and Lake Tyler. The City's supply is limited by well capacities and water shortages are projected beginning in 2020. The City had an average per capita consumption of 200 gpcd in 2011. This value is well over the statewide goal of 140 gpcd. After performing a conservation cost analysis, the ETRWPG believes a water conservation strategy for the City is economically achievable and is therefore recommended. This strategy includes cost

estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce Southern Utilities demand by more than their projected need; therefore, municipal conservation is the only recommended WMS for the City. It should be noted that this WMS will address the shortage for Southern Utilities WUG in ETRWPA.

Southern Utilities	2020	2030	2040	2050	2060	2070
Need (Region I) (ac-ft/yr)	71	74	79	84	90	98
Recommended Strategy: Conservation (ac-ft/yr)	514	866	1,058	1,279	1,527	1,803

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	1,803	$33,264,000	$1,249,000	$808	$2.48

R P M WSC. R P M WSC is located in both Region D and the ETRWPA. The water management strategies for R P M WSC were developed by Region D for both regions. ETRWPA supports the strategies developed by Region D.

R P M WSC provides water service in Van Zandt, Henderson, and Smith Counties. The WUG population is projected to be 2,957 by 2020 and increases to 5,530 by 2070. R P M WSC supplies its customers with groundwater from the Carrizo-Wilcox and Queen City aquifers with five water wells in Van Zandt County. R P M WSC is projected to have a total deficit of 34 ac-ft/yr in 2030 increasing to a deficit of 217 ac-ft/yr by 2070; the shortage projected to occur in Van Zandt County is 25 ac-ft/yr in 2030 increasing to 152 ac-ft/yr by 2070. The shortage in Henderson County is 7 ac-ft/yr in 2030, increasing to 48 ac-ft/yr in 2070. Shortages in Smith County range from 2 ac-ft/yr in 2030 up to 17 ac-ft/yr in 2070.

RPM WSC	2020	2030	2040	2050	2060	2070
Population	2,957	3,602	4,112	4,653	5,116	5,530
Projected Water Demand (ac-ft/yr)	323	378	423	475	519	561
Current Water Supply (Carrizo-Wilcox Aquifer) (ac-ft/yr)	344	344	344	344	344	344
Projected Supply Surplus (+) / Deficit (-) for Region D and ETRWPA (ac-ft/yr)	**21**	**-34**	**-79**	**-131**	**-175**	**-217**
Projected Supply Surplus (+) / Deficit (-) by County in the two regions (ac-ft/yr)						
Van Zandt	14	-25	-58	-93	-124	-152
Henderson	5	-7	-16	-27	-38	-48
Smith	2	-2	-5	-11	-13	-17

Four alternative strategies were considered to meet the WSC's water supply shortages as summarized in the following table. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Water reuse was not considered because the WSC does not have a demand for non-potable water. Surface water was not considered because the WSC does not currently have surface water treatment. Groundwater has been identified as a potential strategy for R P M WSC. The recommended strategy for R P M WSC to meet their projected deficit of 34 ac-ft/yr in 2030 and 217 ac-ft/yr in 2070 would be to construct nine additional water wells similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo-Wilcox Aquifer in the Neches Basin in Van Zandt County. Nine wells with rated capacity of 50 gpm each, pumping at an approximately depth of 560 ft., would provide approximately 27 ac-ft each.

R P M WSC	2020	2030	2040	2050	2060	2070
Needs	0	2	5	11	13	17
Recommended Strategy RPM-WSC: New Wells (Carrizo-Wilcox) (ac-ft/yr)	0	2	5	11	13	17

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy RPM-WSC: New Wells (Carrizo-Wilcox) (ac-ft/yr)	17	$3,469,000	$428,000	$1,972	$6.05

Whitehouse. Current supplies for City of Whitehouse are taken from Carrizo Wilcox, Lake Palestine, and Lake Tyler. The recommended strategy to meet shortages to purchase additional supplies from City of Tyler.

Purchased water costs for this strategy were established at a regional rate chosen for the anticipated category of use within the region. Actual purchased water costs will be determined during contract negotiations between provider and prospective buyers. It is assumed that the potential mining customers will construct a raw water transmission system to transfer supplies from the City of Tyler supply sources. Cost estimates include capital cost for a pipeline, pump stations, and storage tanks.

Whitehouse	2020	2030	2040	2050	2060	2070
Need (ac-ft/yr)	0	0	0	0	39	257
Recommended Strategy SMTH-WTH: Purchase from City of Tyler (ac-ft/yr)	0	0	0	0	39	257

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy SMTH-WTH: Purchase from City of Tyler	257	$7,666,000	$737,000	$2,868	$8.80

Conservation strategies are proposed for the following WUGs.

Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Arp	2	0	0	0	0	0
Dean WSC	11	18	0	0	0	0
Troup	6	11	12	14	17	18
Tyler	657	1,101	1,338	1,613	1,924	2,268

Conservation Strategy (ac-ft/yr)	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Arp	2	$0.00	$2,000	$1,000	$3.07
Dean WSC	18	$0.00	$7,000	$483	$1.48
Troup	18	$0.00	$5,000	$321	$0.98
Tyler	2,268	$58,766,000	$2,026,000	$1,123	$3.45

County Summary. Below is a summary of WUGs in Smith County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Algonquin Water Resources of Texas	Carrizo-Wilcox	0	None
Arp	Carrizo-Wilcox	0	Conservation
Ben Wheeler WSC	Carrizo-Wilcox	0	None
Bullard	Carrizo-Wilcox, Lake Jacksonville	1,182	Purchase from City of Tyler, Water Conservation
Carroll WSC	Carrizo-Wilcox	0	None
County Other	Carrizo-Wilcox, Lake Tyler, Lake Palestine	0	None
Crystal Systems Texas	Carrizo-Wilcox	291	New Wells in Carrizo Wilcox, Water Conservation
Dean WSC	Carrizo-Wilcox	0	Conservation
Emerald Bay MUD	Carrizo-Wilcox	0	None
Jackson WSC	Carrizo-Wilcox	0	None
Lindale	Carrizo-Wilcox	696	New Wells in Carrizo Wilcox, Water Conservation
Lindale Rural WSC	Carrizo-Wilcox	0	None
Overton	Carrizo-Wilcox	32	New Wells in Carrizo Wilcox
R P M WSC	Carrizo-Wilcox	17	Municipal Conservation, New Wells in Carrizo Wilcox
Southern Utilities	Carrizo-Wilcox, Lake Tyler, Lake Palestine	98	Conservation
Troup	Carrizo-Wilcox	0	Conservation
Tyler	Carrizo-Wilcox, Lake Tyler, Lake Palestine	0	Conservation
Walnut Grove WSC	Lake Palestine	0	None
Whitehouse	Carrizo-Wilcox, Lake Tyler, Lake Palestine	257	Purchase from Tyler
Wright City WSC	Carrizo-Wilcox	0	None
Irrigation	Carrizo-Wilcox, Lake Tyler, Lake Palestine, Other Aquifers	0	None
Manufacturing	Carrizo-Wilcox, Lake Tyler, Lake Palestine, Other Aquifers	84	Purchase from Tyler
Livestock	Carrizo-Wilcox, Queen City, Local Supply	0	None
Mining	Local Supply, Other Undifferentiated	0	None
Steam Electric Power	None	0	None

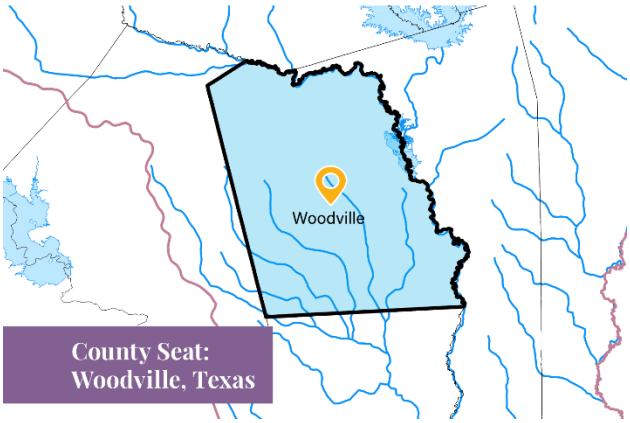
5B.2.19 Trinity County

The county is partially located in the ETRWPA and partially in Region H. Supplies include surface water from local supplies and the Neches River as well as groundwater from the Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, and Other-Undifferentiated aquifers. Municipal demands in Trinity County are less than one percent of the ETRWPA's total municipal demand. While the supplies are limited compared to supplies in other counties in the ETRWPA, there is a small volume of water available for growth not projected in this plan. No WUGs in Trinity County were identified with a need.

County Summary. Below is a summary of WUGs in Trinity County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Centerville WSC	Yegua-Jackson	0	None
County Other	Yegua-Jackson, Trinity County Regional WS	0	None
Groveton	Yegua-Jackson, Trinity County Regional WS	0	None
Pennington WSC	Yegua-Jackson	0	None
Irrigation	Yegua-Jackson	0	None
Livestock	Yegua-Jackson, Local Supply	0	None
Manufacturing	None	0	None
Mining	Yegua-Jackson	0	None
Steam Electric Power	None	0	None

5B.2.20 Tyler County



Current supplies in Tyler County include groundwater from the Gulf Coast aquifer and surface water from Sam Rayburn Reservoir (LNVA), the Neches River, and local supplies. Tyler County represents less than 2 percent of the total municipal demand in the ETRWPA and has a total county demand of approximately 5,000 ac-ft/yr. There is no projected need for any WUG located within Tyler County during the planning period. Based on the water availability estimates included in this plan, there is sufficient water to provide expected future demands in Tyler County.

Conservation strategies are proposed for the following WUGs.

Conservation Strategy (ac-ft/yr)	2020	2030	2040	2050	2060	2070
Chester WSC	2	5	5	5	6	6
Colmesneil	4	6	6	7	7	8
Cypress Creek WSC	2	3	3	3	3	4
Woodville	17	28	30	32	34	36

Conservation Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Chester WSC	6	$0.00	$2,000	$413	$1.27
Colmesneil	8	$0.00	$2,000	$315	$0.97
Cypress Creek WSC	4	$0.00	$1,000	$333	$1.02
Woodville	36	$0.00	$9,000	$305	$0.94

County Summary. Below is a summary of WUGs in Tyler County, current water supply sources, and recommended WMSs (if any).

Water User Group	Current Water Supply Source(s)	Maximum Need (ac-ft/yr)	Recommended Water Management Strategies
Chester WSC	Gulf Coast	0	Conservation
Colmesneil	Gulf Coast	0	Conservation
County Other	Gulf Coast	0	None
Cypress Creek WSC	Gulf Coast	0	Conservation
Lake Livingston WSC	Gulf Coast	0	None
Moscow WSC	Gulf Coast	0	None
Tyler County WSC	Gulf Coast	0	None
Warren WSC	Gulf Coast	0	None
Wildwood POA	Gulf Coast	0	None
Woodville	Gulf Coast, LNVA	0	Conservation
Irrigation	Gulf Coast, Run-of-River	0	None
Manufacturing	Gulf Coast	0	None
Mining	Gulf Coast, Local Supply	0	None
Livestock	Gulf Coast, Local Supply	0	None
Steam Electric Power	Gulf Coast, LNVA (Woodville)	0	None

5B.3 Major Water Providers

This section provides discussions for major water providers (MWP) located in the ETRWPA that meet one of the following criteria:

- The entity has a projected shortage in supplies based on demands of current customers and current reliable supplies. These MWPs include Angelina & Neches River Authority, Angelina Nacogdoches WCID #1, Athens MWA, City of Beaumont, Houston County WCID #1, and Upper Neches River Municipal Water Authority.

- The entity has supply sources in the ETRWPA that are listed as WMSs for WUGs outside the Region. Both the UNRMWA and the SRA are included under this criterion.

- The entity is currently pursuing WMSs to increase the reliability and/or distribution of their supplies. These include the Nacogdoches, Center, Lufkin, Port Arthur, Tyler, Jacksonville, SRA and LNVA.

A management supply factor (MSF) is the ratio of an entities total volume of existing water supplies plus total volume of recommended WMS supplies to the total decadal water demand. A value over 1.0 represents an entity with a surplus of projected supplies while a value less than 1.0 represents an entity with a deficit of projected supplies, or an unmet need. Appendix 5B-C presents the MSF for each MWP for each decade in the planning period. All MWPs have an MSF of at least 1.0 with values ranging from 1.0 for the City of Beaumont in 2060 to 10.63 for Sabine River Authority in every decade.

5B.3.1 Angelina & Neches River Authority

Angelina & Neches River Authority is the sponsor for the Lake Columbia project on Mud Creek in Cherokee and Rusk Counties. Lake Columbia is a recommended strategy in the 2021 Plan. Angelina & Neches River Authority has been granted a water right permit (Permit No. 4228) by the TCEQ to impound 195,500 ac-ft and to divert 85,507 ac-ft/yr (76.3 MGD) for municipal and industrial purposes. Angelina & Neches River Authority currently has contracted customers for 53 percent of the 85,507 ac-ft/yr permitted supply of the proposed Lake Columbia. In addition, Angelina & Neches River Authority has been approached to supply water for mining purposes in Angelina, Cherokee, Nacogdoches, Shelby, San Augustine, Rusk, and Sabine counties. The mining demand will be met with run-of-the-river diversions.

The water suppliers currently under contract with Angelina & Neches River Authority for water from Lake Columbia are listed with current participation percentage in the table below. Also included below is a table showing additional contracted customers Angelina & Neches River Authority and the corresponding demand. The WMSs for Angelina & Neches River Authority were developed to address the total customer demand.

There are four recommended strategies for Angelina & Neches River Authority in the 2021 Plan. They are 1) construction of Lake Columbia, 2) Angelina & Neches River Authority treatment plant and distribution system, 3) development of 10,000 ac-ft/yr of run-of-river supplies (application process is administratively complete) and an additional 20,000 ac-ft/yr of run-of-river supplies in Cherokee County, and 4) development of groundwater supplies in Cherokee County.

Construction of Lake Columbia (Recommended). Lake Columbia is currently projected to be online by 2030. In the 2014 October Draft Long Range Water Supply Plan, the City of Dallas listed Lake Columbia as a recommended strategy for 2070. After considering the local needs in the East Texas Region, Dallas' projected share of the proposed Lake Columbia project is 56,000 ac-ft/yr by 2070. Angelina & Neches River Authority has a water right for Lake Columbia and is currently seeking a 404 permit for construction. An environmental impact study (EIS) has been prepared for Lake Columbia under the direction of the USACE.

The draft EIS was published on January 29, 2010 and public and agency comments on the draft EIS were provided on March 30, 2010. Currently, the Lake Columbia project is subject to completion of the EIS and issuance of a 404 permit from the US Army Corps of Engineers and a completion of Source Water Assessment. According to an April 2011 statement from USACE, a new Draft EIS is necessary before the EIS can be finalized. The consideration of the Draft EIS by USACE will likely involve additional studies and compliance with the USACE Mitigation Manual. Angelina & Neches River Authority and participating entities will share in the costs associated with the Lake Columbia water management strategy. For reservoir construction, unit costs are based on the WAM Run 3 yield estimate of 75,700 ac-ft/yr.

Angelina & Neches River Authority treatment plant and distribution system (Recommended). The cities of Nacogdoches, Jacksonville, and Rusk are assumed to purchase raw water from Lake Columbia and develop their own raw water transmission and treatment facilities. Most of the municipal water users (and current customers of Angelina & Neches River Authority) in Cherokee, Rusk, and Smith Counties will be purchasing treated water from Angelina & Neches River Authority. Costs for water treatment and transmission system are shared among currently contracted entities that are assumed to buy treated water from Angelina & Neches River Authority. This project will not supply any additional raw water. Rather, this project will provide treatment capacity for 22,232 ac-ft/yr of raw water from Lake Columbia.

Run-of-River Supplies (Recommended). Another recommended strategy for Angelina & Neches River Authority is to develop the run-of-river supplies. There is no construction cost to Angelina & Neches River Authority associated with the development of run-of-river supplies. Angelina & Neches River Authority will incur lawyer fees and other costs associated with the permitting process and coordination with Texas Commission on Environmental Quality. It is assumed that the mining customers will develop their own transmission systems to deliver run-of-river supplies from Mud Creek to the area of use, and those costs are included in the county summaries in Section 5B.2.

Groundwater Wells (Recommended). Angelina & Neches River Authority will be developing groundwater supplies in the Carrizo-Wilcox aquifer in Rusk/Cherokee counties to meet the manufacturing demands for the Rusk County Refinery. Angelina & Neches River Authority will be providing treated water to meet this demand. Angelina & Neches River Authority is proposing to develop groundwater wells in Carrizo-Wilcox aquifer in Cherokee and Rusk Counties to meet the needs projected for Rusk County Refinery. The project will provide a supply of 5,600 ac-ft/yr in 2030 and 2040, but the supply will reduce to 4,500 ac-ft/yr by 2070 due to lack of supply availability in the Carrizo-Wilcox aquifer. The cost estimates for developing the wells and supplying treated water are included in the summary table below.

A comparison of the water supplies versus the demands and the recommended strategies to be implemented is shown in the table below. A summary of the strategy costs is also provided below. The cost estimate reported in this section is the cost for developing the total yield of Lake Columbia, 75,720 ac-ft/yr. It is assumed that Dallas will be responsible for 70 percent of the cost for the dam, relocations, and reservoir land acquisitions and Angelina & Neches River Authority will be responsible for the remaining 30 percent. Capital costs for the dam and relocations were extracted from the cost estimates developed for the EIS (based on March 2012 dollars) and updated to reflect September 2018 dollars. Included in the relocation costs are estimates for relocating the four state highways and one railway that will be impacted by the reservoir. Annual costs for the reservoir were developed assuming a 40-year debt service with 3.5% interest rate. Annual costs for the non-reservoir infrastructure was developed for a 20-year debt service with 3.5% interest rate.

Customers for Lake Columbia

Recipient	County	Basin	Percent Participation in Columbia	Contract Amount (ac-ft/yr)
Current Contracted Customers				
Afton Grove WSC, Stryker Lake WSC	Cherokee	Neches	4.5%	3,848
Jacksonville	Cherokee	Neches	5.0%	4,275
New Summerfield	Cherokee	Neches	3.0%	2,565
North Cherokee WSC	Cherokee	Neches	5.0%	4,275
Rusk	Cherokee	Neches	5.0%	4,275
Rusk Rural WSC	Cherokee	Neches	1.0%	855
City of Alto	Cherokee	Neches	0.5%	428
Caro WSC	Nacogdoches	Neches	0.5%	428
Nacogdoches	Nacogdoches	Neches	10.0%	8,551
New London	Rusk	Sabine	1.0%	855
Troup	Smith	Neches	5.0%	4,275
Arp	Smith	Neches	0.5%	428
Blackjack WSC	Smith	Neches	1.0%	855
Jackson WSC	Smith	Neches	1.0%	855
Whitehouse	Smith	Neches	10.0%	8,551
Potential Customers				
City of Dallas		Trinity		56,050

Additional Customer Demand for ANRA

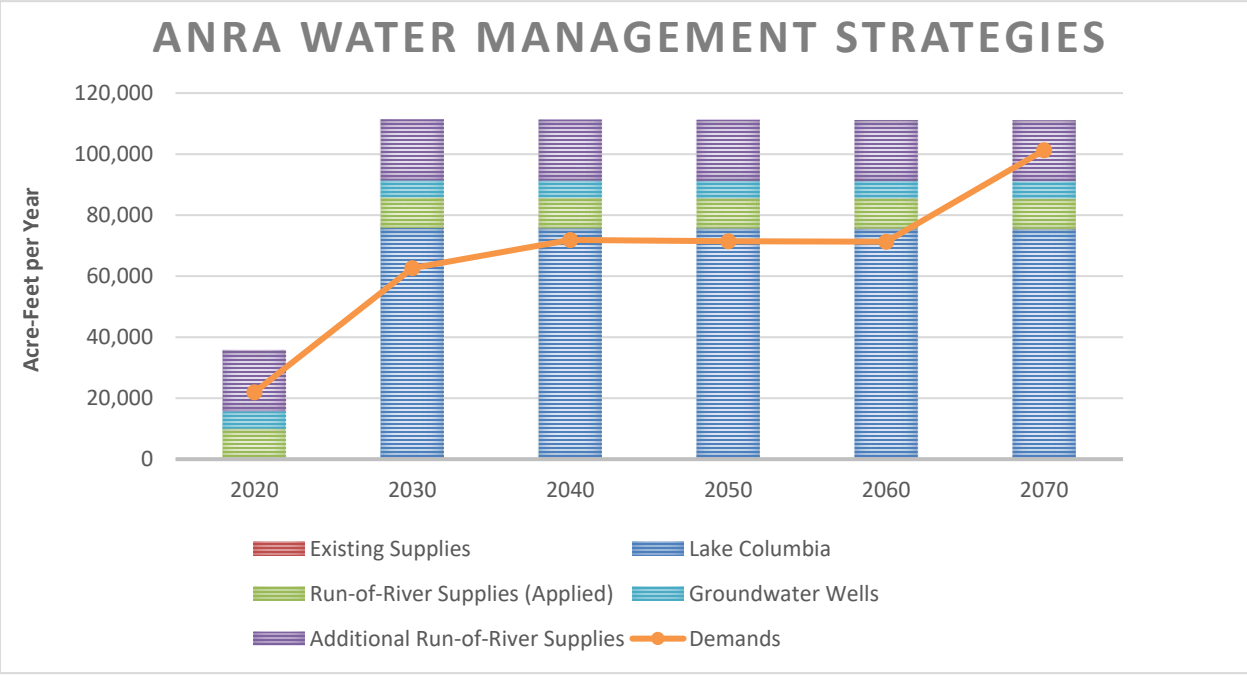
Recipient	2020	2030	2040	2050	2060	2070
Holmwood Utility	65	70	70	70	70	70
Steam Electric Demand – Cherokee	8,000	15,000	20,000	20,000	20,000	20,000
Manufacturing – Rusk County Refinery	5,600	5,600	5,600	5,600	5,600	5,600
Mining - Angelina	474	573	398	300	225	168
Mining - Cherokee	238	247	210	147	84	40
Mining - Nacogdoches	5,475	2,975	118	0	0	0
Mining – San Augustine	2,102	1,102	0	0	0	0
Mining – Rusk	0	305	168	22	0	0
Total Future Customer Demand	**21,953**	**25,871**	**26,563**	**26,138**	**25,978**	**25,877**

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Jasper Aquifer	65	70	70	70	70	70
Demands (ac-ft/yr)						
Current Demands	45,319	45,319	45,319	45,319	45,319	101,369
Potential Demands with Current and Future Customers	67,272	71,190	71,882	71,457	71,297	127,246
Potential Demands (Limited to Lake Columbia Supply)	21,953	71,190	71,882	71,457	71,297	101,277
Surplus or (Shortage)	**(21,888)**	**(71,120)**	**(71,812)**	**(71,387)**	**(71,227)**	**(101,207)**
Water Management Strategies (ac-ft/yr)						
Recommended Strategy ANRA-COL: Lake Columbia	0	75,720	75,640	75,560	75,480	75,400
Recommended Strategy ANRA-WTP: ANRA Treatment Plant and Distribution System*	0	0	0	0	0	0
Recommended Strategy ANRA-ROR: Mud Creek Run-of-River (Application in process)	10,000	10,000	10,000	10,000	10,000	10,000
Recommended Strategy ANRA-ROR: Mud Creek Run-of-River (New Application)	20,000	20,000	20,000	20,000	20,000	20,000
Recommended Strategy ANRA-GW: New Wells (Carrizo-Wilcox)	0	5,600	5,600	5,000	4,800	4,500
Total Supplies from Strategies	**30,000**	**111,320**	**111,240**	**110,560**	**110,280**	**109,900**
Surplus or (Shortage) with WMS	**8,112**	**40,200**	**39,428**	**39,173**	**39,053**	**8,693**

*Strategy will provide 22,232 ac-ft/yr of treatment capacity from Lake Columbia but will not provide any additional raw water.

Strategy	Yield (ac-ft/yr)	Capital cost	Annual Cost	Unit Cost ($/AF)	Unit Cost ($/1000 gal)
Lake Columbia Reservoir	75,720	$402,862,000	$23,509,000	$311	$0.95
ANRA-WTP: ANRA Treatment Plant and Distribution System*		$228,001,000	$49,839,000	$2,242	$6.88
Recommended Strategy ANRA-GW: New Wells (Carrizo-Wilcox)	5,600	$29,775,000	$3,185,000	$569	$1.75
Mud Creek Run-of-River	30,000	0	0	0	0

*Strategy will provide 22,232 ac-ft/yr of treatment capacity from Lake Columbia but will not provide any additional raw water.



5B.3.2 Angelina Nacogdoches WCID #1

Angelina Nacogdoches WCID#1 (AN WCID #1) is a major water provider to Steam Electric Power demands for Luminant and Nacogdoches Power in Cherokee and Nacogdoches counties, respectively. In addition to these customers, Angelina Nacogdoches WCID#1 has a contract with Henderson in Rusk County for future use. The demand for the wholesale customers is supplied from Lake Striker. Angelina Nacogdoches WCID#1 owns a water right for 20,600 ac-ft/yr from Lake Striker. The entity's supplies are not sufficient to meet the contracted demands, and Angelina Nacogdoches WCID#1 has shortages beginning in 2020. Table below includes a summary of demands and supplies for Angelina Nacogdoches WCID#1. The following recommended strategies were proposed by Angelina Nacogdoches WCID#1 for inclusion in the 2021 Plan.

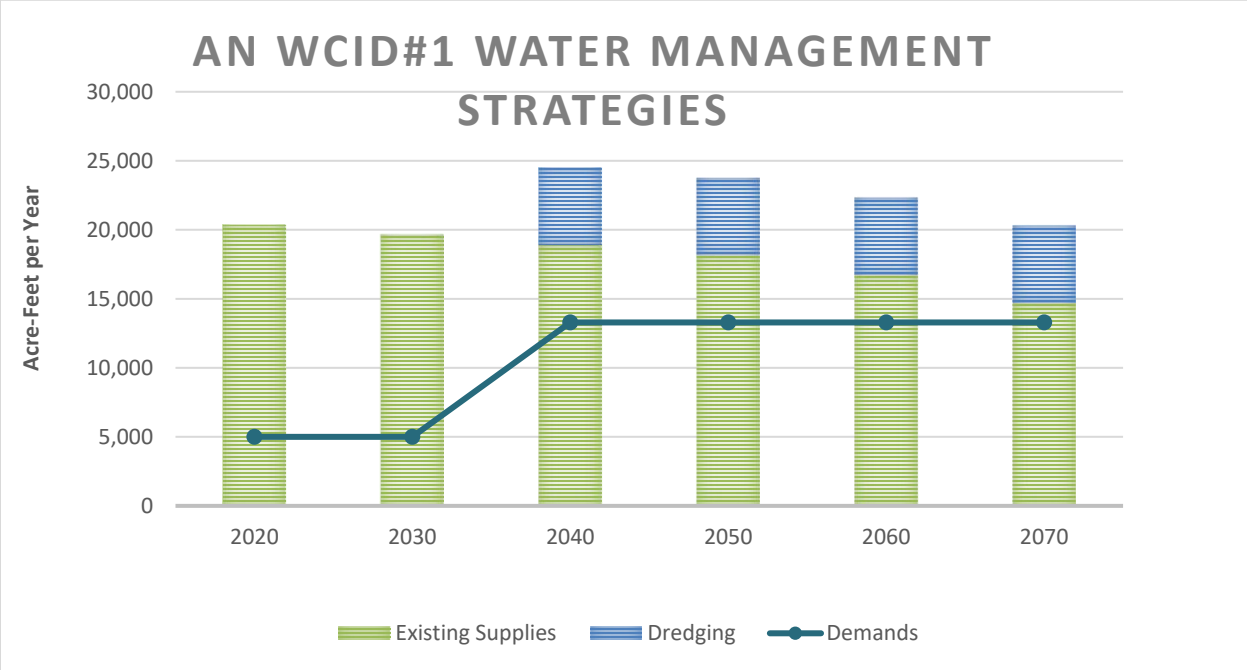
Hydraulic Dredging Operation (Recommended). Angelina Nacogdoches WCID#1 believes that the volumetric survey will result in an additional yield that will address shortages in the first two decades. To address the shortages in the later decades, a second recommended strategy was proposed. The strategy is to conduct hydraulic dredging of Lake Striker to address the Lake sedimentation issues and increase Lake yield. The timing for the dredging operation is expected to be in 2040. Angelina Nacogdoches WCID#1 provided an estimate of the total cost for this strategy. Angelina Nacogdoches WCID#1 also plans to work with TWDB on the adjustment of the normal pool elevation of Lake Striker. The additional yield associated with the normal pool elevation adjustment is not clear at this point; however, it is assumed to yield an approximate amount of 3,500.

Internal studies conducted by Angelina Nacogdoches WCID#1 resulted in higher yield estimates for Lake Striker than those obtained from the Water Availability Model. Angelina Nacogdoches WCID#1 believes that the additional yield in Lake Striker is sufficient to meet the shortages manifested for this entity in this planning cycle. To address this inconsistency, Angelina Nacogdoches WCID #1 is considering conducting volumetric survey of Lake Striker to determine the capacity of the lake and the resulting yield. Angelina Nacogdoches WCID#1 will coordinate with TWDB to schedule the volumetric survey. TWDB will charge a fee for conducting volumetric surveys. A cost estimate is not included for this strategy since this cost will be determined by Angelina Nacogdoches WCID#1 during their negotiations with TWDB.

A summary of the cost estimates for the recommended strategy is provided below. The demands for Angelina Nacogdoches WCID#1 also include a contract with City of Henderson for 8,280 acre-feet per year. While water management strategies are proposed to meet this demand, it was also noted that the contract for City of Henderson is a future demand and the supply to meet this contract is not required in the early decades of the planning cycles.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Lake Striker	20,340	19,635	18,890	18,150	16,715	14,690
Demands (ac-ft/yr)						
Demands	5,000	5,000	13,289	13,289	13,289	13,289
Surplus (Shortage)	**15,340**	**14,635**	**5,601**	**4,861**	**3,426**	**1,401**
Water Management Strategies (ac-ft/yr)						
ANCD-VOL: Hydraulic Dredging (Includes Volumetric Survey and Normal Pool Elevation Change)	0	0	5,600	5,600	5,600	5,600
Surplus or (Shortage) with WMS	**15,340**	**14,635**	**11,201**	**10,461**	**9,026**	**7,001**

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy ANCD-VOL: Hydraulic Dredging Operations (Volumetric Survey and Normal Pool Elevation Adjustment)	5,600	$23,716,000	-	$476	$1.46



5B.3.3 Athens Municipal Water Authority

Athens MWA is a wholesale provider for municipal demand in the City of Athens (Region C and ETRWPA), lakeside irrigation around Lake Athens, Livestock demand in Henderson County (ETRWPA - TPWD Fish Hatchery), and Manufacturing demand in Henderson County (Region C). Athens MWA owns and operates Lake Athens. Athens MWA also owns the Athens WTP, which is operated by the City of Athens. Athens MWA has a water right to divert 8,500 ac-ft/yr from Lake Athens. Of this amount, approximately 5,900 ac-ft/yr can be used to meet projected municipal and manufacturing demands of the City of Athens. Athens MWA also owns a groundwater well on the property of their water treatment plant (WTP) that produces approximately 886 ac-ft/yr, and the City of Athens owns three wells that altogether produce approximately 1,368 ac-ft/yr. There is also a projected local demand of 170 ac-ft/yr for lawn irrigation around the lake. The Athens Fish Hatchery, located at the lake, has a contract with Athens MWA to divert 3,023 ac-ft/yr from Lake Athens to serve the hatchery.

A summary of supplies and demands is included in the table below. The total projected shortages associated with Lake Athens for current customers are 5,567 ac-ft/yr in 2070. Based on the shortages associated with current supplies, Athens MWA has proposed the following WMSs.

Reuse of Fish Hatchery Return Flows (Recommended). A recommended strategy for Athens MWA is the indirect reuse of flows returned from fish hatchery to Lake Athens**.** Currently, approximately 95 to 100 percent of the water diverted for the Fish Hatchery is returned to Lake Athens; however, the fish hatchery is under no contractual obligation to continue this practice. To assure adequate supplies for the fish hatchery and other uses, Athens MWA should work with the fish hatchery to assure that the hatchery continues to return diverted water to Lake Athens for subsequent reuse. For purposes of this plan, it is assumed that 95 percent of the contracted water will be returned. This equates to 2,872 ac-ft/yr of additional supply.

New Groundwater Wells (Recommended). Athens MWA is currently pursuing developing groundwater from the Carrizo-Wilcox aquifer on property near Lake Athens. Based on Athens MWA's total permitted amount in the Carrizo-Wilcox aquifer, it is anticipated that seventeen new wells (with a capacity of 250 gallons per minute each) will be drilled to provide around 2.9 MGD of groundwater supply. The water would be transported directly from the well field to the distribution system.

It should be noted that although Athens MWA has permits to develop the wells, only part of the permitted amount is included in the 2021 Plan as a recommended strategy because current use in the Carrizo-Wilcox aquifer in Henderson County (both in Region C and I) is near the MAG for the county. Due to these MAG limitations, approximately 2,000 acre-feet of supply (10 wells) are included as a recommended strategy for Athens MWA in the 2021 Plan, while the rest of the supply is considered to be an alternate strategy. The strategy will be changed to a recommended strategy when the MAG volumes are updated in the near future. Even with the MAG limitations for this strategy, there are no unmet needs throughout the planning horizon for Athens MWA.

Booster Pump Station Improvements at WTP (Alternative). The firm capacity of the City of Athens' WTP high service pump station (HSPS), which is operated by Athens MWA, is limited. One strategy to address this limitation is to increase the firm capacity of the HSPS is to replace the current 1,200 gpm pump with a 1,600 gpm pump. This is expected to increase the firm capacity of the supply delivered by the HSPS by approximately 0.6 MGD (672 acre-feet per year).

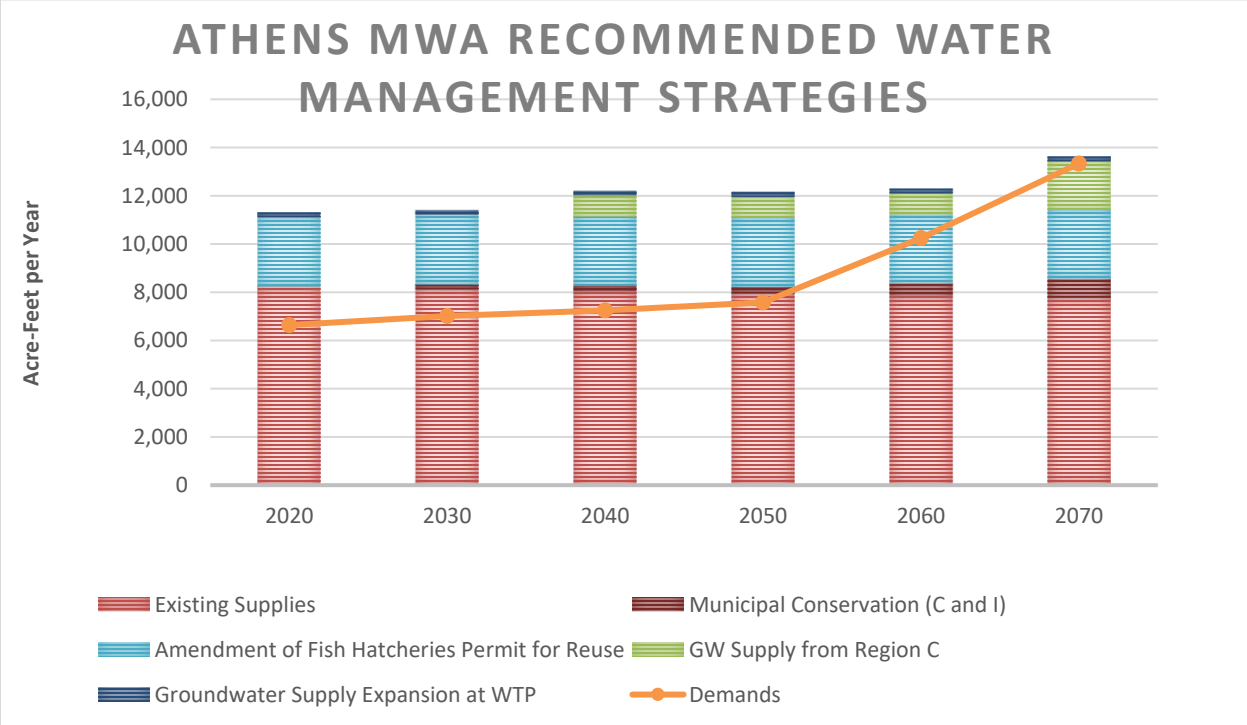
A summary of the amounts and timing of the recommended strategies is presented in the following table and figure.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Lake Athens	5,950	5,864	5,778	5,692	5,606	5,520
Groundwater Well (Athens MWA)	886	886	886	886	886	886
Groundwater Wells (City of Athens)	1,368	1,368	1,368	1,368	1,368	1,368
Total Existing Supplies	8,203	8,117	8,031	7,945	7,859	7,773
Demands (ac-ft/yr)						
Demands (ac-ft/yr)	6,639	7,017	7,245	7,579	10,246	13,340
Surplus (Shortage)	1,564	1,100	786	366	(2,386)	(5,566)
Water Management Strategies (ac-ft/yr)						
AMWA-FH: Indirect Reuse of Flows from Fish Hatcheries	2,872	2,872	2,872	2,872	2,872	2,872
AMWA-GWE: Expanded Groundwater Supply	200	200	200	200	200	200
AMWA-AGW: Athens MWA - New Well(s) in Carrizo Wilcox Aquifer*	0	0	0	0	2,000	2,000
AMWA-BSI: WTP Booster PS Improvement	*450*	*450*	*450*	*450*	*450*	*450*
*New Wells in Carrizo-Wilcox Aquifer (Alternate)**	*1,262*	*1,262*	*1,262*	*1,262*	*1,262*	*1,262*
Surplus or (Shortage) with Recommended and Alternative WMS	**4,784**	**4,784**	**4,784**	**4,784**	**6,784**	**6,784**

Italics indicate alternative strategy.
* Region C strategy.

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy AMWA-FH: Indirect Reuse of Flows from Fish Hatcheries	2,872	$ 0	$ 0	$ 0	$ 0
Recommended Strategy AMWA-GWE: Expanded Groundwater Supply	200	$2,573,000	$218,000	$1,090	$3.35
Recommended Strategy AMWA-AGW: Athens MWA - New Well(s) in Carrizo Wilcox Aquifer*	2,000	$15,151,000	$1,885,000	$943	$2.89
Recommended Strategy AMWA-BSI: WTP Booster PS Improvement	450	$65,000	$57,000	$127	$0.39
*Alternative Strategy: New Wells in Carrizo-Wilcox Aquifer**	*1,262*	*$9,207,000*	*$1,171,000*	*$413*	*$1.27*

* Region C strategy.



5B.3.4 City of Beaumont

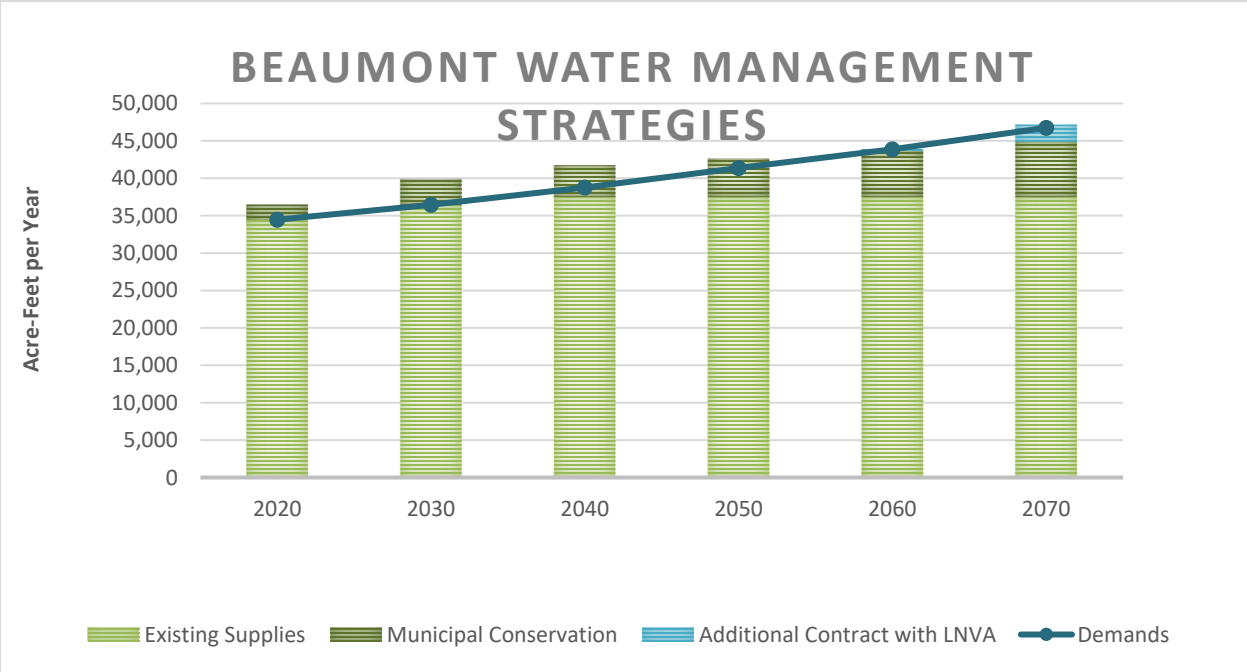
Current supplies include the Neches River, Gulf Coast aquifer, and purchases from Sam Rayburn Reservoir (LNVA); surface water supplies are limited by the City's water treatment plant capacity of 50 MGD. Infrastructure related to groundwater supplies includes three wells with a total capacity of 17 MGD. Beaumont currently supplies water to meet the demands of Jefferson County-Other, Jefferson Manufacturing, and Meeker MWD. Below is the description of the recommended strategy proposed for City of Beaumont in the 2021 Plan.

Municipal Conservation (Recommended). The City is projected to have a water shortage beginning in 2040. In 2011, the City had an average per capita consumption of 219 gpcd, well over the statewide goal of 140 gpcd. After performing a conservation cost analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. This recommended strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce Beaumont's demand by more than their projected need; therefore, municipal conservation is the only recommended WMS for the City. The description of the strategy and cost estimates are included in the discussion on WUG strategies for Jefferson County.

Additional Supplies from LNVA (Recommended). After municipal conservation, the City of Beaumont is still shown to have a need in the 2060 and 2070 decades. Consequently, a recommended strategy is to add an amendment to their supplemental contract with LNVA to obtain additional supplies to meet the rest of their needs.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Municipal Run-of-River	15,407	16,180	17,087	18,254	19,637	20,876
Industrial Run-of-River	526	552	583	623	670	712
Gulf Coast Aquifer	9,500	9,500	9,500	9,500	9,500	9,500
Sam Rayburn (Base LNVA)	6,000	6,000	6,000	6,000	6,000	6,000
Sam Rayburn (Supplemental LNVA)	3,036	4,219	5,603	6,991	8,075	7,718
Total Existing Supplies (Limited by WTP Infrastructure)	**34,469**	**36,451**	**37,525**	**37,525**	**37,525**	**37,525**
Demands (ac-ft/yr)						
Total Demand	**34,469**	**36,451**	**38,773**	**41,368**	**43,882**	**46,743**
Surplus or (Shortage) with Existing Supplies	**0**	**0**	**(1,248)**	**(3,843)**	**(6,357)**	**(9,218)**
Water Management Strategies (ac-ft/yr)						
Municipal Conservation	2,027	3,425	4,202	5,112	6,171	7,382
JEFF-BEA: Additional Contract with LNVA	0	0	0	0	228	2,249
Surplus or (Shortage) with WMSs	**2,027**	**3,425**	**2,954**	**1,270**	**42**	**412**

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	7,382	$60,175,000	$2,076,000	$371	$1.14
Recommended Strategy JEFF-BEA: Amendment to Supplemental Contract with LNVA	2,249	-	$2,199,000	$977	$3.00



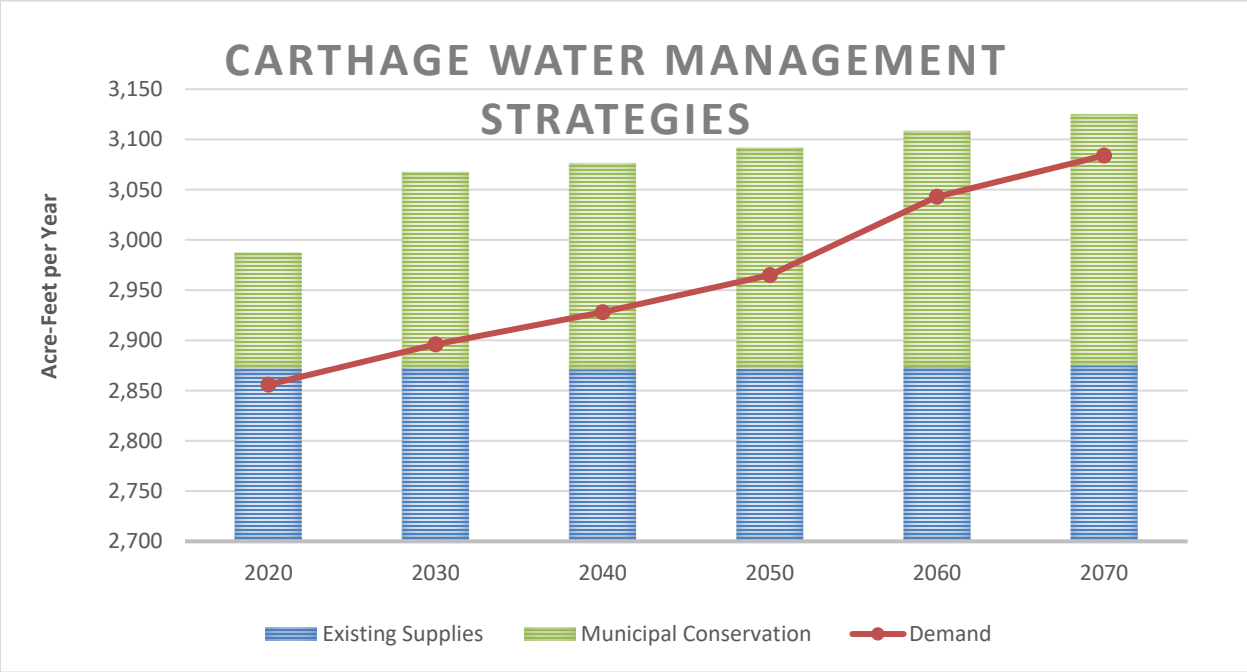
5B.3.5 City of Carthage

City of Carthage is a major water provider in Panola County. The City is the wholesale provider for the Municipal, Manufacturing, and County-Other demands in Panola County. The City owns two groundwater wells that provide approximately 411 ac-ft/yr. The City also has a contract with Panola County Fresh Water Supply District for 12 MGD (13,452 ac-ft/yr) of water from Lake Murvaul. The City's supplies are limited by treatment capacity to 5,695 ac-ft/yr. In this round of planning, City of Carthage has enough supplies to meet the projected demand for the customers in Panola County. Currently, the only water management strategy identified for the City is municipal conservation. If the City signs contracts with additional potential customers, the WMSs will be considered in the next round of planning. Table below summarizes the demands, existing supplies, surplus/deficit values, and municipal conservation volume for the City of Carthage.

Municipal Conservation (Recommended). The City of Carthage had an average per capita over the statewide goal of 140 gpcd in 2011. After performing a conservation cost analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. This recommended strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce the City's demand, increasing the surplus supply available for the City.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Carrizo Wilcox Wells	411	411	411	411	411	411
Lake Murvaul (PC FWSD)	13,452	13,452	13,452	13,452	13,452	13,452
Total Supplies	13,863	13,863	13,863	13,863	13,863	13,863
Total Supplies limited by Treatment Capacity	5,564	5,564	5,564	5,564	5,564	5,564
Demands (ac-ft/yr)						
Total Demand	2,856	2,896	2,928	2,965	3,043	3,084
Surplus or (Shortage)	**2,708**	**2,668**	**2,636**	**2,599**	**2,522**	**2,481**
Water Management Strategies (ac-ft/yr)						
Municipal Conservation	23	39	41	44	47	50
Surplus or (Shortage) with WMSs	**2,731**	**2,707**	**2,677**	**2,643**	**2,569**	**2,531**

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Conservation	50	$0	$11,000	$266	$0.82


CARTHAGE WATER MANAGEMENT STRATEGIES
Acre-Feet per Year
3,150
3,100
3,050
3,000
2,950
2,900
2,850
2,800
2,750
2,700
2020
2030
2040
2050
2060
2070
Existing Supplies
Municipal Conservation
Demand

5B.3.6 City of Center

The City of Center provides major water to Shelbyville WSC and Sand Hills WSC in Shelby County. The City also provides water to retail customers in the City of Center and most of the manufacturing demand in Shelby County. City of Center serves Flat Fork WSC, East Lamar WSC, and Five Way WSC, but these WSCs are within the City limits and hence considered as part of the City of Center demands.

City of Center owns water rights for supplies in Lake Center and Lake Pinkston. Currently the City has sufficient supplies to meet the demand in decades 2020 to 2070. The City is planning WMSs to proactively prepare for satisfying any potential additional demand in the decades. Tyson is one of the major manufacturing demand users in Shelby County. Recently Tyson has expanded its plant operations and the current demand for Tyson alone is greater than the projected manufacturing demand for Shelby County. The City noted that the manufacturing demands for Shelby County are under-projected and need to be revised in the next round of planning.

To meet the current demands and higher expected future demands, the City has proposed three WMSs for the planning period, and they are discussed below.

Reuse (Recommended). The City is permitted to use the return flows from the East Bank WWTP. The discharge point for the treated effluent from the WWTP is on a tributary to Mill Creek. The City is planning an indirect reuse project by means of a reuse pipeline from East Bank WWTP to Lake Center. The total capacity for the indirect reuse project will be approximately 1 MGD (1,121 ac-ft/yr) and the project will be online in 2030.

Toledo Bend to Lake Center (Recommended). The City is also planning to purchase water from Sabine River Authority and to transfer water from Toledo Bend Reservoir to Lake Center. The City will construct the raw water transmission pipeline from Toledo Bend Reservoir to Lake Center. At this time, it is not clear how much water Center will purchase from SRA. For planning purposes, it is assumed that the pipeline will be delivering approximately 7.5 MGD at peak capacity and an annual average of 5 MGD (5,605 ac-ft/yr).

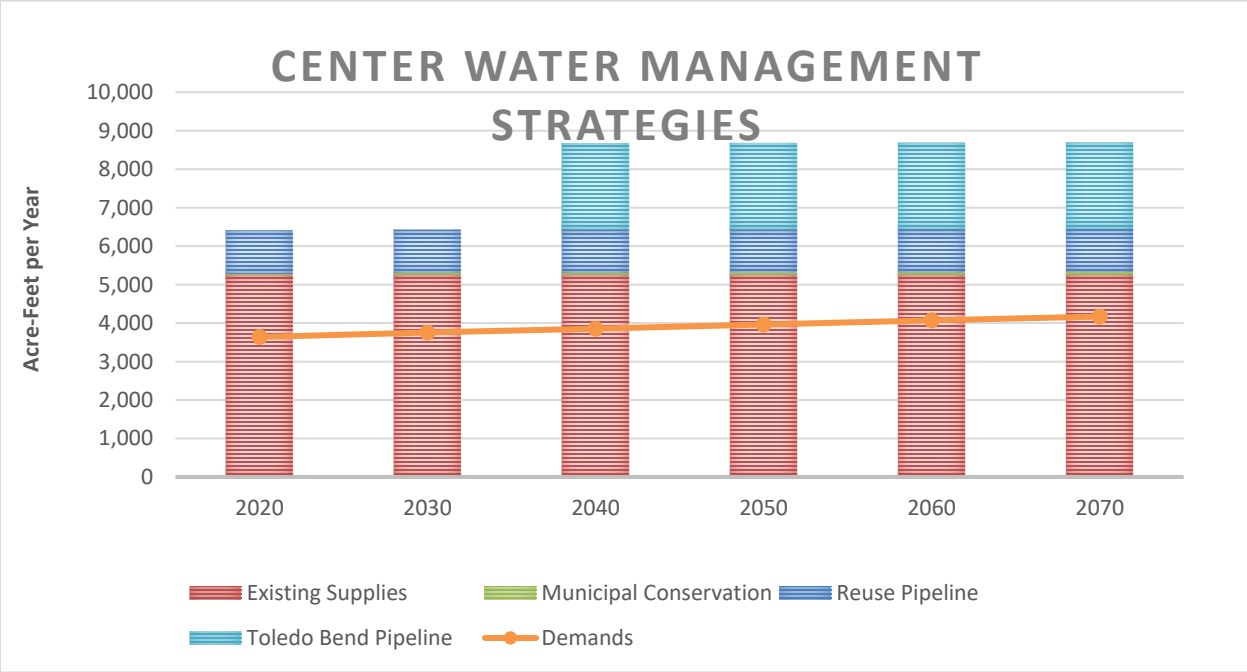
Volumetric Survey of Lake Center and Pinkston Reservoir (Recommended). The City of Center is considering a strategy to conduct volumetric surveys of Lake Center and Pinkston Reservoir to develop an accurate estimate of the capacity of the lakes and thus the yields. The City of Center will coordinate with Texas Water Development Board to get on a schedule for the lake volumetric survey. Texas Water Development Board will charge a fee for conducting volumetric surveys, which is a variable depending on the size of the Lake. This is not proposed as a recommended strategy for City of Center in the 2021 ETRWPA but listed as one of the strategies that the City is considering implementing.

Municipal Conservation (Recommended). In 2011, the City of Center had an average per capita over the statewide goal of 140 gpcd. After performing a conservation cost analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. This recommended strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce the City's demand, increasing the surplus supply available for the City.

A summary of demands, existing supplies, and supplies from WMSs is listed in the table below. A summary of cost estimates is also included in the table below. For a more detailed summary of the WMSs, see the applicable technical memorandums in Appendix 5B-A.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Lake Center	1,460	1,460	1,460	1,460	1,460	1,460
Lake Pinkston	3,800	3,800	3,800	3,800	3,800	3,800
Demands (ac-ft/yr)						
Total Demand	3,640	3,753	3,855	3,961	4,069	4,170
Surplus or (Shortage)	**1,620**	**1,507**	**1,405**	**1,299**	**1,191**	**1,090**
Water Management Strategies (ac-ft/yr)						
Municipal Conservation	26	45	52	57	64	70
CENT-REU: Reuse Pipeline from WWTP to Lake Center	0	1,121	1,121	1,121	1,121	1,121
CENT-TOL: Pipeline from Toledo Bend to Lake Center	0	0	2,242	2,242	2,242	2,242
CENT-VOL: Volumetric Surveys of Lake Center and Lake Pinkston	0	0	0	0	0	0
Total Supplies from Strategies	26	1,166	3,415	3,420	3,427	3,433
Surplus or (Shortage) with WMS	**1,646**	**2,673**	**4,820**	**4,719**	**4,618**	**4,523**

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Municipal Conservation	70	$0	$11,000	$188	$0.58
Recommended Strategy CENT-REU: Reuse Pipeline from WWTP to Lake Center	1,121	$2,456,000	$262,000	$234	$0.72
Recommended Strategy CENT-TOL: Pipeline from Toledo Bend	2,242	$27,775,000	$3,462,000	$1,544	$4.74
Recommended Strategy CENT-VOL: Volumetric Surveys of Lake Center and Lake Pinkston	0	$0	$0	$0	$0


CENTER WATER MANAGEMENT STRATEGIES
Acre-Feet per Year
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2020
2030
2040
2050
2060
2070
Existing Supplies
Municipal Conservation
Reuse Pipeline
Toledo Bend Pipeline
Demands

5B.3.7 Houston County WCID #1

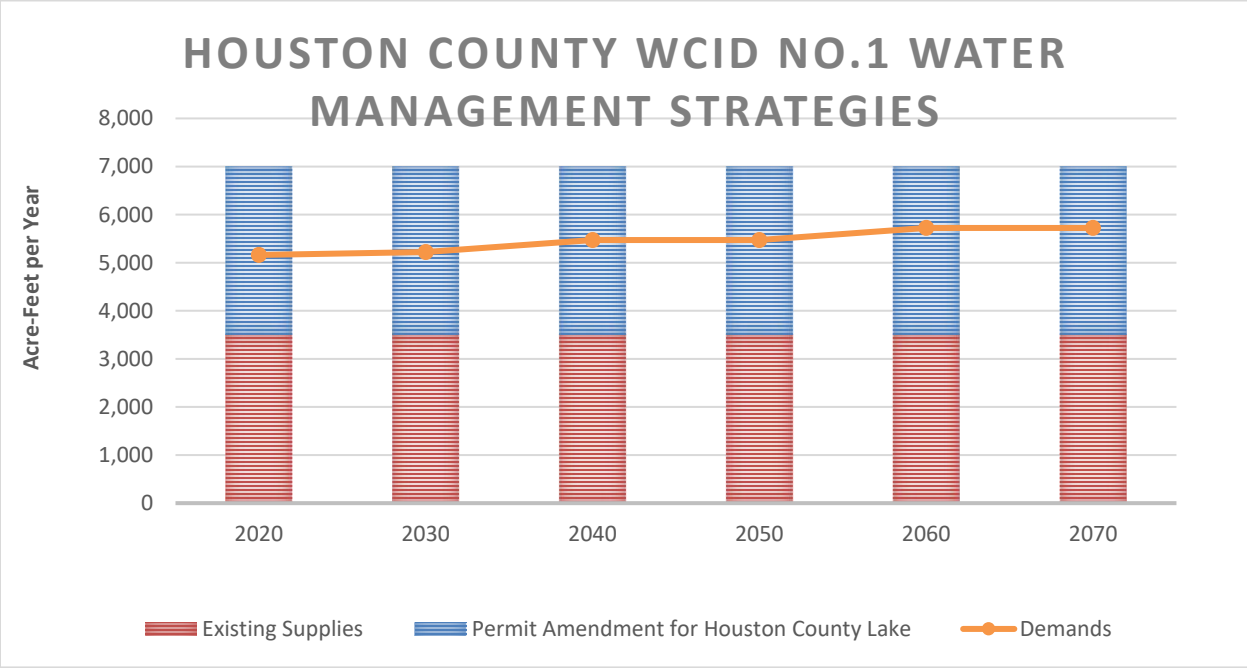
Houston County WCID #1 owns and operates Houston County Lake in the Trinity River Basin in Houston County. This reservoir was originally permitted for 7,000 ac-ft/yr; however, the TCEQ reduced the permitted diversion to 3,500 ac-ft/yr in 1987. In 2009, Houston County WCID #1 applied to the TCEQ for a permit amendment to return their permitted diversion to the firm yield of the lake and add industrial use to the permit. Houston County WCID #1 upgraded their water treatment plant capacity from 3.1 MGD to 6.2 MGD in 2010.

Permit Amendment for Houston County Lake (Recommended). Since 2007, Houston County WCID #1 has received multiple requests for additional water supplies from entities and business including the City of Crockett, the Crockett Economic & Industrial Development Corporation, The Consolidated WSC, Nacogdoches Power, LLC, and the Houston County Judge, Erin Ford. This permit amendment is essential to meet the projected demands of both existing and future customers including The Consolidated WSC, the Cities of Crockett, Grapeland, and Lovelady, Houston county-Other, Houston Manufacturing, Nacogdoches Mining, and Nacogdoches Steam Electric Power. Therefore, the permit amendment is proposed as the recommended strategy for Houston County WCID #1. Environmental flow requirements associated with the permit amendment are currently being negotiated with the TCEQ. It is assumed that there are little to no capital costs associated with the amendment (only engineering and legal costs).

Groundwater Supplies (Alternative). In the event Houston County WCID #1 is unable to reacquire all of their original water rights from the TCEQ, an alternative water management strategy is being added for this entity to develop new wells in the Carrizo-Wilcox aquifer.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Houston County Lake	3,500	3,500	3,500	3,500	3,500	3,500
Total Water Demands (ac-ft/yr)						
Demands	2,788	2,851	2,851	2,851	2,851	2,851
Surplus or (Shortage) with Existing Supplies and Demands (ac-ft/yr)						
Surplus or (Shortage)	712	649	649	649	649	649
Water Management Strategies (ac-ft/yr)						
HCWC-PA: Permit Amendment for Houston County Lake	3,500	3,500	3,500	3,500	3,500	3,500
HCWC-GW: New Wells (Carrizo-Wilcox)	3,500	3,500	3,500	3,500	3,500	3,500
Surplus or (Shortage) with WMS	**7,712**	**7,649**	**7,649**	**7,649**	**7,649**	**7,649**

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy HCWC-PA: Permit Amendment of Houston County Lake	3,500	0	0	0	0
Recommended Strategy HCWC-GW: New Wells (Carrizo-Wilcox)	3,500	$22,793,000	$1,827,000	$522	$1.60


HOUSTON COUNTY WCID NO.1 WATER MANAGEMENT STRATEGIES
Acre-Feet per Year
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2020
2030
2040
2050
2060
2070
Existing Supplies
Permit Amendment for Houston County Lake
Demands

5B.3.8 City of Jacksonville

The City of Jacksonville has sufficient raw water and treatment capacity to meet its projected customer demands for the planning period. Jacksonville has a water right to use 6,200 ac-ft/yr from Lake Jacksonville, but available supply is limited treatment plant capacity. The City has several constraints to providing treated surface water to all its customers. The City's existing surface water treatment plant is currently underutilized and could provide more surface water with the necessary infrastructure improvements. Currently, the City operates the treatment plant for only part of the day. The City may be able to treat more raw water either by implementing infrastructure improvements to the treatment system or by operating the plant for longer time each day. It is recommended that the City of Jacksonville implement infrastructure improvements to fully utilize its existing water sources. City of Jacksonville has chosen to not implement this strategy at this time.

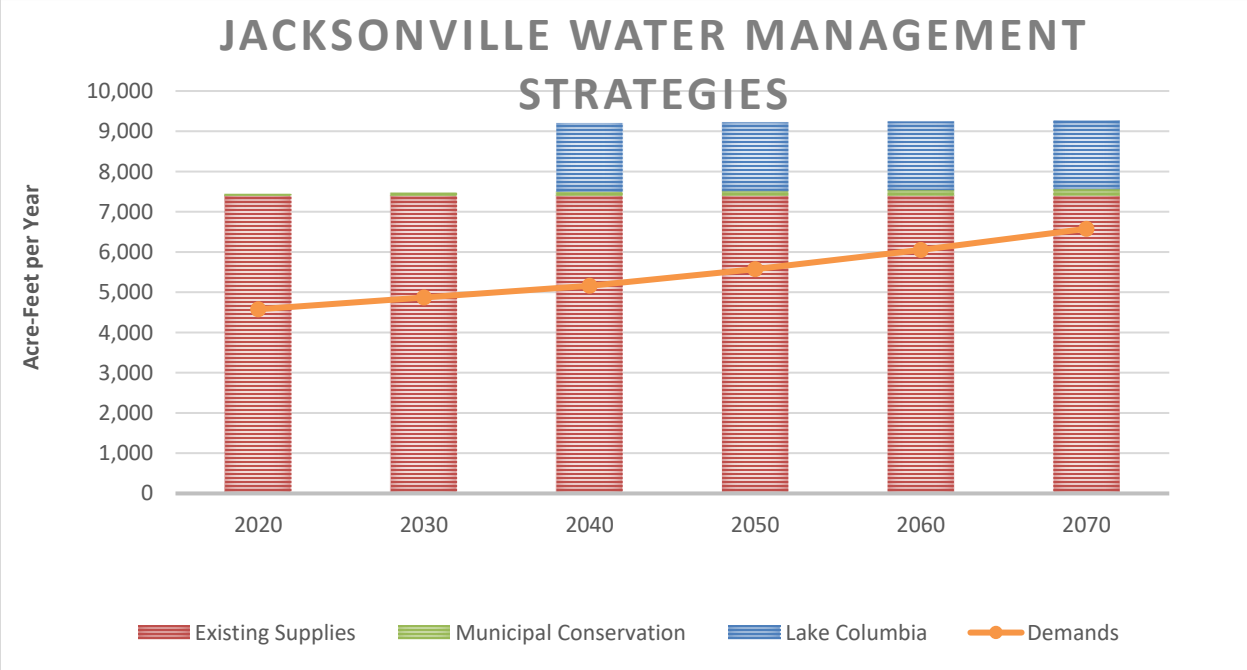
Raw Water Transmission System from Lake Columbia (Recommended). The recommended strategy for City of Jacksonville is a transmission and treatment system to access City's contracted supplies from Lake Columbia. The City of Jacksonville is a participant in the Lake Columbia project. Jacksonville has a contract with Angelina & Neches River Authority for 4,275 ac-ft/yr from Lake Columbia. Lake Columbia will provide a source of additional raw water for Jacksonville beyond this planning period or sooner if the City grows faster than projected. This strategy assumes that water would be diverted at Lake Columbia and transported to Jacksonville for treatment and distribution. It is assumed that the first phase of this project would develop 1,700 ac-ft/yr (1.6 MGD). Subsequent phases would fully develop the City's contracted amount.

Municipal Conservation (Recommended). The City of Carthage had an average per capita over the statewide goal of 140 gpcd in 2011. After performing a conservation cost analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. This recommended strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce the City's demand, increasing the surplus supply available for the City.

The Columbia to Jacksonville Raw Water Transmission System and Municipal Conservation are the recommended WMSs for City of Jacksonville. Owing to the lack of shortages in supplies to current contracted customers and the low projected growth, the transmission system from Lake Columbia is assumed to be a long-term future strategy and not current. A summary of current contracted customer demands, existing supplies, and additional supplies from future WMS is summarized in the table below. A summary of cost estimates for the recommended WMS is listed below. A detailed project summary is included in each WMS technical memorandum in Appendix 5B-A.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Lake Jacksonville	5,173	5,173	5,173	5,173	5,173	5,173
Lake Acker	0	0	0	0	0	0
Carrizo Wilcox Aquifer	2,218	2,218	2,218	2,218	2,218	2,218
Total Existing Supplies	7,391	7,391	7,391	7,391	7,391	7,391
Current Water Demands (ac-ft/yr)						
Demands	4,577	4,868	5,160	5,572	6,050	6,577
Surplus or (Shortage) with Existing Supplies and Demands (ac-ft/yr)						
Surplus or (Shortage)	2,814	2,523	2,231	1,819	1,341	814
Water Management Strategies (ac-ft/yr)						
Municipal Conservation	50	85	110	129	152	178
JACK-COL: Supply from Lake Columbia	0	0	1,700	1,700	1,700	1,700
Surplus or (Shortage) with WMS	**2,864**	**2,608**	**4,041**	**3,648**	**3,193**	**2,692**

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Municipal Conservation	178	$0	$42,000	$291	$1.00
Recommended Strategy JACK-COL: Supply from Lake Columbia	1,700	$ 29,390,000	$ 3,150,000	$ 1,853	$ 5.69



5B.3.9 Lower Neches Valley Authority

Current supplies for the Lower Neches Valley Authority include the Neches River, the B.A. Steinhagen Lake/Sam Rayburn Reservoir system (Sam Rayburn Reservoir), and a run-of-the-river diversion from the Trinity River in Region H. LNVA provides water to several WUGs in the ETRWPA and Region H. The projected water demands supplied by LNVA total over 400,000 ac-ft/yr in 2070. In addition to these demands, there are over 400,000 ac-ft/yr in potential future demands from existing and future customers by 2070. LNVA is pursuing five recommended WMSs to increase its reliable water supplies and to increase its infrastructure to provide conveyance to future customers. These include:

- Purchase from SRA (Toledo Bend Reservoir)
- Neches-Trinity Basin Interconnect
- Beaumont West Regional Reservoir

In addition to these strategies, the construction of Rockland Reservoir is recommended as an alternative water management strategy. A brief discussion of each strategy is presented below.

Purchase from Sabine River Authority (Toledo Bend Reservoir) (Recommended). The proximity of the Sabine River Basin could make the transfer of water from the Sabine River a feasible strategy. The strategy would require a contract with SRA, approximately 13 miles of pipeline, 17 miles of open canals, and 2 pump stations. The strategy is estimated to provide approximately 200,000 ac-ft/yr of supplies for LNVA's customers.

Beaumont West Regional Reservoir (Recommended). This recommended strategy involves the construction of an approximate 1,100-acre reservoir on the northwest end of Beaumont. The reservoir is anticipated to have an approximate capacity of 7,700 acre-feet, which is equivalent to approximately three (3) weeks of water supply to meet municipal and industrial demands downstream. This reservoir is located so that stored water can be sent to all industrial and municipal customers on the LNVA system. In addition, the location of the reservoir provides a significant advantage to provide water in case of an emergency fire water demand, source pollution in the Neches River or Pine Island Bayou, or losses of either of the LNVA pumping stations in severe events, such as what occurred during Hurricane Harvey.

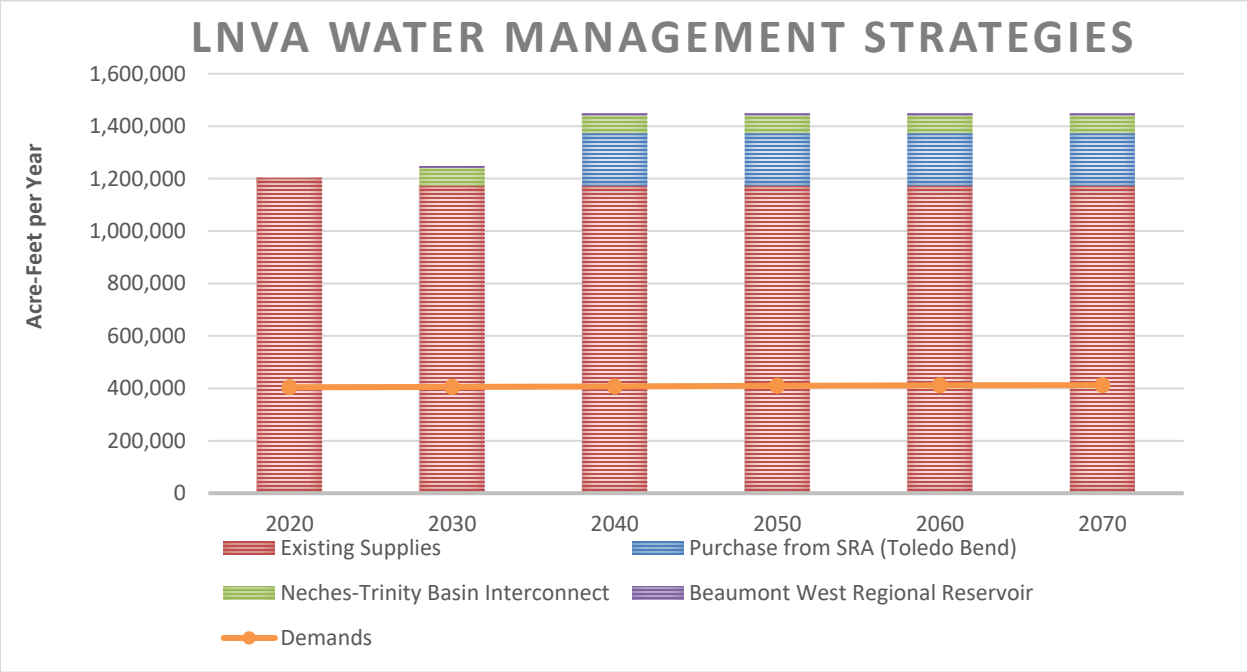
Neches-Trinity Basin Interconnect (Recommended). LNVA is planning to construct an approximate 13 mile, single 84-inch pipeline that runs in an east-west direction, as well as a 62,000 gpm pump station. The proposed pipeline enables the movement of Neches River water westward toward the upper reaches of the Devers Canal system and potentially back into the Trinity River. The water from this strategy will enable LNVA to provide water for irrigation customers in Region H, as well as to serve new industries as they emerge along the IH-10 corridor.

Rockland Reservoir (Alternative Strategy). Rockland Reservoir was authorized for construction, as a federal facility, in 1945 along with Sam Rayburn Reservoir, Lake B. A. Steinhagen and Dam A Lake. A 1947 report recommended construction of Sam Rayburn Reservoir and Lake B.A. Steinhagen with deferral of Rockland Reservoir and Dam A until such time the need develops. The Rockland Reservoir site is located on the Neches River at River Mile 160.4. The top of the flood pool would be at elevation 174 ft. msl with the conservation pool at 165 ft. msl. The Reservoir Site Protection Study updated the yield and costs for the Rockland Reservoir using ENR indexing (TWDB, 2007). No recent detailed cost data has been developed for Rockland Reservoir. Based on the TWDB study, the estimated yield of Rockland is 614,400 ac-ft/yr and the unit cost of water is $0.43 per 1000 gallons (updated to September 2013 dollars). More detailed studies are needed to confirm the yield and costs for this project.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Sam Rayburn / B.A. Steinhagen	792,000	792,000	792,000	792,000	792,000	792,000
Pine Island Bayou Run-of-River*	381,876	381,876	381,876	381,876	381,876	381,876
Lufkin (Sam Rayburn)	28,000	0	0	0	0	0
Total Existing Supplies	**1,201,876**	**1,173,876**	**1,173,876**	**1,173,876**	**1,173,876**	**1,173,876**
Demands (ac-ft/yr)						
Demand	404,039	405,656	407,380	409,518	411,566	412,303
Surplus or (Shortage)	**797,837**	**768,221**	**766,496**	**764,358**	**762,310**	**761,573**
Water Management Strategies (ac-ft/yr)						
LNVA-SRA: Purchase from SRA (Toledo Bend)	0	0	200,000	200,000	200,000	200,000
LNVA-WRR: Beaumont West Regional Reservoir	0	7,700	7,700	7,700	7,700	7,700
LNVA-RGH: Neches-Trinity Basin Interconnect	0	67,000	67,000	67,000	67,000	67,000
Total Increase in Supplies from WMSs	0	74,700	274,700	274,700	274,700	274,700
Surplus or (Shortage) with WMSs	**797,837**	**842,921**	**1,041,196**	**1,039,058**	**1,037,010**	**1,036,273**

* Pumping plants are located on the Pine Island Bayou but will draft water from the Neches River

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy LNVA-SRA: Purchase from SRA (Toledo Bend)	200,000	$529,606,000	$110,157,000	$551	$1.69
Recommended Strategy LNVA-WRR: Beaumont West Regional Reservoir	7,700	$37,538,000	$1,970,00	$256	$0.79
Recommended Strategy LNVA-RGH: Neches-Trinity Basin Interconnect	67,000	$102,375,000	$8,907,000	$133	$0.41


LNVA WATER MANAGEMENT STRATEGIES
Acre-Feet per Year
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
2020
2030
2040
2050
2060
2070
Existing Supplies
Purchase from SRA (Toledo Bend)
Neches-Trinity Basin Interconnect
Beaumont West Regional Reservoir
Demands

5B.3.10 City of Lufkin

The City of Lufkin currently relies on groundwater from the Carrizo-Wilcox aquifer and surface water from Lake Kurth and Sam Rayburn Reservoir. The City's groundwater infrastructure includes 25 wells, including 14 wells acquired from the Abitibi Bowater Corporation. Currently, twelve of the wells provide potable water. Two additional wells have been upgraded to provide potable water, but they are currently permitted for Industrial use and are being re-permitted for Municipal use. The City plans to convert two non-potable wells per year to provide potable water; these upgrades will be complete by 2020. The City provides water to Diboll, Huntington, Redland WSC, Angelina County-Other (Burke, Angelina Freshwater Supply, and Woodlawn WSC) and Manufacturing, Steam Electric Power, and Irrigation demands in Angelina County. Lufkin has a recommended WMS to expand their developed supplies and provide conveyance from Sam Rayburn Reservoir to Lake Kurth. With additional groundwater and surface water supplies, the City expects to provide up to an additional 16 MGD of water to meet industrial demands in Angelina County. In addition, municipal conservation is considered as a recommended WMS from 2020 to 2040 for the City to reduce municipal demands.

While the City of Lufkin does not show a water supply shortage within the planning period, Angelina Manufacturing does. Therefore, the ETRWPG is recommending that a portion of the supplies developed by the City of Lufkin be used to meet the projected industrial needs in the county. The City of Lufkin's recommended strategies are described below.

Develop Sam Rayburn Reservoir Water Rights (Recommended). To meet the City of Lufkin's long-term water needs, Lufkin is continuing to plan and develop a water management strategy to utilize its surface water rights in Sam Rayburn Reservoir. In the late 1960's, the City of Lufkin purchased storage and water production rights for surface water from Sam Rayburn Reservoir through contracts with the LNVA and the U.S. Army Corp of Engineers. The City has a water right to divert up to 28,000 ac-ft annually of surface water from the reservoir. This equates to an average withdrawal rate of 25 MGD.

With the acquisition of Lake Kurth, the long-range plan is to expand the surface water treatment plant near Lake Kurth and treat raw water from Sam Rayburn Reservoir at the expanded facility. For planning purposes, it is assumed that water from Sam Rayburn Reservoir will be diverted from the northern end of the Lake and transported through a 36-inch pipeline. The treatment plant proposed at Lake Kurth will be initially expanded from 16 MGD to 25 MGD with the potential for further expansions beyond this planning period. This strategy is expected to be developed in three phases, with the first phase to develop access to 10 MGD of Sam Rayburn supplies by 2020, second phase with an additional 10 MGD capacity expansion by 2030, and the final phase of 5 MGD capacity expansion by 2040. The initial size of the treatment facility will depend on the projected needs at the time.

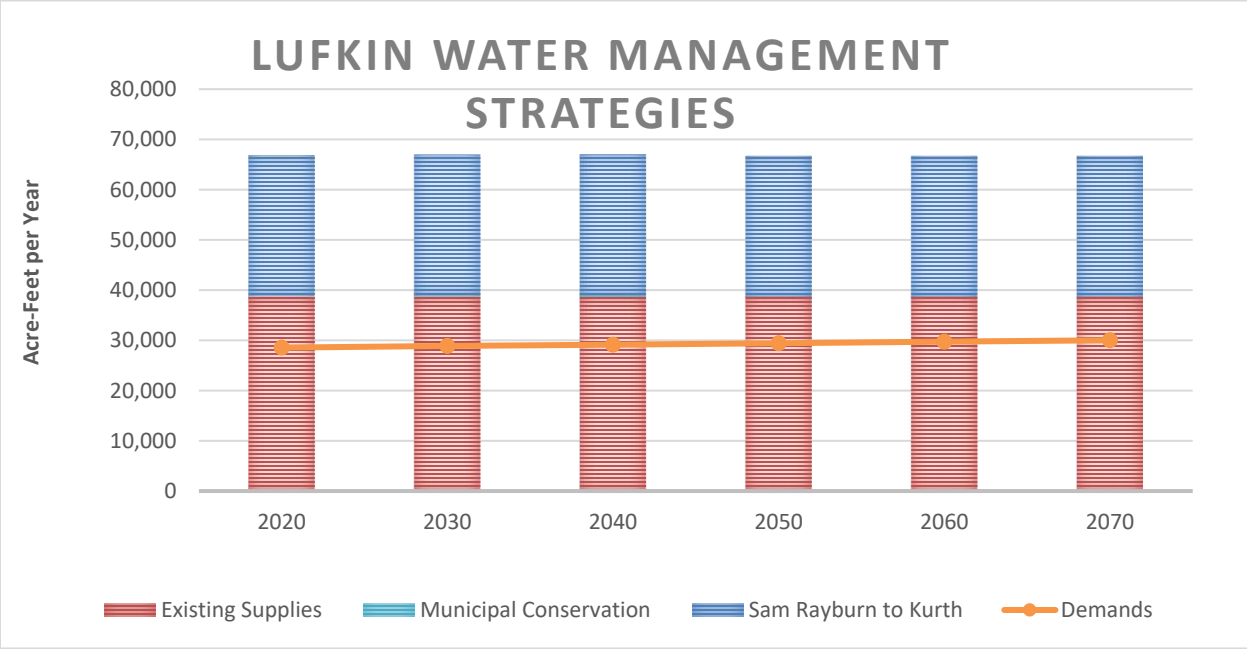
Municipal Conservation (Recommended). In 2011, the City of Lufkin had an average per capita over the statewide goal of 140 gpcd. After performing a conservation cost analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. This recommended strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce the City's demand, increasing the surplus supply available for the City.

The supplies and demands associated with the City of Lufkin are shown in the following table and figure.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Carrizo-Wilcox	20,227	20,227	20,227	20,227	20,227	20,227
Lake Kurth	18,500	18,500	18,500	18,500	18,500	18,500
Sam Rayburn Reservoir (to LNVA)	28,000	0	0	0	0	0
Total Existing Supplies	**66,727**	**38,727**	**38,727**	**38,727**	**38,727**	**38,727**
Demands (ac-ft/yr)						
Total Demand	56,555	28,891	29,138	29,419	29,728	30,014
Surplus (Shortage)	**10,172**	**9,836**	**9,589**	**9,308**	**8,999**	**8,713**
Water Management Strategies (ac-ft/yr)						
Municipal Conservation	151	239	273	0	0	0
LUFK-RAY: Conveyance from Sam Rayburn to Kurth Lake	0	11,210	22,420	28,000	28,000	28,000
Surplus or (Shortage) with WMS	**10,323**	**21,046**	**32,009**	**37,308**	**36,999**	**36,713**

Estimates of capital costs for the Lufkin strategies are included in the table below.

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Municipal Conservation	273	$0	$60,000	$271	$0.83
Recommended Strategy LUFK-RAY: Sam Rayburn Supply – Phase 1 (2030)	11,210	$78,220,000	$14,413,000	$1,286	$3.95
Recommended Strategy LUFK-RAY: Sam Rayburn Supply – Phase 2 (2040)	11,210	$78,199,000	$27,911,000	$1,255	$3.85
Recommended Strategy LUFK-RAY: Sam Rayburn Supply – Phase 3 (2050)	5,580	$8,834,000	$25,722,000	$919	$2.82


LUFKIN WATER MANAGEMENT STRATEGIES
Acre-Feet per Year
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2020
2030
2040
2050
2060
2070
Existing Supplies
Municipal Conservation
Sam Rayburn to Kurth
Demands

5B.3.11 City of Nacogdoches

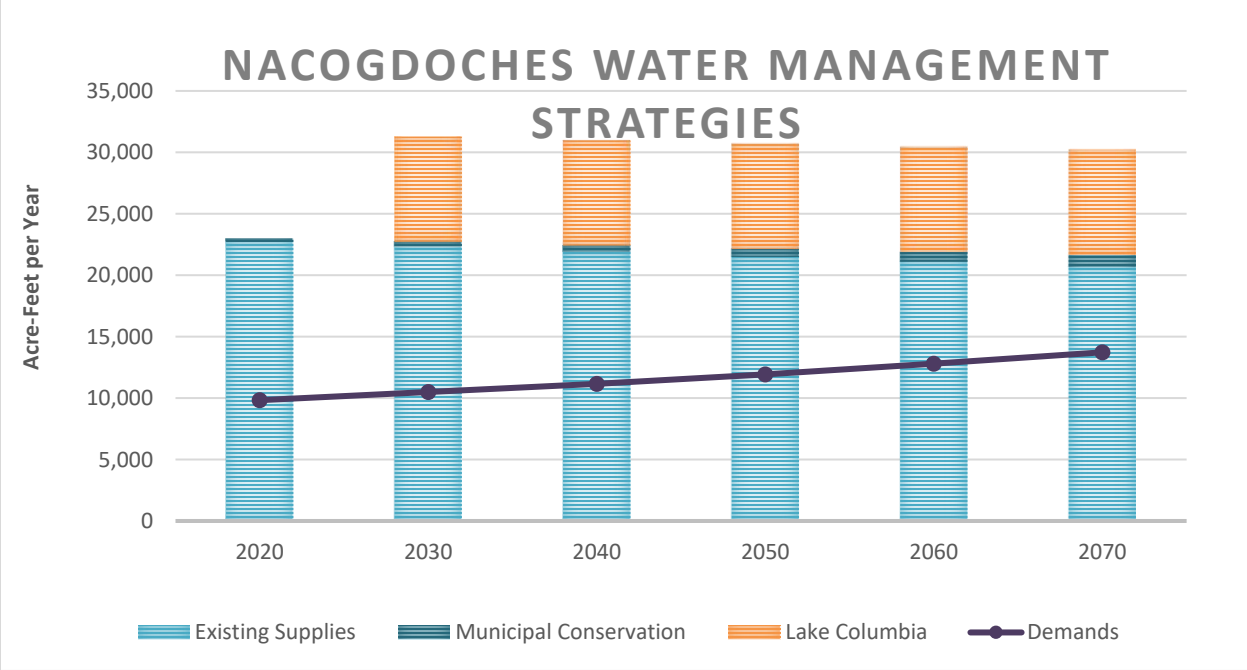
The City of Nacogdoches utilizes groundwater from the Carrizo-Wilcox aquifer and surface water from Lake Nacogdoches. In addition to the City of Nacogdoches retail customers, the City is a major water provider to Appleby WSC, D & M WSC, Nacogdoches MUD#1, Lily Grove SUD, and Melrose WSC. Most, if not all, of the manufacturing demands in the county are also supplied by the City. The Neches WAM shows the firm yield of Lake Nacogdoches to be approximately 16,200 ac-ft/yr by 2020, reducing to 14,200 ac-ft/yr by 2070. Groundwater from the Carrizo-Wilcox aquifer is used to supply much of the southern part of the city, and the City of Nacogdoches has been increasing its groundwater supplies to better serve this section of the city. The City has also developed two new wells, rehabilitated two existing wells, and is in the process of developing another new well. With the City's existing groundwater supplies, Nacogdoches has a reliable supply of approximately 21,000 ac-ft/yr. This supply is sufficient to meet the projected demands in this plan, but the City's current water planning efforts indicate greater population growth and higher demands by the commercial and manufacturing sectors than projected by the TWDB. Therefore, the City has two recommended strategies in the 2021 Regional Water Plan.

Raw Water Transmission System to Lake Columbia (Recommended). The City of Nacogdoches is pursuing one recommended WMS to increase the reliability of its supplies and provide for projected growth using surface water from Lake Columbia. The City of Nacogdoches is also among those contracted for participation in the Lake Columbia project. The City proposes to obtain raw water from Lake Columbia to transmit to Lake Nacogdoches. The existing treatment plant would be expanded to treat the additional water. Currently, there are no alternative strategies proposed for City of Nacogdoches. A summary of demands, existing supplies, and increased supplies from WMSs is provided in the table below. Cost estimates were developed for the raw water transmission system from Lake Columbia to City of Nacogdoches. A summary of cost estimates is included in the table below.

Municipal Conservation (Recommended). The City of Nacogdoches had an average per capita over the statewide goal of 140 gpcd in 2011. After performing a conservation cost analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. This recommended strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce the City's demand, increasing the surplus supply available for the City.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Carrizo-Wilcox	6,492	6,492	6,492	6,492	6,492	6,492
Lake Nacogdoches	16,200	15,800	15,400	15,000	14,600	14,200
Demands (ac-ft/yr)						
Total Demand	9,831	10,498	11,161	11,929	12,802	13,726
Surplus or (Shortage)	**12,861**	**11,794**	**10,731**	**9,563**	**8,290**	**6,966**
Water Management Strategies (ac-ft/yr)						
Municipal Conservation	247	426	532	656	802	966
NACP-COL: Lake Columbia to Nacogdoches Raw Water Transmission System	0	8,551	8,551	8,551	8,551	8,551
Surplus or (Shortage) with WMS	**13,108**	**20,771**	**19,814**	**18,770**	**17,643**	**16,483**

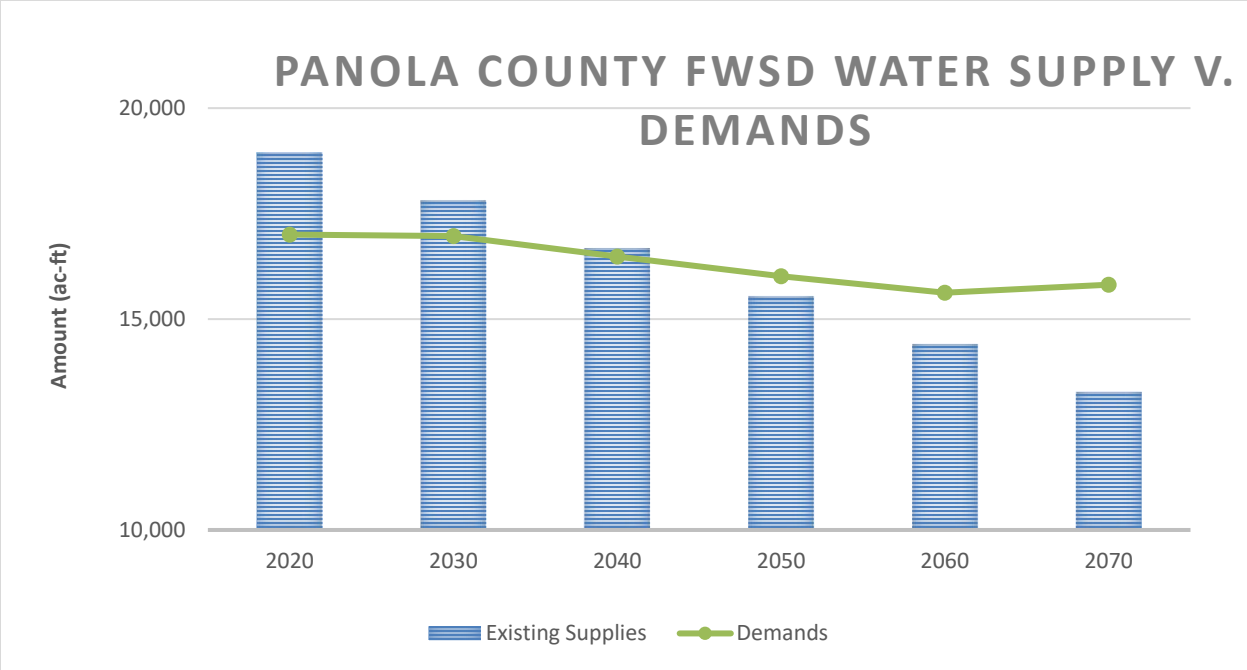
Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Municipal Conservation	966	$27,720,000	$986,000	$1,349	$4.14
Recommended Strategy NACP-COL: Lake Columbia to Nacogdoches Raw Water Transmission System	8,500	$50,754,000	$6,739,000	$788	$2.42



5B.3.12 Panola County Fresh Water Supply District

Panola County Fresh Water Supply District (PC FWSD) is a major water provider in Panola County. PC FWSD is the wholesale provider to City of Carthage and Mining demands in Panola County. PC FWSD owns and operates Lake Murvaul and has a water right for 22,400 ac-ft/yr. In this round of planning, PC FWSD has enough supplies to meet the projected customer demand for the planning period 2020-2070. Currently, no WMSs were identified for this entity. Table below summarizes the demands, existing supplies, and surplus/deficit values.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Lake Murvaul	21,367	20,686	20,006	19,325	18,644	17,963
Demands (ac-ft/yr)						
Total Demand	17,002	16,967	16,481	16,013	15,624	15,815
Surplus or (Shortage)	**4,365**	**3,719**	**3,525**	**3,312**	**3,020**	**2,148**



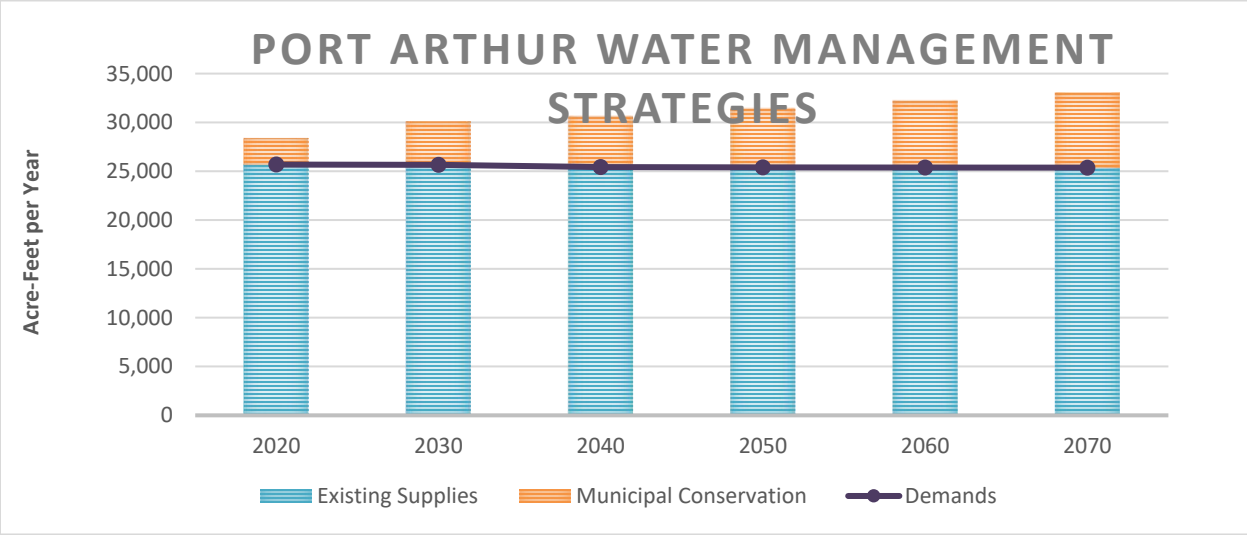
5B.3.13 City of Port Arthur

Current supplies for the City of Port Arthur include raw surface water from Sam Rayburn Reservoir (LNVA). LNVA provides 100 percent of the City's demands; this supply is limited by Port Arthur's water treatment plant capacity of 20 MGD. Construction to upgrade the treatment plant to 40 MGD began in 2014. The City provides treated water to municipal users both inside and outside the city limits and to industrial users including Cheniere LNG and Motiva Enterprises. Below is a description of the recommended WMS for Port Arthur.

Municipal Conservation (Recommended). Port Arthur is not projected to have a water shortage within the planning period. However, the City had an average per capita consumption of 320 gpcd in 2011. This value is well over the statewide goal of 140 gpcd. In addition, their 2013 Water Loss Report submitted to the TWDB had a total percent loss of over 66%. After performing a conservation analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. The recommended water management strategy for Port Arthur is water conservation, which includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Sam Rayburn/B.A. Steinhagen (LNVA)	25,682	25,653	25,432	25,387	25,368	25,367
Demands (ac-ft/yr)						
Total Demand	25,682	25,653	25,432	25,387	25,368	25,367
Existing Surplus / (Shortage)	0	0	0	0	0	0
Water Management Strategies (ac-ft/yr)						
Water Conservation	2,708	4,449	5,222	6,029	6,844	7,664
Surplus /(Shortage) with WMSs	2,708	4,449	5,222	6,029	6,844	7,664

Strategy	Yield (ac-ft/yr)	Total Capital Cost	Total Annualized Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Municipal Conservation	7,664	$51,618,000	$1,981,000	$295	$0.91


PORT ARTHUR WATER MANAGEMENT STRATEGIES
Acre-Feet per Year
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2020
2030
2040
2050
2060
2070
Existing Supplies
Municipal Conservation
Demands

5B.3.14 Sabine River Authority

The SRA is based in the North East Texas planning area (Region D) and the ETRWPA. SRA currently provides water from its Lower Basin system (Toledo Bend Reservoir and the canal system) to water users in the ETRWPA. The SRA provides water from its Upper Basin reservoirs (Lake Tawakoni and Lake Fork) to water users in Region C and the North East Texas planning area (Region D). These sources are fully contracted and SRA has requests for additional water in the Upper Basin. The supply and demand evaluation for the Upper Basin reservoirs is not included in this plan. The upper basin supplies are discussed in Region C and Region D regional plans.

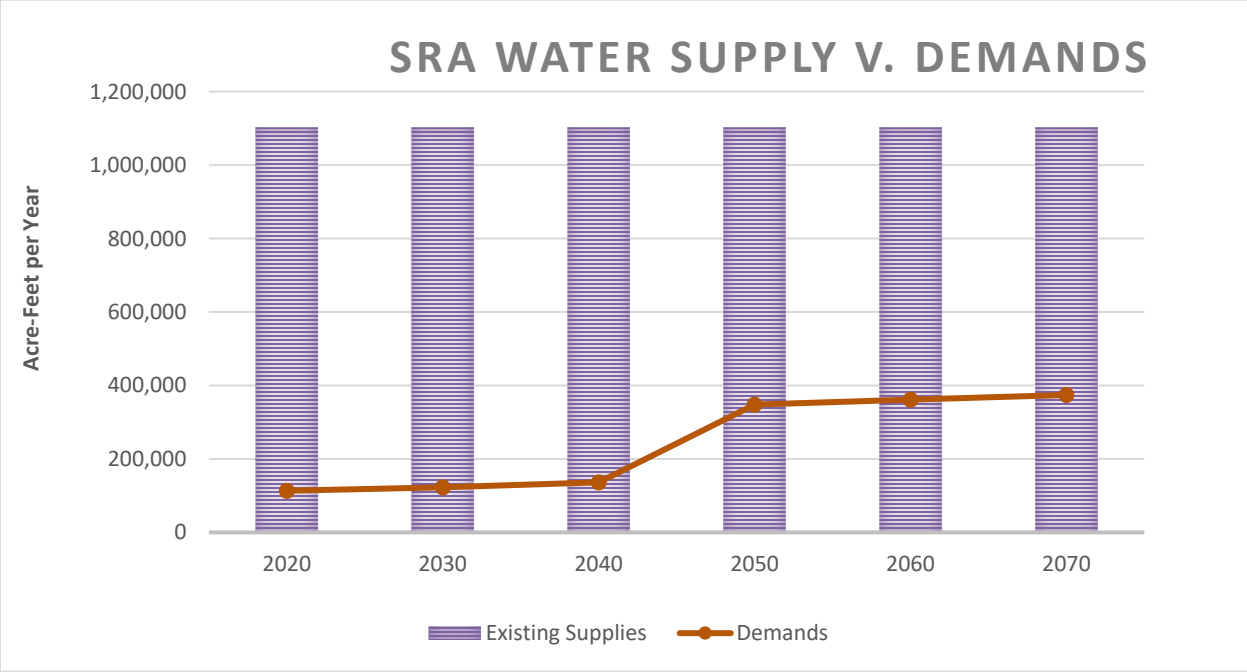
SRA supplies major water to several customers in the East Texas Regional Water Planning Area (ETRWPA) from the Lower Basin supplies (Toledo Bend Reservoir and the canal system). Municipal customers include the Cities of Hemphill, Huxley, and Rose City; Beechwood WSC, El Camino WSC, and Pendleton Harbor WSC, and G-M WSC. In addition to the municipal customers, SRA also supplies Manufacturing demand in Orange and Jefferson Counties and Steam Electric Power demand in Orange, Newton, and Rusk Counties.

SRA has sufficient supplies to meet the current contracted customer demand and surplus supplies for additional potential buyers. In addition to the current customers, several ETRWPA water suppliers have WMSs that use SRA's Toledo Bend Reservoir supplies. The ETRWPA WMSs that use supplies from Toledo Bend Reservoir include: 1) Pipeline from Toledo Bend to City of Center, 2) Transfer from Toledo Bend to Livestock demand in San Augustine County, 3) Contract to supply to Irrigation demand in Orange County, 4) Contract to supply Mining demand in Newton County, 5) Contract to supply Sand Hills WSC and Livestock demand in Shelby County, 6) Contract to supply Steam Electric Power Demand in Rusk County.

It should be noted that these strategies were identified as the recommended strategies for these entities by the *regional planning group*. None of these entities have contacted SRA regarding the potential WMSs. For the successful implementation of these strategies, these users will have to contract with SRA for supplies. The additional discussion for these strategies and the detailed cost estimates are included in the write-up for the specific entities and not included here as they are not SRA's strategies. It should be noted that the cost estimates for these potential future customers do not include the cost of purchasing the water since it is subject to negotiation between the seller (SRA) and future buyers. Informal discussions indicate that the pricing of water will be based on "replacement cost" of alternative water supplies.

A summary of the total demand for the SRA, existing supplies, and surplus is included in the table below.

	2020	2030	2040	2050	2060	2070
Existing Supplies in Lower Basin (ac-ft/yr)						
Toledo Bend Reservoir	970,067	970,067	970,067	970,067	970,067	970,067
Canal System	132,943	132,943	132,943	132,943	132,943	132,943
Demand (ac-ft/yr)						
Canal Customers	76,736	76,736	76,736	76,736	76,736	76,736
Toledo Bend Customers	26,995	26,995	26,995	26,995	26,995	26,995
Potential Future Customers for Toledo Bend Reservoir	9,650	19,206	32,687	244,336	257,898	270,371
Total Demands	113,381	122,937	136,418	348,067	361,629	374,102
Surplus (Shortage)	**999,279**	**999,279**	**999,279**	**999,279**	**999,279**	**999,279**



5B.3.15 City of Tyler

The City of Tyler currently provides wholesale supplies to retail customers, irrigation, and manufacturing demands within the City limits. The City is the wholesale provider for Whitehouse, Southern Utilities, Walnut Grove WSC, and Community Water Company. The current supplies for the City include 34 MGD from Lake Tyler, 30 MGD from Lake Palestine, 0.4 MGD from Bellwood Lake, and 12 groundwater wells in Carrizo Wilcox aquifer producing approximately 8 MGD. The City of Tyler is shown to have sufficient supplies through the planning period using the TWDB approved demand projections.

In addition, there is considerable interest from other users in Smith County in contracting with the City of Tyler for water supplies. There are recommended strategies for Tyler to provide additional water to Bullard, White House, and Manufacturing in Smith County. The City of Tyler has sufficient supplies to meet the proposed demands for the potential future customers throughout the planning horizon.

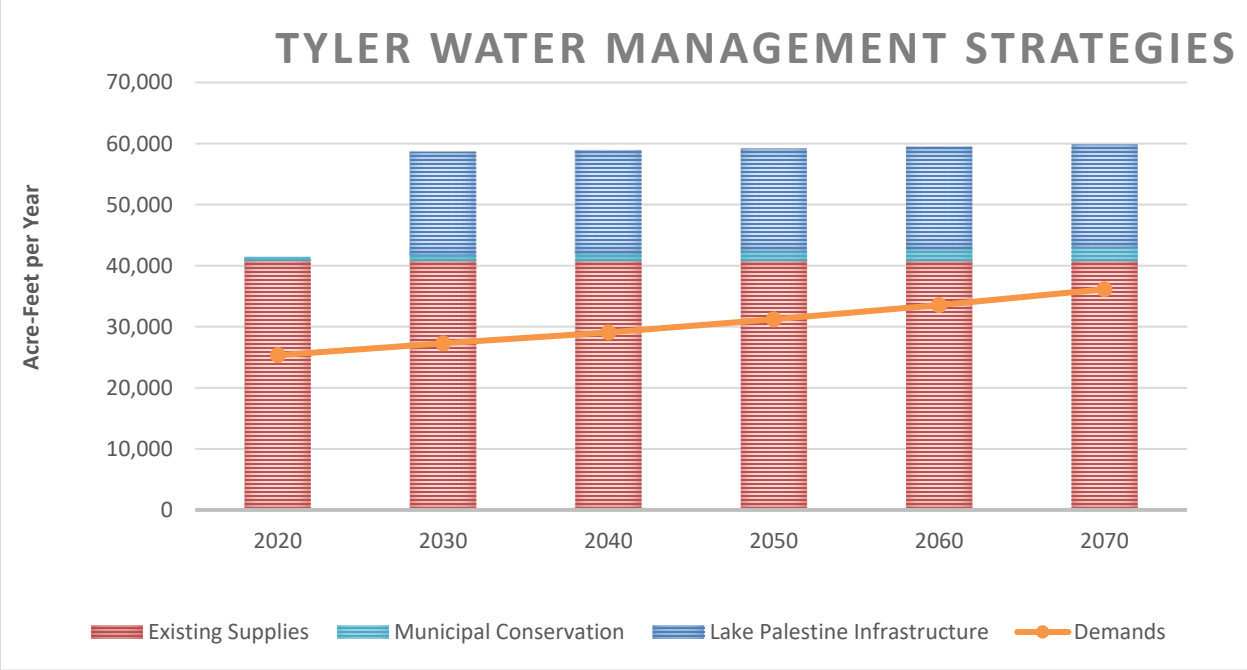
The City of Tyler has recommended strategies to develop infrastructure to develop the rest of Lake Palestine and for municipal conservation. The City's supplies, customer demands, and WMSs are summarized in the table below. Summary of the cost estimates for the recommended strategies are included in the table below.

Lake Palestine Infrastructure (Recommended). The City of Tyler proposed the following recommended strategy for the 2021 Plan. This strategy involved the City developing the additional 30 MGD of Lake Palestine water. The City has developed about half of its contracted supply in Lake Palestine and plans to develop the remaining supply by 2030, as part of its long-term water supply plan.

Municipal Conservation (Recommended). In 2011, the City of Tyler had an average per capita over the statewide goal of 140 gpcd. After performing a conservation cost analysis, the ETRWPG believes that a water conservation strategy for the City is economically achievable. This recommended strategy includes cost estimates related to enhanced public and school education, water conservation pricing implementation, and an enhanced water loss control program. The proposed municipal conservation strategy would reduce the City's demand, increasing the surplus supply available for the City.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Lake Tyler	19,057	19,057	19,057	19,057	19,057	19,057
Bellwood Lake	400	400	400	400	400	400
Lake Palestine	16,815	16,815	16,815	16,815	16,815	16,815
Carrizo Wilcox Wells	4,484	4,484	4,484	4,484	4,484	4,484
Demand (ac-ft/yr)						
Current Customers	25,176	26,724	28,124	29,806	31,670	33,625
Potential Future Customers	166	552	947	1,399	1,885	2,515
Total Demands	25,342	27,276	29,072	31,205	33,555	36,140
Surplus (Shortage)	15,414	13,480	11,684	9,551	7,201	4,616
Water Management Strategies (ac-ft/yr)						
Municipal Conservation	657	1,101	1,338	1,613	1,924	2,268
TYLR-PAL: Lake Palestine Expansion	0	16,815	16,815	16,815	16,815	16,815
Surplus or (Shortage) with WMSs	**16,072**	**31,396**	**29,838**	**27,979**	**25,939**	**23,699**

Strategy	Yield (ac-ft/yr)	Capital Cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy: Municipal Conservation	2,263	$58,766,000	$2,026,000	$1,123	$3.45
Recommended Strategy TYLR-PAL: Lake Palestine Expansion	16,815	$111,190,000	$15,385,000	$915	$2.81



5B.3.16 Upper Neches River Municipal Authority

The Upper Neches River Municipal Water Authority (UNRMWA) owns and operates the Lake Palestine system in the Neches River Basin. Upper Neches River Municipal Water Authority has a water right for 238,110 ac-ft/yr from Lake Palestine and a downstream run-of-river diversion. City of Palestine, City of Tyler, and City of Dallas have contracts for supplies from Lake Palestine for amounts of 28,000 ac-ft/yr, 67,200 ac-ft/yr, and 114,337 ac-ft/yr, respectively. After supplying the contracted amounts to these three contracted customers, Upper Neches River Municipal Water Authority is expected to have 28,573 ac-ft/yr available to supply to other entities in ETRWPA. In addition to these three cities, UNRMWA is expected to have small needs from local irrigation and manufacturing users taking supplies from around the lake. The yield for Lake Palestine was estimated using the Water Availability Model for the Neches Basin in the 2021 East Texas Regional Plan. The yield estimates were not revised for the 2021 Plan because there were no changes made to the volumetric information for the lake or the Neches Basin WAM since the last round of planning. Based on the yield analysis from the 2021 East Texas Regional Plan, Lake Palestine is projected to have a yield of 197,710 ac-ft/yr in 2020, reducing to 189,010 ac-ft/yr by 2070. Based on current contracts and the available supplies from the Neches Basin WAM, the UNRMWA shows a small shortage during the planning period for Lake Palestine supplies. UNRMWA does not think the shortages to be real as the shortage is primarily associated with the reduced firm yield of Lake Palestine due to projected sediment accumulation in the lake. UNRMWA believes that the storage-area-elevation curves used in the Water Availability Models are severely under-predicting the storage volumes available in various parts of the lake, due to the data collection methodology used to develop the curves. Therefore, UNRMWA believes that the lake yield is much larger than what is projected by the Water Availability Models. UNRMWA is currently working with Texas Water Development Board to develop revised and refined volumetric information for Lake Palestine, but this information is not available for the 2021 planning cycle. The lake yield may be recomputed in the next planning cycle.

To address the shortages for the planning period UNRMWA has evaluated multiple potentially feasible WMSs and have the following recommendation for the 2021 ETRWPA Regional Plan. The UNRMWA was the sponsor the proposed Lake Fastrill project. With the current uncertainties surrounding this project, the UNRMWA in conjunction with the City of Dallas has identified the need for a Lake Fastrill replacement project. The City of Dallas is actively working with the UNRMWA to identify the best replacement project for the loss of the supply that would have been provided by Lake Fastrill. Neches River run-of-river diversion is recommended as the most feasible Lake Fastrill replacement project. Compared to the Lake Fastrill project, all Run-of-river diversion strategies provide lesser firm yield, but avoid environmental impacts and some of the permitting challenges associated with a large, main-stem reservoir on the Neches River.

UNRMWA and City of Dallas are considering development of a water supply project from the run-of-river diversions on Upper Neches River and using Lake Palestine, tributary storage, and/or groundwater as system resources. Using the run-of-river diversions operated as a system with Lake Palestine is the recommended strategy. Run-of-river diversions operated as a system with off-channel tributary storage and as conjunctive use along with groundwater are proposed as alternative strategies. All the potentially feasible WMSs for UNRMWA and City of Dallas are discussed in the 2015 Report *Upper Neches River Water Supply Project Feasibility Study*.

Neches Run-of-River Diversions with Lake Palestine (Recommended). This recommended strategy includes run-of-river diversions near SH 21 on Neches River operated as a system with storage in Lake Palestine. UNRMWA will be the project sponsor for this WMS. The run-of-river diversions will be taken from the river segment between the existing Rocky Point diversion and the Weches Dam site below the SH21 crossing, between the Neches River National Wildlife Refuge and upstream of the Weches Dam site. The run-of-the-river diversions will be authorized under a new appropriation of surface water, subject to senior water rights and environmental flows. New facilities required for this WMS include a small diversion dam on the Neches River, a river intake and pump station, and a transmission pipeline and booster pump station supporting transmission to Lake Palestine. The run-of-river diversions are an interruptible

supply and the firm yield associated with the WMS is the incremental increase in the firm yield of Lake Palestine resulting from the system operation of the new diversions and the transmission facilities with the Lake Palestine.

The feasibility report includes multiple infrastructure alternatives for the recommended strategy, each resulting in a different amount of firm yield at Lake Palestine. Run-of-river diversions with a 108-inch transmission pipeline and a pump station capacity of 317 cfs was selected as the recommended transmission system to yield 68,625 ac-ft/yr of firm yield at Lake Palestine. It should be noted that the project configuration for the recommended WMS for UNRMWA in the 2021 ETRWPA Regional Plan is different from the configuration discussed in Dallas' October 2014 *Draft Long Range Water Supply Plan* (Draft LRWSP). The project configuration discussed in the City of Dallas Draft LRWSP resulted in a firm yield of 47,250 ac-ft/yr (42 MGD) that is projected to meet Dallas needs starting 2070. A project configuration with a larger firm yield was recommended in ETRWPA Regional Plan so as to meet the projected needs for City of Dallas, shortages for UNRMWA associated with reduced Lake Palestine yield due to sedimentation, and needs for other potential customers in ETRWPA. For regional planning purposes, the WMS is expected to be online in 2020 to address the shortages projected for the current contracted customers for Lake Palestine and potential steam electric power customers in Anderson County. The WMS timing can be changed to a later date if the timing of needs for the current contracted customers and steam electric power customers changes. City of Dallas is expected to use their share of supplies from this WMS starting in 2060.

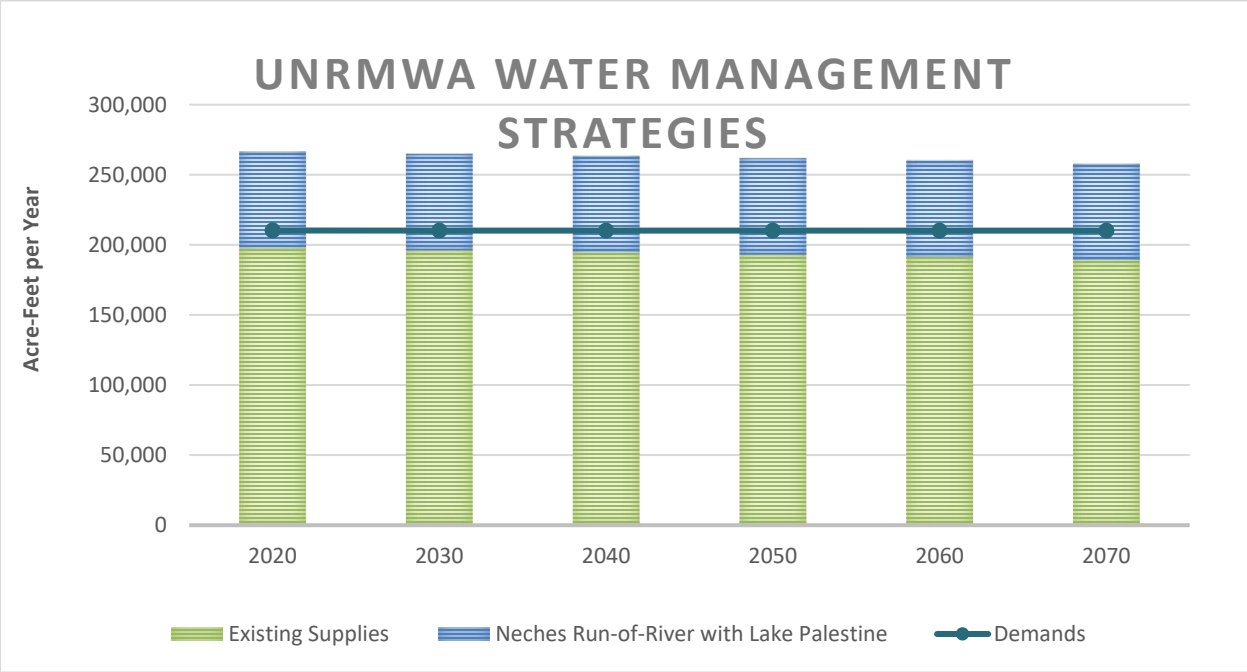
Neches Run-of-River Diversions with Tributary Storage (Alternative). The first alternative strategy for UNRMWA includes new run-of-river diversions from the Neches River segment between the existing Rocky Point diversion dam and the Weches dam site with storage in a new tributary or off-channel reservoir. This alternative strategy includes system operations with Lake Palestine. Facilities for implementation of this WMS include a small diversion dam on the Neches River, a high capacity river intake pump station, a transmission pipeline to the reservoir, and a tributary or off-channel reservoir. The interruptible run-of-river diversions will be backed up using stored water in the tributary or off-channel reservoir. Run-of-river diversions and any impoundment of local runoff in a tributary or off-channel reservoir are subject to inflow passage for senior water rights and environmental protection. The recommended infrastructure combinations for this WMS can provide a firm yield of 75,000 ac-ft/yr (67 MGD).

Neches Run-of-River Diversions with Groundwater (Alternative). A conjunctive use WMS is the second proposed alternative strategy for UNRMWA. The WMS includes new run-of-river diversions from the Neches River segment between the existing Rocky Point diversion dam and the Weches dam site with groundwater supplies from new wells in Carrizo, Wilcox, and Queen City aquifers in Anderson and Cherokee Counties. This alternative strategy includes system operations with Lake Palestine. New facilities for the implementation of this WMS include a small diversion dam on the Neches River, a river intake and pump station, wells located on properties controlled by Campbell Timberland Management, LLC and Forestar (USA) Real Estate Group, Inc., and a transmission system for the delivery of the supplies to the potential customers. The interruptible run-of-river supplies will be backed up using groundwater delivered to the run-of-river diversion point using bed and banks of the Neches River and several tributary streams. The run-of-river diversions are subject to inflow passage for senior water rights and environmental protection, but the groundwater supplies are not. The recommended infrastructure combinations for this WMS can provide a firm yield of 84,875 ac-ft/yr (76 MGD).

Planning level opinion of probable constructions costs were provided by UNRMWA for inclusion in the table below.

	2020	2030	2040	2050	2060	2070
Existing Supplies (ac-ft/yr)						
Palestine System	197,710	196,110	194,610	193,010	191,310	189,010
Demands (ac-ft/yr)						
Demands (With Current Contracted Customers)	210,247	210,224	210,202	210,184	210,169	210,169
Demands (With Current Contracted and Potential Customers)	210,247	210,224	210,202	210,534	257,769	260,068
Surplus (Shortage) with Current Supplies (ac-ft/yr)						
Surplus (Shortage) (With Current Contracted Customers)	(12,537)	(14,114)	(15,592)	(17,174)	(18,859)	(21,159)
Surplus (Shortage) (With Current Contracted and Potential Customers)	(12,537)	(14,114)	(15,592)	(17,174)	(66,109)	(68,409)
Water Management Strategies (ac-ft/yr)						
Recommended Strategy UNM-LP: Neches Run-of-River Diversions with Lake Palestine	68,625	68,625	68,625	68,625	68,625	68,625
Surplus or (Shortage) with WMSs for Current Contracted Customers	56,088	54,511	53,033	51,451	49,766	47,466
Surplus or (Shortage) with WMSs for Current and Potential Contracted Customers	56,088	54,511	53,033	51,451	2,516	216

Strategy	Yield (ac-ft/yr)	Capital cost	Annual Cost	Unit Cost ($/ac-ft)	Unit Cost ($/1000 gal)
Recommended Strategy UNM-LP: Run-of-River Diversions with Lake Palestine (Recommended)	68,625	$518,977,000	$47,246,000	$688	$2.11
Alternate Strategy UNM-TS: Neches Run-of-River with Tributary Storage	75,000	$404,497,000	$26,598,000	$355	$1.09
Alternate Strategy UNM-GW: Neches Run-of-River with Groundwater	84,875	$326,646,000	$38,237,000	$451	$1.38



5B.4 Texas Water Development Board Database

The 2021 Regional Water Planning Data Web Interface (DB22) is an electronic database provided by the Texas Water Development Board which collects, maintains, and analyzes water planning data. The Regional Water Planning Groups and their contracted consultants may enter data for their respective regions in order to facilitate development of useful and relevant regional and state water plans. The DB22 Reports required by the TWDB are included as an Appendix ES-A, Report 13.

5B.5 Summary of Recommended and Alternative Water Management Strategies

The tables below (Table 5B.1 and Table 5B.2) include a summary of all recommended and alternative strategies considered for the WUGs and WWPs in the ETRWPA for the 2021 Plan.

Table 5B.1 2021 Needs, Recommended, and Alternative Water Management Strategies for Water User Groups

NEEDS RECOMMENDED STRATEGY *ALTERNATIVE STRATEGY* BALANCE (Does not include Alternative totals)

County	WUG	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Strategy Source	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
ANDERSON	ELKHART	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	6	6	7	7	8	CT	$0.00	$2,000	$316	$0.97
	FRANKSTON	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	6	7	7	7	8	CT	$0.00	$2,000	$308	$0.94
	NORWOOD WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	0	0	0	0	0	CT	$0.00	$1,000	$500	$1.53
	PALESTINE	Needs	0	0	0	0	0	0					
		Municipal Conservation	81	129	140	150	161	172	CT	$0.00	$30,000	$212	$0.65
	PLEASANT SPRINGS WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	4	5	5	5	6	CT	$0.00	$2,000	$407	$1.25
	TDCJ BETO GURNEY &	Needs	0	0	0	0	0	0					
		Municipal Conservation	16	27	29	30	32	34	CT	$0.00	$6,000	$208	$0.64
	TDCJ COFFIELD MICHAEL	Needs	0	0	0	0	0	0					
		Municipal Conservation	44	75	80	85	91	96	CT	$0.00	$8,000	$102	$0.31
ANGELINA	LUFKIN	Needs	0	0	0	0	0	0					
		Municipal Conservation	151	239	273	0	0	0	CT	$0.00	$60,000	$271	$0.83
	MANUFACTURING	Needs	(1,449)	(1,625)	(1,625)	(1,625)	(1,625)	(1,625)					
		Purchase from Lufkin (Sam Rayburn)	1,625	1,625	1,625	1,625	1,625	1,625	WWP	$0.00	$530,000	$326	$1.00
	MINING	Needs	(473)	(572)	(397)	(299)	(224)	(167)					
		Purchase from ANRA (Mud Creek)	0	572	397	299	224	167	WWP	$7,927,000	$1,245,000	$2,177	$6.68
CHEROKEE	ALTO	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	6	7	7	9	10	CT	$0	$3,000	$326	$1.00
	ALTO RURAL WSC	Needs	0	0	0	(65)	(137)	(215)					
		Municipal Conservation	9	16	18	21	25	28	CT	$0	$8,000	$316	$0.97
		New Wells (Carrizo-Wilcox)	0	0	0	191	191	191	CT	$2,426,000	$202,000	$1,058	$3.25
	BLACKJACK WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	3	4	5	5	6	CT	$0	$2,000	$360	$1.10
	JACKSONVILLE	Needs	0	0	0	0	0	0					
		Municipal Conservation	50	85	110	129	152	178	CT	$0	$42,000	$291	$0.89
	MINING	Needs	(238)	(247)	(210)	(147)	(84)	(40)					
		Purchase from ANRA (Mud Creek)	0	247	210	147	84	40	WUG & WWP	$7,013,000	$853,000	$3,453	$10.60
	RUSK	Needs	0	0	0	0	0	(122)					
		New Wells (Carrizo-Wilcox)	0	0	0	0	0	122	CT	$2,361,000	$192,000	$1,574	$4.83
		Municipal Conservation	15	26	30	34	40	46	CT	$0	$14,000	$361	$1.11
	WELLS	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	0	0	0	0	0	CT	$0	$1,000	$500	$1.53
	WRIGHT CITY WSC	Needs	0	0	0	(24)	(71)	(99)					
		New Wells (Carrizo-Wilcox)	0	0	0	25	71	121	CT	$2,361,000	$192,000	$1,574	$4.83
HARDIN	WILDWOOD POA	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	6	7	7	8	8	CT	$0.00	$2,000	$300	$0.92

Table 5B.1 2021 Needs, Recommended, and Alternative Water Management Strategies for Water User Groups (cont.)

NEEDS RECOMMENDED STRATEGY *ALTERNATIVE STRATEGY* BALANCE (Does not include Alternative totals)

County	WUG	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Strategy Source	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
HENDERSON	ATHENS	Needs	(7)	(13)	(16)	(20)	(30)	(40)					
		Municipal Conservation	7	13	16	20	23	27	CT	$786,000	$25,000	$1,156	$3.55
		Fish Hatchery Reuse	0	0	0	0	6	14	Region C	Strategy discussed in Table 5B.2			
		New Wells (Carrizo-Wilcox)	0	0	0	0	4	10	Region C	Strategy discussed in Table 5B.2			
	BROWNSBORO	Needs	0	0	0	0	0	0					
		Municipal Conservation	3	0	0	0	0	0	CT	$0	$2,000	$667	$2.05
	EDOM WSC	Needs	(2)	(3)	(4)	(5)	(7)	(9)	CT				
		New Wells (Carrizo-Wilcox)	2	3	4	5	7	9	CT	$1,088,000	$136,000	$2,125	$6.52
	CHANDLER	Needs	0	0	0	0	0	(118)					
		Municipal Conservation	9	17	21	26	32	36	CT	$0	$11,000	$362	$1.11
		New Wells (Carrizo-Wilcox)	0	0	0	0	0	101	CT	$1,397,000	$113,000	$1,119	$3.43
	IRRIGATION	Needs	0	0	0	0	(30)	(50)					
		Fish Hatchery Reuse	0	0	0	0	10	16	Region C	Strategy discussed in Table 5B.2			
		New Wells (Carrizo-Wilcox)	0	0	0	0	20	34	Region C	Strategy discussed in Table 5B.2			
	MINING	Needs	(10)	(21)	(10)	0	0	0					
		New Wells (Carrizo-Wilcox)	0	19	10	0	0	0	CT	$201,000	$15,000	$789	$2.42
	MOORE STATION WSC	Needs	0	0	0	0	(38)	(111)					
		New Wells (Carrizo-Wilcox)	0	0	0	0	38	111	CT	$1,417,000	$116,000	$1,045	$3.21
	R P M WSC	Needs	0	(7)	(16)	(27)	(38)	(48)					
		New Wells (Carrizo-Wilcox)	0	7	16	27	38	48	Region D	$3,469,000	$428,000	$1,972	$6.08
HOUSTON	COUNTY-OTHER	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	3	3	4	4	4	CT	$0.00	$1,000	$300	$0.92
	CROCKETT	Needs	0	0	0	0	0	0					
		Municipal Conservation	19	29	30	32	34	36	CT	$0.00	$11,000	$367	$1.13
	LIVESTOCK	Needs	0	0	0	0	0	(201)					
		New Wells (Yegua-Jackson)	0	0	0	0	0	201	CT	$399,000	$39,000	$194	$0.60
	LOVELADY	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	3	3	3	4	4	CT	$0.00	$1,000	$316	$0.97
	TDCJ EASTHAM UNIT	Needs	0	0	0	0	0	0					
		Municipal Conservation	15	25	27	29	30	32	CT	$0.00	$4,000	$152	$0.47
JASPER	JASPER	Needs	0	0	0	0	0	0					
		Municipal Conservation	75	124	141	158	178	196	CT	$15,444,000	$532,000	$3,008	$9.23
	KIRBYVILLE	Needs	0	0	0	0	0	0					
		Municipal Conservation	6	9	10	11	11	12	CT	$0	$3,000	$305	$0.94
	LIVESTOCK	Needs	(8,932)	(8,932)	(8,932)	(8,932)	(8,932)	(8,932)					
		Purchase from LNVA (Sam Rayburn)	8,932	8,932	8,932	8,932	8,932	8,932	CT	$0	$2,911,000	$326	$1.00

Table 5B.1 2021 Needs, Recommended, and Alternative Water Management Strategies for Water User Groups (cont.)

NEEDS RECOMMENDED STRATEGY *ALTERNATIVE STRATEGY* BALANCE (Does not include Alternative totals)

County	WUG	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Strategy Source	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
JEFFERSON	BEAUMONT	Needs	0	0	(1,248)	(3,843)	(6,357)	(9,218)					
		Municipal Conservation	2,027	3,425	4,202	5,112	6,171	7,382	CT	$60,175,000	$2,076,000	$371	$1.14
		Amendment to Supplemental Contract with LNVA	0	0	0	0	228	2,249	WWP	Strategy discussed in Table 5B.2			
	PORT ARTHUR	Needs	0	0	0	0	0	0					
		Municipal Conservation	2,708	4,449	5,222	6,029	6,844	7,664	CT	$51,618,000	$1,981,000	$295	$0.91
	COUNTY-OTHER	Needs	0	0	0	0	(855)	(1,950)					
		Municipal Conservation	34	0	0	0	0	0	CT	$0	$20,000	$588	$1.80
		Purchase from LNVA (Sam Rayburn)	0	0	0	0	855	1,950	WWP	$21,665,000	$2,402,000	$1,232	$3.78
	MANUFACTURING	Needs	(101,138)	(143,513)	(143,497)	(143,479)	(143,462)	(143,446)					
		Purchase from LNVA (Sam Rayburn)	0	143,513	143,497	143,479	143,462	143,446	WWP	$279,210,000	$69,673,000	$485	$1.49
	STEAM ELECTRIC POWER	Needs	(2,391)	(2,391)	(2,391)	(2,391)	(2,391)	(2,391)					
		Purchase from LNVA (Sam Rayburn)	0	2,391	2,391	2,391	2,391	2,391	WWP	$32,302,000	$3,464,000	$1,449	$4.45
NACOG-DOCHES	APPLEBY WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	9	17	20	23	27	32	CT	$0.00	$9,000	$336	$1.03
	COUNTY-OTHER	Needs	0	0	0	0	0	0					
		Lake Naconiche Regional Water System	0	1,700	1,700	1,700	1,700	1,700	CT	$42,117,000	$5,363,000	$3,155	$9.68
	CUSHING	Needs	0	0	0	0	(8)	(30)					
		Municipal Conservation	10	19	24	30	37	45	CT	$1,030,000	$42,000	$1,083	$3.32
	D & M WSC	Needs	0	0	(32)	(135)	(251)	(374)					
		New Wells (Carrizo-Wilcox)	0	0	32	135	251	374	CT	$4,567,000	$373,000	$997	$3.06
	GARRISON	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	6	8	9	10	12	CT	$0.00	$3,000	$286	$0.88
	NACOGDOCHES	Needs	0	0	0	0	0	0					
		Municipal Conservation	247	426	532	656	802	966	CT	$27,720,000	$986,000	$1,349	$4.14
	LIVESTOCK	Needs	(5,970)	(6,399)	(6,896)	(7,472)	(8,131)	(9,113)					
		New Wells (Carrizo-Wilcox)	0	6,399	6,896	7,472	8,131	9,113	CT	$26,677,000	$2,695,000	$296	$0.91
	MINING	Needs	(5,475)	(2,975)	(118)	0	0	0					
		Purchase from ANRA (Mud Creek)	0	2,975	118	0	0	0	WUG & WWP	$14,557,000	$4,159,000	$1,398	$4.29
NEWTON	NEWTON	Needs	0	0	0	0	0	0					
		Municipal Conservation	6	10	10	11	12	12	CT	$0	$4,000	$393	$1.21
	MINING	Needs	(115)	(59)	0	0	0	0					
		Purchase from SRA (Toledo Bend)	115	59	0	0	0	0	WWP	$0	$111,000	$965	$2.96
ORANGE	IRRIGATION	Needs	(526)	(526)	(526)	(526)	(526)	(526)					
		Purchase from SRA (Sabine Run of River)	0	526	526	526	526	526	WWP	$14,624,000	$1,355,000	$2,576	$7.91

Table 5B.1 2021 Needs, Recommended, and Alternative Water Management Strategies for Water User Groups (cont.)

NEEDS RECOMMENDED STRATEGY *ALTERNATIVE STRATEGY* BALANCE (Does not include Alternative totals)

County	WUG	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Strategy Source	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
PANOLA	CARTHAGE	Needs	0	0	0	0	0	0					
		Municipal Conservation	23	39	41	44	47	50	CT	$0.00	$11,000	$266	$0.82
	PANOLA-BETHANY WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	0	0	0	0	1	2	CT	$0.00	$0	$0	$0.00
	LIVESTOCK	Needs	(982)	(982)	(982)	(982)	(982)	(982)					
		New Wells (Carrizo-Wilcox)	0	982	982	982	982	982	CT	$1,172,000	$122,000	$124	$0.38
POLK		No Needs or Strategies Identified											
RUSK	JACOBS WSC	Needs	0	0	0	0	0	(22)					
		New Wells (Carrizo-Wilcox)	0	0	0	0	0	22	CT	$1,795,000	$140,000	$6,364	$19.53
	HENDERSON	Needs	0	0	0	0	0	0					
		Municipal Conservation	83	148	179	235	283	334	CT	$9,900,000	$370,000	$1,431	$4.39
	KILGORE	Needs	0	0	0	0	0	0					
		Municipal Conservation	10	19	21	25	28	32	CT	$0.00	$8,000	$289	$0.89
	MT ENTERPRISE WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	8	0	0	0	0	CT	$0.00	$3,000	$500	$1.53
	NEW LONDON	Needs	0	0	0	0	0	0					
		Municipal Conservation	13	22	26	30	36	40	CT	$0.00	$6,000	$174	$0.53
	OVERTON	Needs	(66)	(122)	(177)	(241)	(310)	(384)					
		New Wells (Carrizo-Wilcox)	0	122	177	241	310	384	CT	$8,914,000	$846,000	$2,034	$6.24
		Municipal Conservation	8	15	18	21	24	28	CT	$0	$7,000	$289	$0.89
	TATUM	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	8	9	10	12	14	CT	$0.00	$4,000	$316	$0.97
	WRIGHT CITY WSC	Needs	0	0	0	0	0	21					
		New Wells (Carrizo-Wilcox)	0	0	0	0	0	22	CT	$2,361,000	$192,000	$1,574	$4.83
	LIVESTOCK	Needs	0	0	(20)	(51)	(83)	(83)					
		New Wells (Carrizo-Wilcox)	0	0	20	51	83	83	CT	$283,000	$24,000	$289	$0.89
	MINING	Needs	0	(305)	(168)	(22)	0	0					
		Purchase from ANRA (Mud Creek)	0	305	168	22	0	0	WUG & WWP	$14,808,000	$1,291,000	$4,233	$12.99
	STEAM ELECTRIC POWER	Needs	(1,103)	(1,103)	(1,103)	(1,103)	(1,103)	(1,103)					
		Purchase from SRA (Toledo Bend)	0	1,103	1,103	1,103	1,103	1,103	WWP	$30,008,000	$2,795,000	$2,534	$7.78
SABINE	HEMPHILL	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	8	7	7	8	8	CT	$0.00	$2,000	$286	$0.88
SAN AUGUSTINE	SAN AUGUSTINE	Needs	(120)	(105)	(92)	(89)	(89)	(89)					
		Municipal Conservation	10	17	18	20	22	23	CT	$2,297,000	$79,000	$3,661	$11.23
		New Wells (Carrizo-Wilcox)	0	105	92	89	89	89	CT	$1,045,000	$88,000	$838	$2.57
	LIVESTOCK	Needs	(1,333)	(1,539)	(1,774)	(2,048)	(2,349)	(2,349)					
		Purchase from SRA (Toledo Bend)	0	1,539	1,774	2,048	2,349	2,349	WWP	$41,302,000	$4,121,000	$1,754	$5.38
	MINING	Needs	(2,102)	(1,102)	0	0	0	0					
		Purchase from ANRA (Mud Creek)	0	1,102	0	0	0	0	WUG & WWP	$35,769,000	$3,911,000	$3,549	$10.89

Table 5B.1 2021 Needs, Recommended, and Alternative Water Management Strategies for Water User Groups (cont.)

NEEDS RECOMMENDED STRATEGY *ALTERNATIVE STRATEGY* BALANCE (Does not include Alternative totals)

County	WUG	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Strategy Source	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
SHELBY	CENTER	Needs	0	0	0	0	0	0					
		Municipal Conservation	26	45	52	57	64	70	CT	$0.00	$11,000	$187.90	$0.58
	SAND HILLS WSC	Needs	(65)	(76)	(85)	95	(107)	(117)					
		Purchase from Center	61	68	77	87	97	105	CT	$0	$102,000	$971	$2.98
		Municipal Conservation	4	8	8	9	10	12	CT	$0	$3,000	$353	$1.08
	TENAHA	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	6	6	7	8	8	CT	$0.00	$2,000	$308	$0.94
	LIVESTOCK	Needs	(6,491)	(8,761)	(11,524)	(14,896)	(19,006)	(19,006)					
		Purchase from SRA (Toledo Bend)	6,491	8,761	11,524	14,896	19,006	19,006	WWP	$0	$18,582,000	$978	$3.00
SMITH	ARP	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	0	0	0	0	0	CT	$0.00	$2,000	$1,000	$3.07
	BULLARD	Needs	(141)	(332)	(526)	(739)	(956)	(1,182)					
		Municipal Conservation	11	22	28	36	44	54	CT	$0	$14,000	$297	$0.91
		Purchase from Tyler	0	322	511	718	928	1,145	CT	$14,264,000	$1,615,000	$1,410	$4.33
	CRYSTAL SYSTEMS TEXAS	Needs	0	0	0	(52)	(164)	(291)					
		Municipal Conservation	18	38	52	71	92	118	CT	$954,000	$39,000	$471	$1.45
		New Wells (Carrizo Wilcox)	0	0	78	192	310	538	Region D	$2,531,000	$231,000	$429	$1.42
	DEAN WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	11	18	0	0	0	0	CT	$0.00	$7,000	$483	$1.48
	LINDALE	Needs	(25)	(136)	(259)	(384)	(535)	(696)					
		New Wells (Carrizo Wilcox)	25	136	259	384	535	696	Region D	$7,592,000	$714,000	$370	$1.13
		Municipal Conservation	7	14	18	23	29	36	CT	$0.00	$8,000	$260	$0.80
	OVERTON	Needs	(4)	(7)	(12)	(18)	(25)	(32)					
		New Wells (Carrizo Wilcox)	0	7	12	18	25	32	CT	$8,914,000	$846,000	$2,034	$6.24
	R P M WSC	Needs	0	(2)	(5)	(11)	(13)	(17)					
		New Wells (Carrizo-Wilcox)	0	2	5	11	13	17	Region D	$3,469,000	$428,000	$1,972	$6.05
	SOUTHERN UTILITIES	Needs	(71)	(74)	(79)	(84)	(90)	(98)					
		Municipal Conservation	514	866	1,058	1,279	1,527	1,803	CT	$33,264,000	$1,249,000	$808	$2.48
	TROUP	Needs	0	0	0	0	0	0					
		Municipal Conservation	6	11	12	14	17	18	CT	$0.00	$5,000	$321	$0.98
	TYLER	Needs	0	0	0	0	0	0					
		Municipal Conservation	657	1,101	1,338	1,613	1,924	2,268	CT	$58,766,000	$2,026,000	$1,123	$3.45
	WHITEHOUSE	Needs	0	0	0	0	(39)	(257)					
		Purchase from Tyler (Lake Palestine/ Lake Tyler/ Carrizo-Wilcox)	0	0	0	0	39	257	WWP	$7,666,000	$737,000	$2,868	$8.80
	MANUFACTURING	Needs	0	(84)	(84)	(84)	(84)	(84)					
		Purchase from Tyler (Lake Palestine/ Lake Tyler/ Carrizo-Wilcox)	0	84	84	84	84	84	Region D	$6,198,000	$545,000	$6,488	$19.91
TRINITY		No Needs or Strategies Identified											

Table 5B.1 2021 Needs, Recommended, and Alternative Water Management Strategies for Water User Groups (cont.)

NEEDS RECOMMENDED STRATEGY *ALTERNATIVE STRATEGY* BALANCE (Does not include Alternative totals)

County	WUG	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Strategy Source	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
TYLER	CHESTER WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	5	5	5	6	6	CT	$0.00	$2,000	$414	$1.27
	COLMESNEIL	Needs	0	0	0	0	0	0					
		Municipal Conservation	4	6	6	7	7	8	CT	$0.00	$2,000	$316	$0.97
	CYPRESS CREEK WSC	Needs	0	0	0	0	0	0					
		Municipal Conservation	2	3	3	3	3	4	CT	$0.00	$1,000	$333	$1.02
	WOODVILLE	Needs	0	0	0	0	0	0					
		Municipal Conservation	17	28	30	32	34	36	CT	$0.00	$9,000	$305	$0.94

(1) Entities split into more than one county within the East Texas Regional Water Planning Area reflect the cumulative need in the region.
(2) The annual and unit costs shown are for the decade with the highest annual and unit cost.
(3) CT denotes Consultant Team.
(4) Strategies with a sponsor in other regions do not appear in Appendix 5B-A.
(5) For Water User Groups (WUG) that are also Wholesale Water Providers (WWP), see Table 5B.2 for full list of strategies.
(6) Entities split into more than one region reflect only the need in the East Texas Regional Water Planning Area.

Table 5B.2 2021 Needs and Water Management Strategies for Wholesale Water Providers (ac-ft per year)

NEEDS RECOMMENDED STRATEGY *ALTERNATIVE STRATEGY* BALANCE (Does not include Alternative totals)

WWP	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
ANRA	Needs	(21,888)	(62,569)	(71,812)	(71,457)	(71,297)	(101,207)	----			
	Lake Columbia	0	75,720	75,640	75,560	75,480	75,400	$402,862,000	$23,509,000	$311	$0.95
	ANRA Treatment and Distribution System	0	0	0	0	0	0	$228,001,000	$49,839,000	$2,242	$6.88
	Run-of-River Supplies, Neches (New Application)	20,000	20,000	20,000	20,000	20,000	20,000	$0	$0	$0	$0.00
	Run-of-River Supplies, Neches (Submitted Application)	10,000	10,000	10,000	10,000	10,000	10,000	$0	$0	$0	$0.00
	New Wells (Carrizo-Wilcox Aquifer)	0	5,600	5,600	5,000	4,800	4,500	$29,775,000	$3,185,000	$569	$1.75
	RECOMMENDED WMS TOTAL	30,000	111,320	111,240	110,560	110,280	109,900				
AN WCID#1	Needs	0	0	0	0	0	0	----			
	Lake Striker Hydraulic Dredging (Volumetric Survey and Normal Pool Elevation Adjustment)	0	0	5,600	5,600	5,600	5,600	$23,716,000	-	$476	$1.46
	RECOMMENDED WMS TOTAL	0	0	5,600	5,600	5,600	5,600				
ATHENS MWA	Needs	0	0	0	0	(2,386)	(5,566)	----			
	Indirect Reuse of Flows from Fish Hatcheries	2,872	2,872	2,872	2,872	2,872	2,872	$0	$0	$0	$0.00
	Expanded Groundwater Supply	200	200	200	200	200	200	$2,573,000	$218,000	$1,090	$3.35
	New Wells in Carrizo-Wilcox Aquifer (Region C)	0	0	0	0	2,000	2,000	$15,151,000	$1,885,000	$943	$2.89
	New Wells in Carrizo-Wilcox Aquifer (Region C)	*1,262*	*1,262*	*1,262*	*1,262*	*1,262*	*1,262*	*$9,207,000*	*$1,171,000*	*$413*	*$1.27*
	WTP Booster PS Improvement	*450*	*450*	*450*	*450*	*450*	*450*	*$65,000*	*$57,000*	*$127*	*$0.39*
	RECOMMENDED WMS TOTAL	3,072	3,072	3,072	3,072	5,072	5,072				
BEAUMONT	Needs	0	0	(1,248)	(3,843)	(6,357)	(9,218)	----			
	Amendment to Supplemental Contract with LNVA	0	0	0	0	228	2,249	-	$2,199,000	$977	$3.00
	RECOMMENDED WMS TOTAL	0	0	0	0	228	2,249				
CARTHAGE	No Needs or Strategies Identified	-	-	-	-	-	-	----			
CENTER	Needs	0	0	0	0	0	0	----			
	Reuse Pipeline from WWTP to Lake Center	0	1,121	1,121	1,121	1,121	1,121	$2,456,000	$262,000	$234	$0.72
	Pipeline from Toledo Bend to Lake Center	0	0	2,242	2,242	2,242	2,242	$27,775,000	$3,462,000	$1,544	$4.74
	RECOMMENDED WMS TOTAL	0	1,121	3,363	3,363	3,363	3,363				
HOUSTON CO WCID #1	Needs	0	0	0	0	0	0	----			
	Permit Amendment for Houston County Lake	3,500	3,500	3,500	3,500	3,500	3,500	$0	$0	$0	$0.00
	New Wells in Carrizo-Wilcox Aquifer	*3,500*	*3,500*	*3,500*	*3,500*	*3,500*	*3,500*	*$22,793,000*	*$1,827,000*	*$522*	*$1.60*
	RECOMMENDED WMS TOTAL	3,500	3,500	3,500	3,500	3,500	3,500				

Table 5B.2 2021 Needs and Water Management Strategies for Wholesale Water Providers (ac-ft per year) (cont.)

NEEDS RECOMMENDED STRATEGY *ALTERNATIVE STRATEGY* BALANCE (Does not include Alternative totals)

WWP	2021 Needs and Strategies	2,020	2,030	2,040	2,050	2,060	2,070	Capital Costs ($)	Annual Costs ($)	Unit Costs before Amortization ($/acre-feet)	Unit Costs before Amortization ($/1000 gal)
JACKSONVILLE	Needs	0	0	0	0	0	0	----			
	Supply from Lake Columbia	0	0	1,700	1,700	1,700	1,700	$29,390,000	$3,150,000	$1,853	$5.69
	RECOMMENDED WMS TOTAL	0	0	1,700	1,700	1,700	1,700				
LNVA	Needs	0	0	0	0	0	0	----			
	Purchase from SRA (Toledo Bend)	0	0	200,000	200,000	200,000	200,000	$529,606,000	$110,157,000	$551	$1.69
	Beaumont West Regional Reservoir	0	7,700	7,700	7,700	7,700	7,700	$37,538,000	$1,970,000	$256	$0.79
	Neches-Trinity Basin Interconnect	0	67,000	67,000	67,000	67,000	67,000	$102,375,000	$8,907,000	$133	$0.41
	RECOMMENDED WMS TOTAL	0	74,700	274,700	274,700	274,700	274,700				
LUFKIN	Needs	0	0	0	0	0	0	----			
	Conveyance from Rayburn to Kurth Lake – Phase 1 (2030)	0	11,210	11,210	11,210	11,210	11,210	$78,220,000	$14,413,000	$1,286	$3.95
	Conveyance from Rayburn to Kurth Lake – Phase 2 (2040)	0	0	11,210	11,210	11,210	11,210	$78,199,000	$27,911,000	$1,255	$3.85
	Conveyance from Rayburn to Kurth Lake – Phase 3 (2050)	0	0	0	5,580	5,580	5,580	$8,834,000	$25,722,000	$919	$2.82
	RECOMMENDED WMS TOTAL	0	11,210	22,420	28,000	28,000	28,000				
NACOGDOCHES	Needs	0	0	0	0	0	0	----			
	Lake Columbia to Nacogdoches Raw Water Transmission System	0	8,551	8,551	8,551	8,551	8,551	$50,754,000	$6,739,000	$788	$2.42
	RECOMMENDED WMS TOTAL	0	8,551	8,551	8,551	8,551	8,551				
PANOLA COUNTY FWSD	No Needs or Strategies Identified							----			
PORT ARTHUR	See Table 5B.1 for Conservation Strategy Details; No Needs or Additional Strategies Identified							----			
SRA	No Needs or Strategies Identified							----			
TYLER	Needs	0	0	0	0	0	0	----			
	Lake Palestine Expansion	0	16,815	16,815	16,815	16,815	16,815	$111,190,000	$15,385,000	$915	$2.81
	RECOMMENDED WMS TOTAL	0	16,815	16,815	16,815	16,815	16,815				
UNRMWA	Needs	(12,537)	(14,114)	(15,592)	(17,174)	(66,109)	(68,409)	----			
	Neches Run-of-River with Lake Palestine	68,625	68,625	68,625	68,625	68,625	68,625	$518,977,000	$47,246,000	$688	$2.11
	Neches Run-of-River with Tributary Storage	*75,000*	*75,000*	*75,000*	*75,000*	*75,000*	*75,000*	*$404,497,000*	*$26,598,000*	*$355*	*$1.09*
	Neches Run-of-River with Groundwater	*84,875*	*84,875*	*84,875*	*84,875*	*84,875*	*84,875*	*$326,646,000*	*$38,237,000*	*$451*	*$1.38*
	RECOMMENDED WMS TOTAL	68,625	68,625	68,625	68,625	68,625	68,625				

(1) Needs incorporate existing supplies, existing contract demands, and future contract demands.
(2) The annual and unit costs shown are for the decade with the highest annual and unit costs.
(3) Strategies with a sponsor in other regions do not appear in Appendix 5B-A; see applicable regional water plan for strategy details.
(4) Recommended WMS Total does not include demand reduction from a Wholesale Water Provider's (WWP) customers' recommended Municipal Conservation strategy, if applicable.
(5) See Table 5B.1 for applicable demand reductions from Water User Group (WUG) Municipal Conservation strategies.