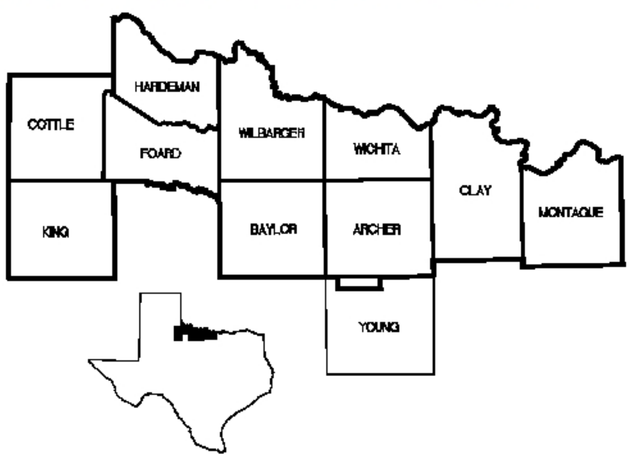
REGION B REGIONAL WATER PLAN

December 2015



Biggs & Mathews, Inc.
Freese and Nichols, Inc.
Alan Plummer Associates, Inc.
Red River Authority of Texas

REGION B REGIONAL WATER PLAN

Prepared for

Region B Water Planning Group

<u>Members</u>

Mr. Curtis W. Campbell, Chairman
Mr. Wilson Scaling, Vice Chairman
Mr. Dean Myers, Secretary

Ms. Tamela Armstrong
Mr. J. K. (Rooter) Brite
Mr. Jack Campsey
Judge Mark Christopher
Mr. N.E. Deweber
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Mr. Bobby Kidd
Judge Kenneth Liggett
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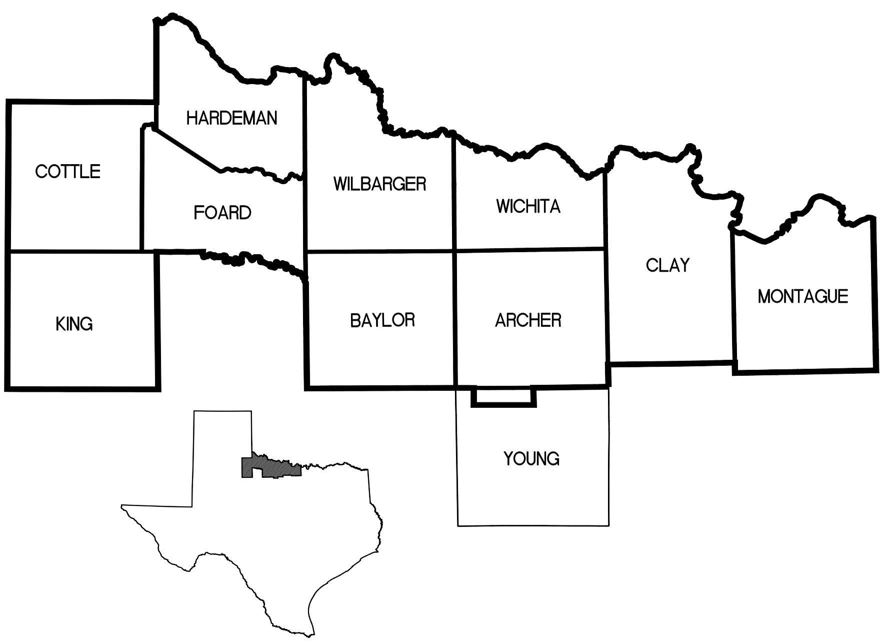
Mr. Monte McMahon
Mr. Tracy Mesler
Mr. Jerry L. Payne
Mr. Russell Schreiber
Mayor Gayle Simpson

December 2015



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Chapter 11 Implementation and Comparison to Previous Regional Water Plan

REGION B REGIONAL WATER PLAN
Partial List of Acronyms

Acronym	Name	Meaning
DFC	Desired Future Condition	Criteria for which is used to define the amount of available groundwater from an aquifer.
GAM	Groundwater Availability Model	Numerical groundwater flow model. GAMs are used to determine the aquifer response to pumping scenarios. These are the preferred models to assess groundwater availability.
GCD	Groundwater Conservation District	Generic term for all or individual state recognized Districts that oversee the groundwater resources within a specified political boundary.
GMA	Groundwater Management Area	Sixteen GMAs in Texas. Tasked by the Legislature to define the desired future conditions for major and minor aquifers within the GMA.
MAG	Managed Available Groundwater	The MAG is the amount of groundwater that can be permitted by a GCD on an annual basis. It is determined by the TWDB based on the DFC approved by the GMA. Once the MAG is established, this value must be used as the available groundwater in regional water planning.
MGD	Million Gallons per Day	Measurement of rate of use. Typically used when sizing infrastructure.
gpm	Gallons per minute	Measurement of rate. Typically used to describe a diversion rate or capacity of water wells.
RWPG	Regional Water Planning Group	The generic term for the planning groups that oversee the regional water plan development in each respective region in the State of Texas
SB1	Senate Bill One	Legislation passed by the 75th Texas Legislature that is the basis for the current regional water planning process.
SB2	Senate Bill 2	Legislation passed by the 77th Texas Legislature that built on policies created in SB1.
TCEQ	Texas Commission on Environmental Quality	Texas Agency charged with oversight of Texas surface water rights and WAM program.
TWDB	Texas Water Development Board	Texas Agency charged with oversight of regional water plan development and oversight of GCDs
WAM	Water Availability Model	Computer model of a river watershed that evaluates surface water availability based on Texas water rights.
WCWID #2	Wichita County Water Improvement District #2	Entity responsible for operating the Lake Kemp and Diversion system for irrigation use.
WMS	Water Management Strategy	Strategies available to RWPG to meet water needs identified in the regional water plan.

REGION B REGIONAL WATER PLAN
Partial List of Acronyms

Acronym	Name	Meaning
WUG	Water User Group	A group that uses water. Six major types of WUGs: municipal, manufacturing, mining, steam electric power, irrigation and livestock.
WWP	Wholesale Water Provider	Entity that has or is expected to have contracts to sell 1,000 ac-ft/yr or more of wholesale water.

EXECUTIVE SUMMARY

2016 FINAL PLAN

REGION B

DECEMBER 2015

EXECUTIVE SUMMARY

2016 FINAL PLAN
REGION B

Introduction

Senate Bill 1 of the 75th Texas Legislature was passed in 1997 to set the process of developing a comprehensive state water plan. To accomplish this task, the state was divided into 16 regional water planning groups. This report describes Region B as designated by Senate Bill 1. Region B is comprised of ten entire counties and a portion of one county in north central Texas. Specifically, those counties are Archer, Baylor, Clay, Cottle, Foard, Hardeman, King, Montague, Wichita, Wilbarger, and the City of Olney in Young County. Figure 1 shows the region, cities, towns, and the counties it encompasses. Since the initiation of this process the Region B RWPG has developed three regional water plans and this plan, 2016 Plan, is the fourth regional water plan, which is an update of the 2011 Regional Water Plan for Region B.

Regional Water Planning Group – Area B Voting Members

Regional Water Planning Group - Area B (Voting Members)			
Name	**Organization**	**Interest**	**County**
Dale Hughes	W.T. Waggoner Estate	Agricultural	Wilbarger
Wilson Scaling	Scaling Ranch	Agricultural	Clay
Judge Mark Christopher	Foard County	Counties	Foard
Judge Kenneth Liggett	Clay County	Counties	Clay
Monte McMahon	American Electric Power	Electric Generating Utility	Wilbarger
J. K. (Rooter) Brite	J. A. Ranch	Environmental	Montague/All
Rebecca L. Dodge	Midwestern State University	Environmental	Wichita/All
Jerry L. Payne	Public	General Public	Clay
Jack Campsey	Gateway Groundwater Conservation District	Groundwater Management Areas	Hardeman
Tracy Messler	Upper Trinity Groundwater Conservation District	Groundwater Management Areas	Montague
Tamela Armstrong	Alliance Power Company	Industrial	Wichita
Russell Schreiber	City of Wichita Falls	Municipalities	Wichita
Mayor Gayle Simpson	City of Crowell	Municipalities	Foard
Curtis W. Campbell	Red River Authority of Texas	River Authorities	All
Dean Myers	Bowie Industries, Inc.	Small Business	Montague
Bobbie Kidd	Greenbelt Municipal and Industrial Water Authority	Water Districts	Foard, Hardeman
Mike McGuire	Rolling Plains Groundwater Conservation District	Water Districts	Baylor
N. E. Deweber	Baylor Water Supply Corporation	Water Utilities	Baylor

Regional Water Planning Group – Area B Non-Voting Members

Regional Water Planning Group - Area B (Non-Voting Members)	
Name	**Organization**
Jarrett Atkinson	Panhandle (a) Regional Water Planning Group
Rich Bilinski	U.S. Army Corps of Engineers
Chester Carthel	Llano Estocado (O) Regional Water Planning Group
Darrell Dean	TDA - North Texas Regional Office
Robert Mauk	Texas Parks & Wildlife
Mike McGuire	Brazos (G) Water Planning Group
Cliff Moore	Texas Commission on Envioromental Quaility
Walt Sears	Northeast Texas (D) Regional Water Planning Group
Jack Stevens	Tarrant Regional Water District
Leeni Vilpas	Pacific Architects & Engineers
Tom Barnett	Texas Water Development Board

This water plan is developed in accordance with the Planning Guidelines set forth in 31 Texas Administrative Code 357.7 and all applicable rules. As required by rule, the plan is organized into eleven chapters as follows:

1. Planning Area Description
2. Population and Water Demand Projections
3. Water Availability and Existing Water Supplies
4. Identification of Water Needs
5. Water Management Strategies
6. Impacts of Regional Water Plan
7. Drought Response Information, Activities, and Recommendations
8. Unique Stream Segments and Reservoir Sites and Other Recommendations
9. Reporting of Financing Mechanisms for Water Management Strategies
10. Adoption of Plan and Public Participation
11. Implementation and Comparison to the Previous Regional Water Plan

Planning Area Description

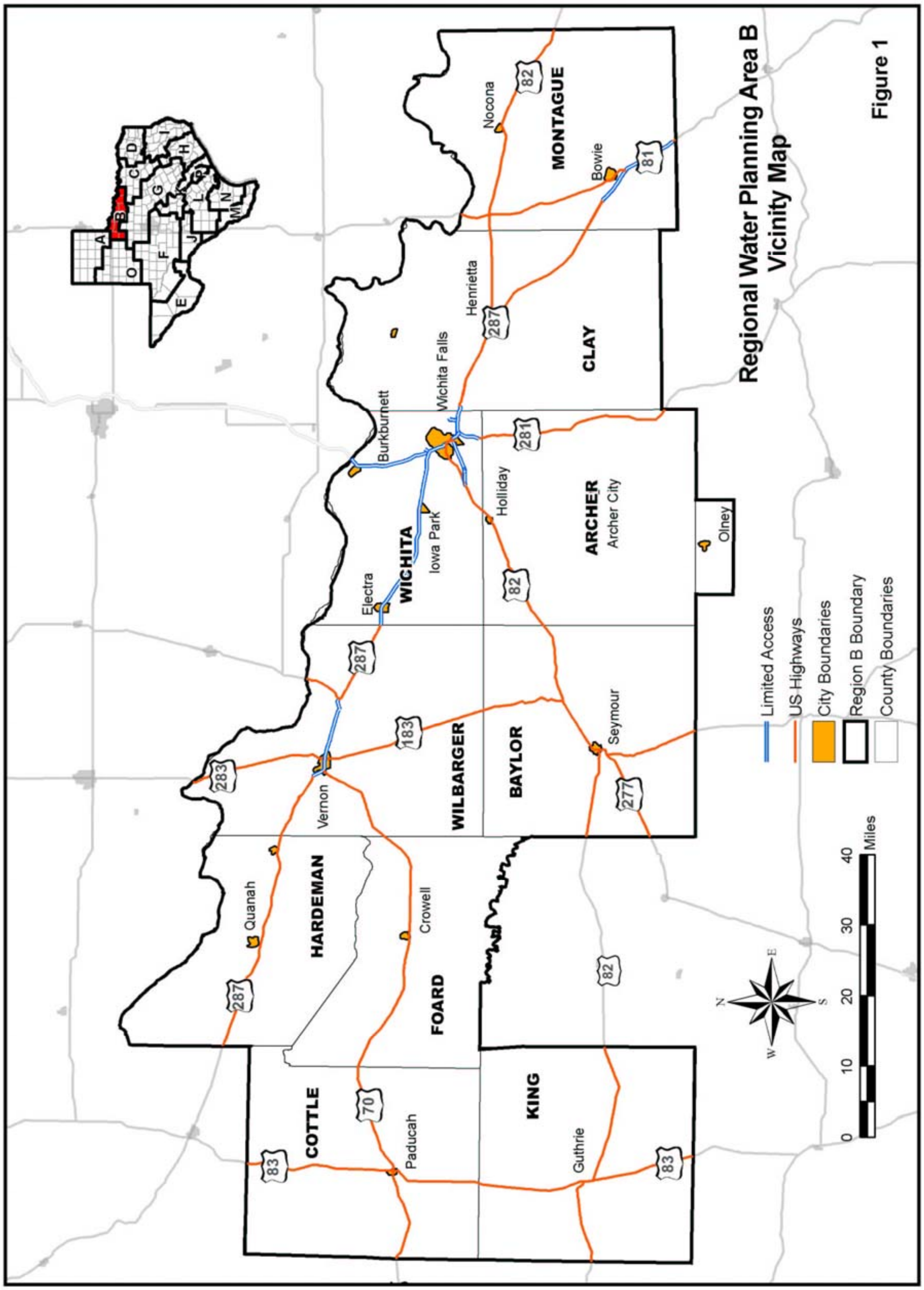
Region B lies mainly in the Red River Basin, however, southern portions of Archer, Clay, and Montague Counties lie in the Trinity River Basin, and southern portions of Archer, Baylor, and King Counties lie in the Brazos River Basin as shown on Figure 1.

In 2010, the total population of the region was reported to be 199,298, with the largest population center, the City of Wichita Falls, being 104,553 or 52 percent of the total. The second largest city was Vernon with a population of 11,002.

In general, most of the population is concentrated in eastern portions of the region with over one-half located in and around Wichita Falls. The January 1, 2010 estimated population density of the region ranged from a high of 209 persons per square mile (Wichita County) to a low of less than one person per square mile (King County). This is similar to the 2000 Census estimates, indicating little to no regional population growth over the past ten years. Regional population is forecasted to increase by approximately 10 percent over the study period.

The City of Wichita Falls is the largest water demand center in the region. Other demand centers include Seymour, Henrietta, Quanah, Bowie, Nocona, Burkburnett, Electra, Iowa Park, Vernon, Olney, and Archer City.

While the population of Region B is only expected to reach near 229,000 by 2070, the Dallas-Fort Worth Metroplex, located just east of the region, is expected to top 9 million.


Regional Water Planning Area B
Vicinity Map
Figure 1
Limited Access
US Highways
City Boundaries
Region B Boundary
County Boundaries
0 10 20 30 40 Miles
MONTAGUE
CLAY
ARCHER
WICHITA
WILBARGER
BAYLOR
HARDEMAN
FOARD
COTTLE
KING
Nocona
Bowie
Henrietta
Wichita Falls
Burkburnett
Holliday
Archer City
Olney
Iowa Park
Electra
Seymour
Vernon
Quanah
Crowell
Paducah
Guthrie
82
81
287
281
283
183
277
70
83

Population and Water Demand Projections

The population projections for Region B were:

- Developed by TSDC and the Office of the State Demographer for 2011 to 2050 utilizing a cohort approach for county-level population.
- Based on Recent and Projected Demographic trends, including birth rates, survival rates, and net migration rates of population groups defined by age, gender and race/ethnicity
- Developed for 2060 and 2070 projections based on the trend of average annual growth rates of the 2011 to 2050 projections.
- Developed for 2060 and 2070 for counties that showed a decline in population from 2011 to 2050, by retaining the population at the highest population attained prior to the decline.

The City with the highest projected growth rate is Wichita Falls. It is expected to grow by approximately 12 percent in the next fifty years. Table ES-1 shows the population projections for each incorporated city by county and rural areas outside of any incorporated entity (Other Rural).

The water demands for Region B have been divided into several categories for analysis purposes. The various uses analyzed include water for municipal use (MUN), industrial or manufacturing (MFG), power plant cooling (PWR), mining (MIN), agricultural irrigation (IRR), and livestock watering (STK). Table ES-2 shows the amounts of water predicted to be required for these categories through the year 2060. The water demand is shown in acre-feet (Ac-Ft) units with one acre-foot being equivalent to 325,851 gallons of water.

Total water consumption for the region is predicted to remain approximately level from 2020 to 2070.

Table ES-1
Population Projections

CITY	COUNTY	RIVER BASIN	2000 POP.	2010 POP.	2020 POP.	2030 POP.	2040 POP.	2050 POP.	2060 POP.	2070 POP.
Archer City	Archer	RED	1,848	1,834	1,834	1,834	1,834	1,834	1,834	1,834
Holliday	Archer	RED	1,632	1,758	1,982	2,257	2,330	2,330	2,330	2,330
Lakeside City	Archer	RED	984	997	1,021	1,050	1,058	1,058	1,058	1,058
Seymour	Baylor	BRAZOS	2,908	2,740	2,740	2,740	2,740	2,740	2,740	2,740
Henrietta	Clay	RED	3,264	3,141	3,259	3,361	3,361	3,361	3,361	3,361
Petrolia	Clay	RED	782	686	712	734	734	734	734	734
Paducah	Cottle	RED	1,498	1,186	1,224	1,224	1,224	1,224	1,224	1,224
Crowell	Foard	RED	1,141	948	986	995	995	995	995	995
Chillicothe	Hardeman	RED	798	707	731	749	755	770	778	784
Quanah	Hardeman	RED	3,022	2,641	2,728	2,797	2,821	2,876	2,905	2,927
Bowie	Montague	TRINITY	5,219	5,218	5,427	5,626	5,716	5,817	5,881	5,928
Nocona	Montague	RED	3,198	3,033	3,155	3,271	3,323	3,381	3,419	3,446
Saint Jo	Montague	TRINITY	898	1,043	1,085	1,125	1,143	1,163	1,176	1,185
Burkburnett	Wichita	RED	10,927	10,811	11,151	11,557	11,876	12,100	12,314	12,495
Electra	Wichita	RED	3,168	2,791	2,879	2,984	3,066	3,124	3,179	3,226
Iowa Park	Wichita	RED	6,431	6,355	6,555	6,794	6,981	7,113	7,238	7,345
Wichita Falls	Wichita	RED	104,197	104,553	107,835	111,767	114,848	117,013	119,080	120,838
Vernon	Wilbarger	RED	11,660	11,002	11,758	12,398	12,785	13,175	13,447	13,653
Olney	Young	BRAZOS	3,396	3,285	3,370	3,485	3,568	3,655	3,740	3,822
Other Rural			34,999	34,569	35,875	37,182	37,770	38,297	38,709	39,048
Total			**201,970**	**199,298**	**206,307**	**213,930**	**218,928**	**222,760**	**226,142**	**228,973**

Table ES-2
Projected Water Demand (Acre-Feet)

YEAR	2010	2020	2030	2040	2050	2060	2070
MFG	3,547	4,158	4,392	4,720	5,016	5,016	5,016
PWR	13,360	10,360	10,360	10,360	10,360	10,360	10,360
MIN	909	5,203	4,342	2,978	1,837	1,701	1,701
IRR	99,895	99,614	97,236	94,902	92,614	92,614	92,614
STK	12,489	10,761	10,761	10,761	10,761	10,761	10,761
MUN	40,964	32,553	32,773	32,784	32,987	33,405	33,818
TOTAL	171,164	162,649	159,864	156,505	153,575	153,857	154,270

Water Availability and Existing Water Supplies

Water users in the Region B planning area receive surface water from sources in the Brazos, Trinity, and Red River Basins. There are six major reservoirs in Region B that are used for water supply and several smaller reservoirs that were previously used for water supply or supply very small amounts of water. Special Water Resources as designated by the TWDB include surface water resources that are located in one region and used in whole or in part in another region. Millers Creek Lake is partially located in Region B, but used by the North Central Texas MWD in the Brazos G Region. A small amount of water is sold by North Central Texas MWD to users in Baylor County. Greenbelt Lake is located in the Panhandle Planning Area (Region A) and is used in both Regions A and B.

In addition, groundwater is primarily supplied in Region B by two aquifers, the Seymour and the Blaine. The Seymour is designated a major aquifer and is found in the central and western portions of the region. It is currently used in Hardeman, Wilbarger, Wichita, Clay, Baylor, Foard, and Counties. The Blaine is considered a minor aquifer and useable groundwater is limited to the westernmost portion of the region. These aquifers provide a large percentage of available supply in these counties. In addition, the upper portion of the Trinity Aquifer occurs in Montague County in the eastern part of the region. Limited quantities of groundwater are used from the Trinity for municipal and irrigation uses. There are also other formations within the region that are used for ground water supply in limited areas. The TWDB identifies these sources as "Undifferentiated Other Aquifer". These formations are not well defined in the literature, but still provide substantial quantities of water in Archer, Clay, Cottle, Montague, Wichita and Wilbarger Counties.

The total amount supply currently available to Region B is approximately 171,000 acre-feet per year, as shown in Table ES-3. This includes all groundwater in place and reliable supplies from surface water and reuse. By 2070, the supply to Region B decreases by about 20,000 acre-feet per year, which is mostly due to the reduced storage capacity of existing reservoirs due to sediment accumulation.

The supply to water users total approximately 132,000 acre-feet per year, which is less than the total available regional supply due to operational and contractual constraints, infrastructure limitations and water treatment capacities. A comparison of the regional supply to the supply available to the water users is shown in Figure ES-1.

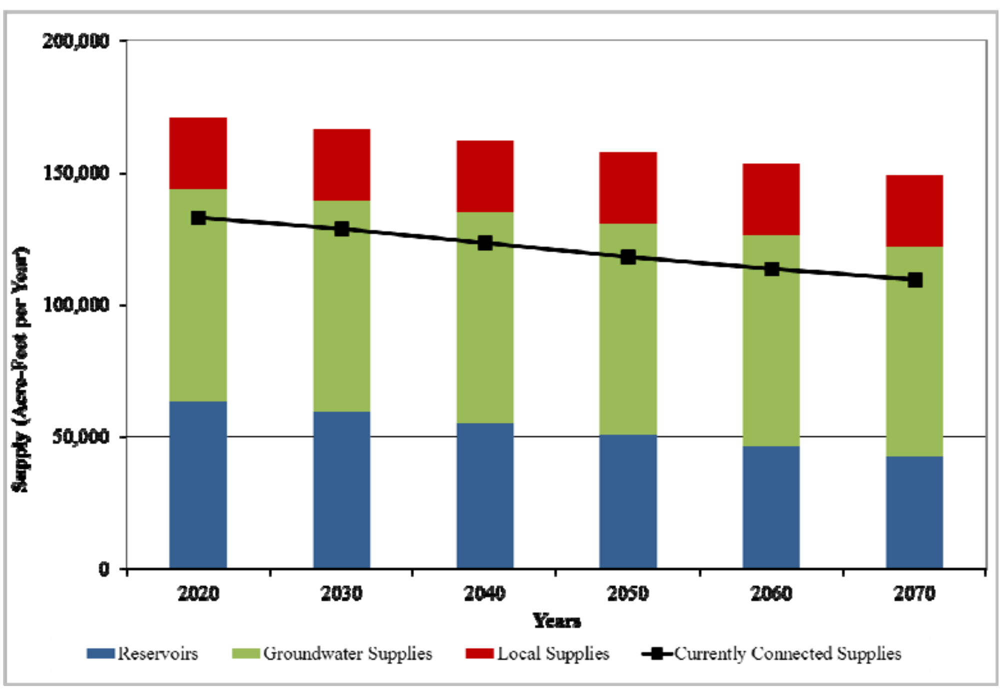
Table ES-3
Summary of Reliable Supplies to Region B
(Values are in Acre-feet per Year)

	2010	2020	2030	2040	2050	2060	2070
Reservoirs in Region B	156,687	59,412	55,270	51,128	46,986	42,846	38,771
Reservoirs outside Region B[1]	1,778	3,850	3,782	3,714	3,646	3,578	3,440
Run-of-the-River Supplies	15,411	15,411	15,411	15,411	15,411	15,411	15,411
Local Supplies	11,316	11,757	11,757	11,757	11,757	11,757	11,757
Groundwater Supplies	190,817	80,413	80,175	80,140	80,019	79,676	79,676
Reuse		324	327	325	0	0	0
Total	**376,007**	**171,167**	**166,722**	**162,475**	**157,819**	**153,268**	**149,055**

Notes: 1. The supply reported for reservoirs outside of Region B is only the amount of water that is supplied to water users in Region B.

Figure ES-1

Comparison of Reliable Supplies to Supplies Available to Water Users



Identification of Water Needs

A comparison of current supply to demand was performed using the projected demands and the existing supplies. Allocations of existing supplies were based on the most restrictive of current water rights, contracts, reliable supply for surface water and modeled available groundwater (MAG) for groundwater. The allocation process did not directly address water quality issues such as nitrates. Salinity was addressed to some extent by not assigning supplies with known high salinity levels for municipal use. This included most of the Blaine Aquifer.

On a regional basis, there is a projected shortage of 29,753 acre-feet in 2020 and a maximum project shortage of 44,946 acre-feet in 2070, as shown in Table ES-4. These needs are calculated by subtracting the regional demand from the total regional water supply. It includes both shortages for some water users and surpluses for others. Considering only the shortages, a summary of the need by county is presented in Table ES-5.

Table ES–4
Comparison of Supplies and Demands for Region B
-Values are in Acre-Feet per Year-

	2020	2030	2040	2050	2060	2070
Supply	132,907	128,603	123,127	117,993	113,424	109,333
Demand	162,659	159,875	156,514	153,584	153,866	154,279
Surplus/Storage	**-29,752**	**-31,272**	**-33,387**	**-35,591**	**-40,442**	**-44,946**

Table ES-5
Comparison of Supply and Demand by County
-Values are in Acre-feet per Year-

County	2020	2030	2040	2050	2050	2070
Archer	-1,278	-1,475	-1,401	-1,385	-1,406	-1,496
Baylor	-518	-442	-343	-249	-249	-249
Clay	-45	-49	-47	-52	-59	-64
Cottle	0	0	0	0	0	0
Foard	0	0	0	0	0	0
Hardeman	-2,491	-2,253	-2,022	-1,798	-1,798	-1,798
King	0	0	0	0	0	0
Montague	-1,315	-250	-281	0	0	0
Wichita	-26,978	-29,263	-31,519	-33,783	-36,883	-39,970
Wilbarger	-2,196	-2,303	-2,880	-3,914	-4,797	-5,674
Young (P)	0	0	0	0	0	-5
Total	**-34,821**	**-36,035**	**-38,493**	**-41,181**	**-45,192**	**-49,256**

A shortage occurs when developed supplies are not sufficient to meet projected demands. In Region B, there are twenty-four water user groups with identified water quantity shortages during the planning period.

Total shortages for all water user groups are projected to be approximately 34,821 acre-feet per year in 2020, increasing to 38,493 acre-feet per year in 2040 and approximately 49,256 acre-feet per year by the year 2070. Table ES-6 lists the water user groups with projected water shortages. The comparison of supply versus demands by user group for Region B is presented in the Water User Group Summary Tables in Appendix B.

Table ES-6
Projected Water Shortages for Water User Groups
-Values are in Acre-feet per Year-

Water User Group	2020	2030	2040	2050	2060	2070
Archer City	-128	-124	-122	-122	-126	-131
Holliday	-110	-127	-135	-139	-145	-151
Lakeside City	-44	-46	-47	-48	-50	-53
Scotland	-112	-161	-174	-177	-179	-183
Windthorst WSC	-172	-190	-195	-200	-206	-212
Irrigation - Archer	-488	-528	-567	-604	-670	-736
Mining - Archer	-255	-333	-194	-131	-67	-67
Irrigation - Baylor	-388	-312	-213	-119	-119	-119
Livestock - Baylor	-130	-130	-130	-130	-130	-130
Dean Dale SUD	-21	-22	-20	-24	-34	-42
Irrigation - Hardeman	-2,491	-2,253	-2,022	-1,798	-1,798	-1,798
Mining - Montague	-1,315	-250	-281	0	0	0
County-Other - Wichita	-51	-66	-80	-91	-102	-114
Electra	-315	-348	-375	-405	-436	-464
Iowa Park	-424	-449	-472	-498	-525	-553
Wichita Falls	-6,683	-7,074	-7,427	-7,797	-8,275	-8,746
Irrigation - Wichita	-18,069	-19,777	-21,485	-23,196	-25,694	-28,188
Manufacturing - Wichita	-1,254	-1,361	-1,486	-1,595	-1,640	-1,686
Steam Electric Power - Wichita	-175	-181	-187	-193	-199	-204
Vernon	0	0	-45	-151	-174	-194
Irrigation - Wilbarger	-1,082	-344	0	0	0	0
Manufacturing - Wilbarger	0	0	-32	-115	-131	-143
Steam Electric Power - Wilbarger	-1,114	-1,959	-2,803	-3,648	-4,492	-5,337
County-Other - Young	0	0	0	0	0	-5
Total	**-34,820**	**-36,035**	**-38,493**	**-41,181**	**-45,192**	**-49,256**

Region B has two wholesale water providers: City of Wichita Falls and Wichita County Water Improvement District (WID) No. 2. The City of Wichita Falls is a regional provider for much of the water in Wichita, Archer, and Clay Counties. The City also provides water to customers as far away as the City of Olney in Young County. Considering current customer contracts and City demands, Wichita Falls has an immediate need of nearly 12,000 acre-feet per year, which increases to over 15,000 acre-feet per year by 2070. When applying the safe supply requirements of 20 percent above the firm demands for the City and customers without a specified contract amount (Holliday and Wichita County Manufacturing), the safe supply need for Wichita Falls increases to over 15,700 acre-feet per year in 2020.

Wichita County WID No. 2 provides irrigation water to users in Archer, Clay, and Wichita counties. The City of Wichita Falls and Wichita County WID No. 2 jointly provide water from Lake Kemp/Diversion system to the AEP steam electric power plant in Wilbarger County and the Dundee Fish Hatchery near Lake Diversion. For simplicity, the contracts for both of these customers and associated supplies are shown only on the WID. Based on this analysis, the needs for the Wichita County WID No. 2 are over 21,000 acre-feet per year in 2020 and increase to over 36,000 acre-feet per year by 2070

A summary of the supply and demand comparison for Region B's wholesale water providers is shown in Table ES-7. A more detailed analysis is included in Appendix B.

Table ES-7
Projected Water Shortages for Wholesale Water Providers
-Values are in Acre-feet per Year-

	2020	2030	2040	2050	2060	2070
Wichita Falls						
Supplies Less Current Customer Demand	-11,919	-12,546	-13,123	-13,706	-14,379	-15,045
Customer Safe Supply Surplus/ Shortage	-15,776	-16,449	-17,059	-17,679	-18,406	-19,124
Wichita County WID No. 2						
Supplies Less Current Customer Demand	-21,430	-24,076	-26,718	-29,364	-32,825	-36,285

While many water user groups were not identified with a water quantity shortage, several were found to have little to no supplies above the projected demands, and thus water reliability concerns. The Region B Regional Water Planning Group recognized that these entities were likely to need to develop new supplies to provide a safe level of supply. To determine which entities may be impacted, a safe supply was defined as being able to meet the projected demands plus 20 percent of the demand. This was applied only to municipal and manufacturing water user groups. Using these criteria, twenty-eight municipal and manufacturing water users were identified with safe supply shortages. Of these users, sixteen are also shown to have firm supply shortages. The region shows a projected safe supply shortage of nearly 15,000 acre-feet per year in 2020, increasing to 19,380 acre-feet per year by 2070. In addition, two water users were found to have water quantity concerns,

In summary, a total of 36 water user groups were identified with one or more of a quantity, reliability or quality need. Twenty-four water user groups were identified with firm quantity needs. An additional twelve water user groups have projected safe supply shortages (reliability), and two municipal suppliers in Wilbarger County and two irrigation users were found to have water quality concerns.

Water Management Strategies

Water management strategies were developed for water user groups to meet projected needs in the context of their current supply sources, previous supply studies and available supply within the region. Where site-specific data were available, this information was used. When specific well fields could not be identified, assumptions regarding well capacity, depth of well and associated costs were developed based on county and aquifer. The primary new surface water supplies are associated with the use of unappropriated water in the Wichita River Basin. A summary of the available supplies for strategies is included in Appendix G.

Municipal and manufacturing strategies were developed to provide water of sufficient quantity and quality that is acceptable for its end use. Water quality issues affect water use options and treatment requirements. For the evaluations of the strategies, it was assumed that the final water product would meet existing state water quality requirements for the specified use. For example, a strategy that provided water for municipal supply would meet existing drinking water standards, while water used for mining may have a lower quality.

The consideration and selection of water management strategies for water user groups with needs followed TWDB guidelines and were conducted in open meetings with the Region B RWPG. In accordance with state guidance, the potentially feasible strategies were evaluated with respect to:

- Quantity, reliability and cost;
- Environmental factors, including effects on environmental water shortages, wildlife habitat and cultural resources;
- Impacts on water resources, such as playas and other water management strategies;
- Impacts on agriculture and natural resources; and
- Other relevant factors.

Conservation:

Water conservation strategies must be considered for all water users with a need. In Region B, this includes municipal, manufacturing, mining, agricultural water, and steam electric power users. Water conservation strategies will help address the needs through adoption of Advanced Conservation strategies.

Water conservation is a demand management strategy than can reduce projected demands and extend the availability of existing supplies. Water conservation strategies have been specifically identified for municipal, irrigation and mining demands. It is expected that conservation strategies will also be adopted by manufacturing and livestock demands, but these have not been quantified. Table ES-8 provides a summary of the conservation savings by decade.

Table ES-8

Summary of Conservation Savings by Water Use

Values are in Acre-feet per Year

Use	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	4,972	5,160	5,182	5,462	5,848	6,157
Irrigation	22,995	22,758	22,525	22,297	22,297	22,297
Mining	1,301	1,086	746	461	426	426
SEP	1,114	1,959	2,803	3,648	4,492	5,337
Total	**30,382**	**30,963**	**31,256**	**31,868**	**33,063**	**34,217**

Wholesale Water Providers:

The City of Wichita Falls has developed strategies to meet both short term needs due to on-going drought conditions and a long term strategy to meet long term growth related demands. The recommended strategies shown in Table ES-9 could provide 21,178 acre-feet by the year 2020 with an additional 18,600 acre-feet of supply in 2040 when Lake Ringgold is completed.

Table ES-9

Recommended Water Management Strategies for Wichita Falls

-Values in Acre-Feet per Year-

Recommended Strategies	Capital Cost	2020	2030	2040	2050	2060	2070
Water Conservation	$36,656,000	4,484	4,484	4,484	4,484	4,484	4,484
Indirect Reuse	$36,400,000	11,210	11,210	11,210	11,210	11,210	11,210
Local Seymour Aquifer	$19,674,000	2,242	2,242	2,242	2,242	2,242	2,242
Wichita River Supply	$11,230,000	2,242	2,242	2,242	2,242	2,242	2,242
Lake Ringgold	$330,500,000			18,600	18,600	18,600	18,600
Precipitation Enhancement		1,000	1,000	1,000	1,000	1,000	1,000
Total	**$434,460,000**	**21,178**	**21,178**	**39,778**	**39,778**	**39,778**	**39,778**

The Wichita County Water Improvement District No. 2 operates a canal system that distributes water to farmers from Diversion Lake in Wichita County, Archer County, and extends slightly into Clay County. To help meet the projected shortages, conservation to reduce water losses through its canal system was considered. Based on a study completed in 2009 nine canal segments, divided into three priority groups, should be considered for conversion to pipelines. The costs for conversion of the canals to pipe along with the water savings are presented in Table ES-10. In addition to this strategy, it is recommended that the Chloride Control Project for the Wichita River Basin be implemented to improve water quality in the Lake Kemp/Diversion system.

Table ES-10

Recommended Water Management Strategies for WCWID No. 2

-Values in Acre-Feet per Year-

Recommended Strategies	Capital Cost	2020	2030	2040	2050	2060	2070
Canal Conversion to Pipeline	$8,538,000	13,034	13,034	13,034	13,034	13,034	13,034
Chloride Control	$59,371,000	0	0	0	0	0	0
Total	**$67,909,000**	13,034	13,034	13,034	13,034	13,034	13,034

County Summaries:

There are ten full counties and one partial county in Region B, of which two (Cottle and King Counties) show no projected water needs. This subchapter discusses the water issues of each county with water needs and outlines the proposed water management strategies to meet the identified needs.

***Archer County* -** The maximum projected water need for Archer County is 1,800 acre-feet per year with most of this need (736 acre-feet per year) associated with an irrigation supply shortage. The remainder of the need is associated with insufficient supplies for existing contracts with Wichita Falls. As Wichita Falls develops its strategies to meet its contractual demands, these water needs will be met. The safe need for Archer County through the planning period is 2,109 acre-feet per year. This safe supply need will be met through Wichita Falls' supplies. Mining is shown to have an unmet need due to limited supplies. A summary of the recommended strategies for Archer County is shown on Table ES-11.

Table ES-11

Archer County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/ 1,000 gal	Implement Decade
Archer City	Water Conservation	32	2.11	2040
	By Contract	183	NA	2020
	Voluntary Transfer	20	0.35	2020
City of Holliday	Water Conservation	39	1.85	2040
	By Contract	214	NA	2020
Lakeside City	Water Conservation	15	1.85	2040
	By Contract	79	NA	2020
Scotland	Water Conservation	28	1.85	2030
	By Contract	115	NA	2020
	Voluntary Transfer	122	5.00	2020
Windthorst WSC	Water Conservation	34	1.85	2030
	By Contract	238	NA	2020
	Voluntary Transfer	54	0.35	2020
Irrigation	Water Conservation	737	0.07	2020
Mining	Water Conservation	101	NA	2020
TOTAL		**2,011**		
Unmet Max Mining Need of 212 acre-feet per year in 2030.				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

***Baylor County* -** The maximum projected water need for Baylor County is 518 acre-feet per year with most of this need (388 acre-feet per year) associated with an irrigation supply shortage. Livestock has a need of 130 acre-feet per year, which cannot be met through available supplies in the county. A summary of the recommended strategies for Baylor County is shown on Table ES-12

Table ES-12

Baylor County Recommended Strategies Summary

Water User	**Strategy Description**	**Supply (ac-ft/yr)**	**Cost/ 1,000 gal**	**Implement Decade**
County-Other	Water Conservations	14	$2.35	2050
Irrigation	Water Conservation	331	NA	2020
TOTAL		345		
Unmet Irrigation Need of 57 acre-feet per year in 2020.				
Unmet Livestock Need of 130 acre-feet per year through planning period				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

***Clay County* -** The maximum projected water need for Clay County is 42 acre-feet per year associated with a supply shortage for Dean Dale SUD. Safe need for Clay County is 140 acre-feet per year. A summary of the recommended strategies for Clay County is shown on Table ES-13.

Table ES-13

Clay County Recommended Strategies Summary

Water User	**Strategy Description**	**Supply (ac-ft/yr)**	**Cost/ 1,000 gal**	**Implement Decade**
Dean Dale SUD	Water Conservation	7	2.46	2070
	By Wichita Falls Contract	90	NA	2020
County Other	Water conservation	18	2.35	2050
	Voluntary Transfer	53	3.50	2020
TOTAL		168		
ALTERNATE STRATEGIES – NONE IDENTIFIED				

***Foard County* -** Foard County has sufficient supplies to meet its needs. There is a small safe supply need associated with customers of Greenbelt MIWA. The Authority has sufficient supplies to meet the safe water needs. There is a safe need only of 33 acre-feet per year for Foard

County with most of that need (28 acre-feet per year) associated with the City of Crowell. A summary of the recommended strategies for Foard County is shown on Table ES-14.

Table ES-14

Foard County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/ 1,000 gal	Implement Decade
County Other	Water Conservation	1	$2.70	2040
	Voluntary Transfer	5	$3.50	2020
Crowell	Water Conservation	2	$2.24	2040
	Voluntary Transfer	28	$3.50	2020
TOTAL		36		
ALTERNATE STRATEGIES – NONE IDENTIFIED				

***Hardeman County* - ** The maximum projected water need for Hardeman County is 2,491 acre-feet per year with all being associated with an irrigation supply shortage. Also there is a safe supply need of 163 acre-feet per year for County Other, Quanah, and Manufacturing. A summary of the recommended strategies for Hardeman County is shown on Table ES-15.

Table ES-15

Hardeman County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/ 1,000 gal	Implement Decade
Irrigation	Water Conservation	794	N/A	2020
County Other	Water Conservation	13	$2.32	2050
	Voluntary Transfer	16	$3.50	2020
Quanah	Water Conservation	48	$1.84	2070
	Voluntary Transfer	79	$3.50	2020
Manufacturing	Voluntary Transfer	66	$3.50	2020
TOTAL		1,016		
Unmet Irrigation Need of 1,697 acre-feet per year through planning period				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

***Montague County* - ** The maximum projected water need for Montague County is 805 acre-feet per year and all being associated with a mining supply shortage. The safe need for Montague County is 996 acre-feet per year. A summary of the recommended strategies for Montague County is shown on Table ES-16.

Table ES-16

Montague County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/ 1,000 gal	Implement Decade
Mining	Water Conservation	910	NA	2020
County Other	Water Conservation	144	$2.37	2070
	Voluntary Transfer	191	$3.50	2020
Bowie	Water Conservation	81	$1.84	2070
TOTAL		1,326		
Unmet Safe Bowie Need of 90 acre-feet per year by2070.				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

***Wichita County* -** The maximum projected water need for Wichita County is 39,955 acre-feet per year with most of this need (28,188 acre-feet per year) associated with an irrigation supply shortage. The safe need for Wichita County is 44,705 acre-feet per year. Most of the needs in the county will be met through strategies developed by Wichita Falls and WCWID No.2. A summary of the recommended strategies is presented in Table ES-17.

Table ES-17

Wichita County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/ 1,000 gal	Implement Decade
County Other	Water Conservation	36	$2.37	2070
	By Contract	159	NA	2020
	Voluntary Transfer	60	$5.00	2030
Burkburnett	Water Conservation	254	$2.37	2070
	By Contract	190	NA	2070
Electra	Water Conservation	105	$1.85	2070
	By Contract	477	NA	2020
Iowa Park	Water Conservation	91	$1.84	2070
	By Contract	602	NA	2020
Wichita Valley	Water Conservation	24	$2.12	2070
	By Contract	34	NA	2070
Wichita Falls	Water Conservation	2,242	$0.97	2030
	Indirect Reuse	11,210	$2.00	2020
	Local Seymour Aquifer	2,242	$4.70	2020
	Wichita River Supply	2,242	$2.37	2020
	Lake Ringgold	18,600	$4.56	2040
	Precipitation Enhancement	1,000		2020
Irrigation	Water Conservation	17,193	0.15	2020
Manufacturing	By Contract	2,317	NA	2020
Steam Electric	By Contract	204	NA	2020
TOTAL		58,282		
Unmet Irrigation Need over planning period, with a maximum of 11,487 acre-per year by 2070.				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

***Wilbarger County* - **The maximum projected need for Wilbarger County is 6,756 acre-feet per year, with most of that need (5,337 acre-feet per year) being associated with steam electric power. Wilbarger County has limited water supplies available for water management strategies. As a result, the only option for steam electric power is alternative cooling technology. Water conservation, direct reuse and developing additional wells for Vernon are the recommended strategies for Wilbarger County. These strategies are summarized in Table ES-18.

Table ES-18

Wilbarger County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/1,000 gal	Implement Decade
County-Other	Conservation	45	$2.37	2050
	Voluntary Transfer (Vernon)	53	NA	2020
Vernon	Conservation	202	$0.53	2050
	Direct Reuse	400	$8.37	2040
	New Groundwater	600	$4.81	2020
Irrigation	Conservation	3,160	NA	2020
Manufacturing	Voluntary Transfer (Vernon)	445	NA	2020
Steam Electric	Alternative Cooling	5,337	$1.29	2020
TOTAL		7,082		
ALTERNATE STRATEGIES – NONE IDENTIFIED				

***Young County* - **The maximum projected water need for Young County is 5 acre-feet per year and a safe need of 26 acre-feet per year and all being associated with a County Other shortage. The City of Olney is developing an indirect reuse project which would shore up its supplies in Lakes Olney-Cooper. With this additional water, Olney would have sufficient supplies to meet the small county-other need identified in the Region B portion of Young County. A summary of the recommended strategies is shown in Table ES-19.

Table ES-19

Young County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/ 1,000 gal	Implement Decade
County Other	Water Conservation	5	$2.60	2060
	Voluntary Transfer	21	$3.50	2050
Olney	Indirect Reuse	885	NA	2020
TOTAL		911		
ALTERNATE STRATEGIES – NONE IDENTIFIED				

Legislative Recommendations

In accordance with 31 TAC 357.7 (a)(9), 31 TAC 357.8, and 31 TAC 357.9, the following recommendations are proposed to facilitate the orderly development, management, and conservation of the water resources available within Region B:

It is recommended that the Chloride Control Project on the Wichita River and the Pease River be made a regional priority in order to enhance the water quality of Lake Kemp and Lake Diversion, and reclaim those lakes as a viable cost effective short term and long term regional water supply source.

- It is recommended that the State consider providing adequate funding to implement brush management and other land stewardship programs.
- It is recommended that the state support both federal and state efforts to rehabilitate existing sediment control structures.
- It is recommended that no segments be designated as "Unique Stream/River Segments" at this time.
- It is recommended that the Legislature extend the protections for unique reservoir sites beyond the current expiration date of September 1, 2015 for Lake Ringgold.
- It is recommended that the state regulatory agencies consider allowing continued long-term use of bottled water programs.
- It is recommended that the state fund required management strategies adopted Region B.
- It is recommended that the Legislature support the grass-roots regional water planning process enacted by SB1. However, it is recommended that consideration be given to updating the Regional Water Plans every 10 years (Instead of every 5 years).
- It is recommended that the state continue to fund agricultural water use data collection.
- It is recommended that surface water uses that will not have a significant impact on the region's water supply be deemed consistent with the regional water plan even though not specifically recommended in the plan.
- With regards to conservation, it is recommended that the Legislature continue to allow each region to establish realistic, appropriate, and voluntary water conservation goals.

- It is recommended that the gallons per capita per day (gpcd) calculation of water use be based on residential water use only.
- It is recommended funding be provided to update the hydrology for all Water Availability Models (WAMS).
- It is recommended that the economic model be updated and that the future crop mix and base year irrigation demands be reevaluated.
- It is recommended that the State should consider funding detailed studies with regards to various forms of evaporation products.
- It is recommended that State should consider legislative action in support of studies and funding for cloud seeding operations.

Implementation and Comparison to Previous Regional Water Plan

Due to the extreme drought conditions, the 2016 Region B Water Plan is quite different from the 2011 Region B Plan. Many of the surface water supplies are at the lowest levels that they have ever been in their history, all due the new drought of record conditions throughout the region. In addition, groundwater supplies have been reduced specifically due to the use of the MAG's as a ceiling. Therefore, due to the reduction in water supplies, many water users that previously showed no needs, are now showing needs and those that had needs in the 2011 Plan now have much greater needs. Consequently, 28 new strategies were developed for the 2016 plan.

CHAPTER 1

PLANNING AREA DESCRIPTION

2016 FINAL PLAN

REGION B

DECEMBER 2015

CHAPTER 1

DESCRIPTION OF REGION
2016 FINAL PLAN
REGION B

1.1 Region B Overview

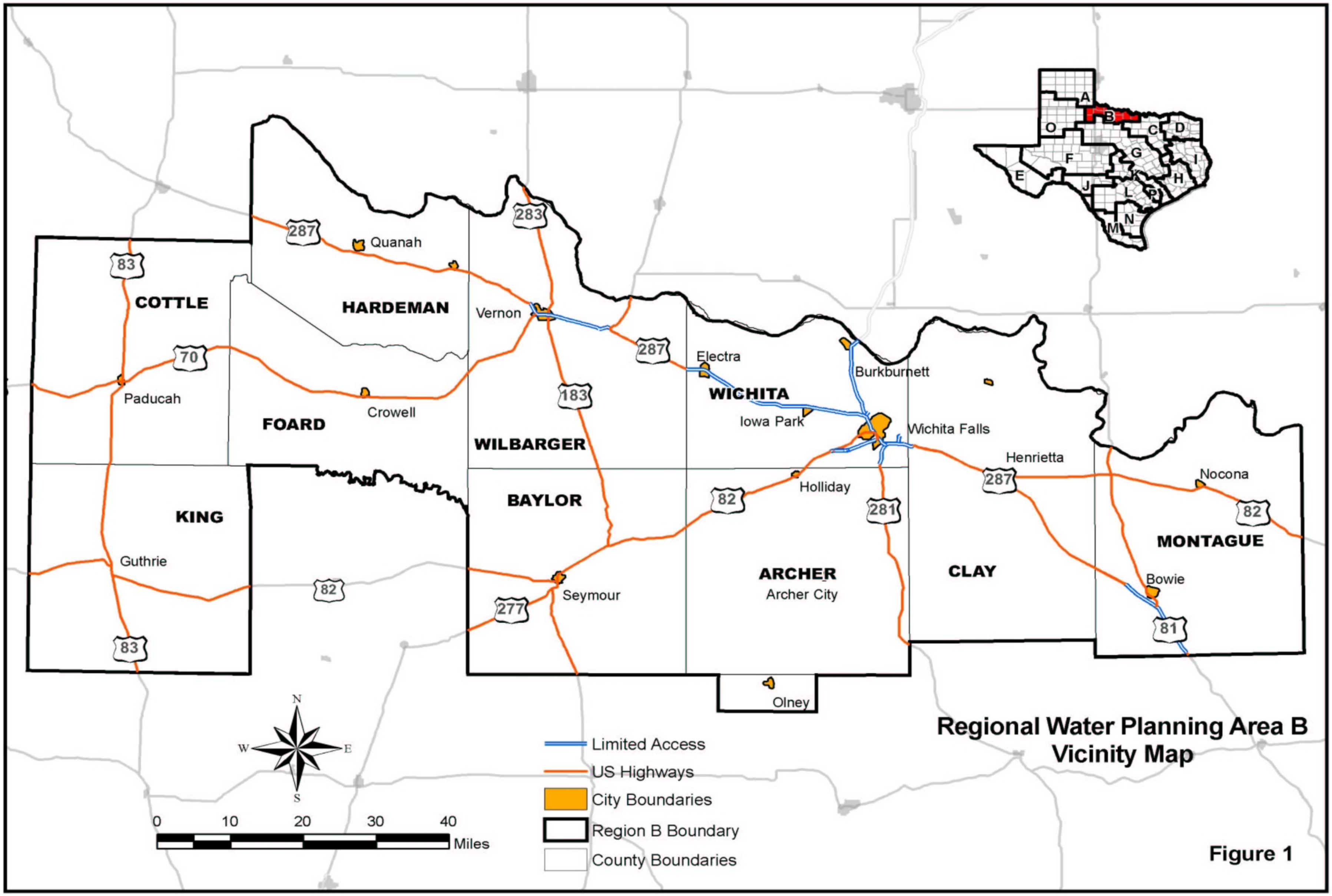
Senate Bill 1 of the 75^{th} Texas Legislature was passed in 1997 to set the process of developing a comprehensive state water plan. To accomplish this task, the state was divided into 16 regional water planning groups. This report describes Region B as designated by Senate Bill 1. Region B is comprised of ten entire counties and a portion of one county in north central Texas. Specifically, those counties are Archer, Baylor, Clay, Cottle, Foard, Hardeman, King, Montague, Wichita, Wilbarger, and the City of Olney in Young County. Figure 1 shows the region, cities, towns, and the counties it encompasses.

Region B lies mainly in the Red River Basin, however, southern portions of Archer, Clay, and Montague Counties lie in the Trinity River Basin, and southern portions of Archer, Baylor, and King Counties lie in the Brazos River Basin, as shown on the Surface Water Map in Figure 2.

In 2010, the total population of the region was reported to be 199,298, with the largest population center, the City of Wichita Falls, being 104,553 or 52 percent of the total. The second largest city was Vernon with a population of 11,002.

1.2 Population And Demographic Data

In general, most of the population is concentrated in eastern portions of the region with over one-half located in and around Wichita Falls. The January 1, 2010 estimated population density of the region ranged from a high of 209 persons per square mile (Wichita County) to a low of less than one person per square mile (King County). Regional population is forecasted to increase by approximately 11 percent over the study period. The forecasts of projected populations will be examined in more detail in Chapter 2 of this report. Table 1-1 shows the 2000 census population by county and the corresponding census population in 2010. Tables 1-2 through 1-5 give a more in-depth breakdown of the regional demographics.


COTTLE
HARDEMAN
FOARD
WILBARGER
WICHITA
CLAY
MONTAGUE
KING
BAYLOR
ARCHER
Quanah
Vernon
Paducah
Crowell
Electra
Burkburnett
Iowa Park
Wichita Falls
Henrietta
Nocona
Holliday
Guthrie
Seymour
Archer City
Bowie
Olney
287
283
83
70
183
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0
10
20
30
40
Miles
Limited Access
US Highways
City Boundaries
Region B Boundary
County Boundaries
Regional Water Planning Area B
Vicinity Map
Figure 1

Table 1-1:
County Populations

County	Area (sq. mi)	2000 Population	2010 Population	% Change	2010 Density people/sq.mi.
Archer	910	8,854	9,054	2.3%	10
Baylor	871	4,093	3,726	-9.0%	4
Clay	1,098	11,006	10,752	-2.3%	10
Cottle	901	1,904	1,505	-21.0%	2
Foard	707	1,622	1,336	-17.6%	2
Hardeman	695	4,724	4,139	-12.4%	6
King	912	356	286	-19.7%	< 1
Montague	931	19,117	19,719	3.1%	21
Wichita	628	131,664	131,500	-0.1%	209
Wilbarger	971	14,676	13,535	-7.8%	14
Young	185	3,396	3,746	10.3%	20

The following tables describe the demography of the region as of the 2010 census.

Table 1-2:
2010 Demographics – Breakdown by Race

	Percentage Of Population That Is…				
County	White	Black	Hispanic	Native	Asian
Archer	96.2%	0.8%	8.5%	1.2%	0.3%
Baylor	94.7%	3.0%	12.4%	0.6%	0.1%
Clay	95.5%	1.0%	5.2%	1.5%	0.2%
Cottle	87.9%	10.1%	23.8%	0.7%	0.1%
Foard	92.9%	4.9%	17.4%	0.4%	0.7%
Hardeman	90.0%	6.3%	21.5%	1.0%	0.4%
King	95.1%	0.0%	16.5%	1.4%	0.0%
Montague	96.1%	0.6%	10.4%	1.3%	0.6%
Wichita	83.2%	10.7%	17.9%	1.3%	2.2%
Wilbarger	86.9%	8.7%	27.7%	1.5%	1.0%
Young	95.1%	1.7%	17.4%	1.2%	0.6%
Average	92.1%	4.3%	16.2%	1.1%	0.6%

Table 1-3:
2010 Demographics – Breakdown by Age

County	Percentage of Population That is Age…							
	<5	**5-17**	**18-24**	**25-44**	**45-64**	**65-74**	**75-84**	**85**
Archer	5.2	18.9	7.6	21.3	30.9	9.3	5.3	1.4
Baylor	6.1	14.5	6.7	19.7	27.9	13.0	8.2	3.9
Clay	5.6	17.1	6.3	21.3	31.9	10.5	5.7	1.6
Cottle	5.2	18.1	5.8	17.9	29.3	12.8	7.9	3.1
Foard	4.3	16.5	7.2	19.3	28.8	12.4	7.7	3.7
Hardeman	6.5	18.1	6.4	21.6	27.9	11.0	6.1	2.5
King	3.8	19.9	6.6	23.1	33.2	7.0	6.0	0.4
Montague	6.3	16.7	7.2	21.8	28.3	11.0	6.3	2.4
Wichita	6.8	16.3	14.1	25.5	24.2	6.7	4.6	1.7
Wilbarger	7.1	18.5	9.5	22.7	26.6	8.0	5.1	2.4
Young	6.5	17.5	7.6	22.0	27.9	9.1	6.7	2.7

Table 1-4:
2010 Demographics – Breakdown by Income and Education

County	Median Family Income	High School Diploma or Better	Bachelor's Degree or Better	Family Income Below Poverty Level
Archer	$56,452.00	86.5%	20.0%	11.3%
Baylor	$33,445.00	83.7%	24.1%	15.4%
Clay	$53,776.00	88.5%	18.2%	10.3%
Cottle	$34,639.00	76.2%	16.1%	15.4%
Foard	$33,750.00	78.0%	21.8%	15.4%
Hardeman	$36,377.00	80.2%	18.6%	26.6%
King	$65,000.00	81.7%	20.5%	5.9%
Montague	$44,231.00	82.0%	16.6%	15.6%
Wichita	$45,086.00	85.2%	20.1%	15.6%
Wilbarger	$41,658.00	79.0%	16.5%	20.7%
Young	$44,429.00	78.6%	16.7%	16.0%
Average	$44,440.00	81.8%	19.0%	13.9%

Table 1-5:
2010 Demographics – Breakdown by Occupation

County	Percentage of Population That Work In…						
	Management	Service	Sales	Farming	Construction	Production	Unemployed
Archer	33.6%	14.1%	22.1%	11.9%	6.2%	17.1%	2.1%
Baylor	32.3%	10.2%	24.3%	7.9%	16.0%	4.0%	1.1%
Clay	30.8%	16.4%	24.5%	10.6%	5.6%	15.1%	3.4%
Cottle	29.5%	26.9%	25.5%	14.7%	9.2%	3.9%	2.0%
Foard	45.0%	17.3%	17.8%	13.7%	6.6%	7.8%	8.7%
Hardeman	33.5%	20.2%	20.1%	11.5%	1.8%	15.8%	6.9%
King	39.5%	13.3%	9.5%	42.4%	9.0%	2.9%	4.2%
Montague	31.1%	15.0%	20.1%	16.0%	6.7%	16.5%	4.2%
Wichita	30.8%	20.5%	25.1%	2.9%	5.3%	13.9%	3.8%
Wilbarger	27.3%	25.4%	21.3%	8.1%	6.6%	10.6%	3.2%
Young	24.4%	18.2%	27.1%	14.5%	8.6%	14.3%	3.6%
Average	32.5%	18.0%	21.6%	14.0%	7.4%	11.1%	3.9%

1.3 Water Use Demand Centers

The City of Wichita Falls is the largest demand center in the region. Other demand centers include Vernon, Burkburnett, Iowa Park, Bowie, Olney, Henrietta, Nocona, Seymour, Electra, Quanah and Archer City. Table 1-6 below shows the population of these demand centers and also the gallons per capita per day (GPCD) usage for each center.

Table 1-6:
Regional Demand Centers

County	City	2010 Population	2010 Municipal Water Use	Water Use
			(Ac-Ft)	(GPCD)
Archer	Archer City	1,834	333	147
Baylor	Seymour	2,740	611	203
Clay	Henrietta	3,141	720	191
Hardeman	Quanah	2,641	543	163
Montague	Bowie	5,218	1,027	173
Montague	Nocona	3,033	693	186
Wichita	Burkburnett	10,811	1,843	143
Wichita	Electra	2,791	575	160
Wichita	Iowa Park	6,355	1,210	162
Wichita	Wichita Falls	104,553	23,049	188
Wilbarger	Vernon	11,002	2,671	196
Young	Olney	3,285	707	184

While the population of Region B is only expected to reach near 229,000 by 2070, the Dallas-Fort Worth Metroplex, located just east of the region, is expected to top 9 million. This population could likely impose increasing pressures on the water base recreational resources of the Region, as the number of people willing to travel into Region B for recreational purposes increase.

1.4 Water Supply and Use

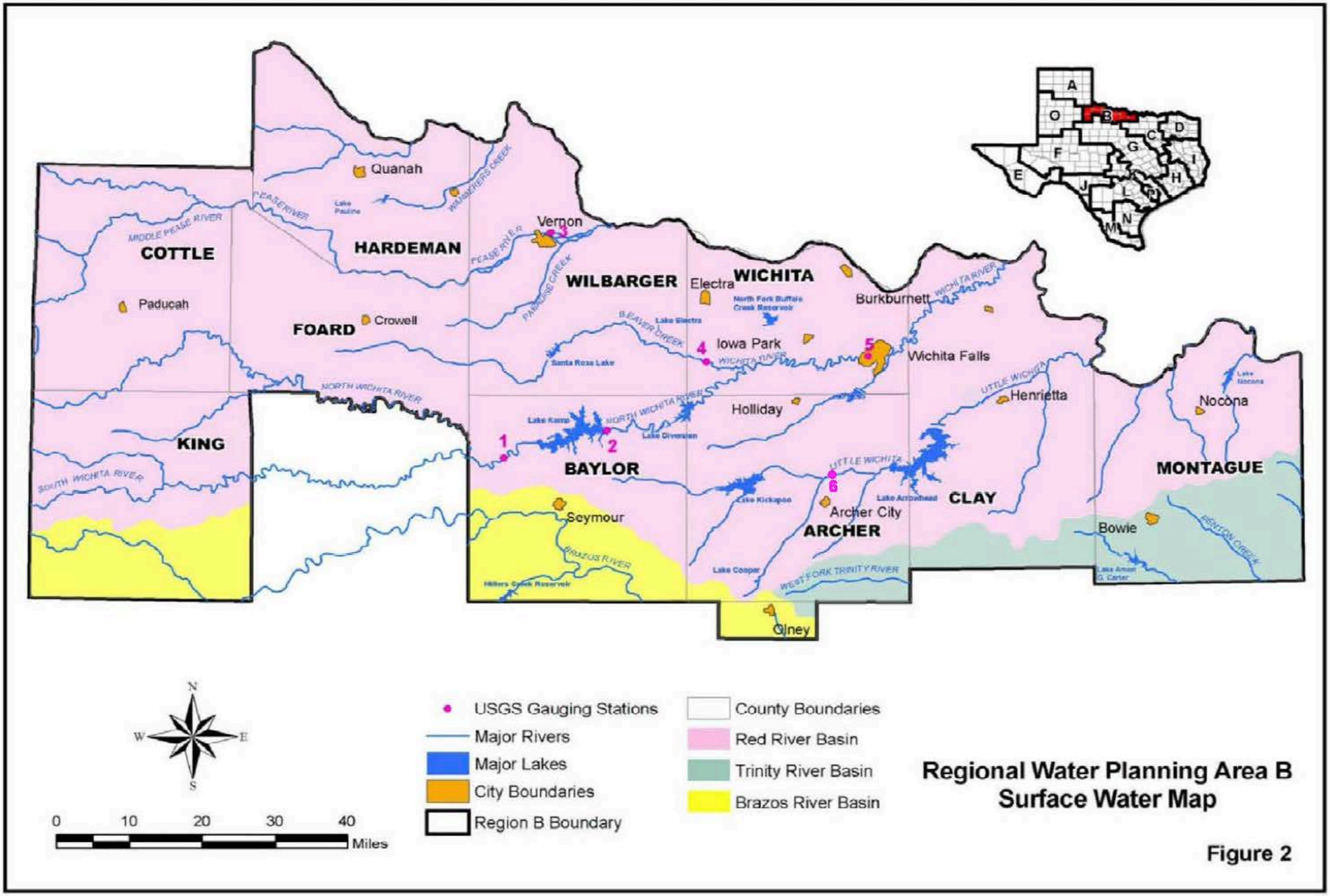
Water providers have continuously strived to develop the water resources in Region B so that they can deliver potable water to the people, irrigation water to the farmers and ranchers, and water to promote industrial and economic growth. In 1901, the dam at Lake Wichita in Wichita County was completed, signifying the beginning of 90 years of water management for recreation, irrigation, and human consumption for north central Texas. In 1924, the dam at Lake Kemp was completed, making it one of the largest man-made lakes in the world. The lake was originally designed for flood prevention and water supply, however, soon after construction, it was determined that its water was too saline to drink. This led to the discovery of natural salt-water springs in Foard, King, and Knox Counties which have caused the water in the Big Wichita and Pease Rivers to be very difficult to treat for human consumption, consequently it has been only used for irrigation and steam electric power purposes until recently. This natural phenomenon has prompted the Red River Authority to initiate the Red River Chloride Control Project on the Big Wichita River. By building brine lakes and low-flow dams, the amount of dissolved solids and chlorides in the water has been reduced. As a result, water from Lake Kemp may be utilized for other uses. In fact, in September, 2008 the City of Wichita Falls completed a 10 MGD reverse osmosis (R.O.) plant to treat Lake Kemp water and supplement their current water supply.

There are 10 significant lakes and 4 major streams that are used for water supply in the region. Figure 2 - "Surface Water Map" shows the location of the major surface water sources in Region B. Charts 1 through 12 depict the average monthly and average annual stream flows in cubic feet per second (CFS) at various USGS gauging stations which are shown on Figure 2. (NOTE: The site number shown for each chart represents the USGS gauging station shown on Figure 2.) Table 1-7 shows the Year 2010 firm yield for each significant lake in Region B.

Table 1-7:
Year 2010 Firm Yields for Lakes in Region B

Water Source	Basin	Lake Firm Yield (ac-ft)	Conservation Capacity (ac-ft)
Lake Kemp/Diversion	Red River	61,900	245,434
Lake Kickapoo/Arrowhead	Red River	38,200	321,822
Amon Carter Lake	Trinity	2107	27826
Lake Electra	Red River	462	5,606
Lake Nocona	Red River	1,260	21,749
Olney Lake	Red River	780	6,165
Santa Rosa Lake	Red River	3,075	8,245
North Fork Buffalo Cr.	Red River	840	14,378

In addition to the lakes listed in the previous table, some municipalities and water supply corporations obtain their raw water from wells.



Regional Water Planning Area B
Surface Water Map

Figure 2

Chart-1:

Streamflow Data – Site 1

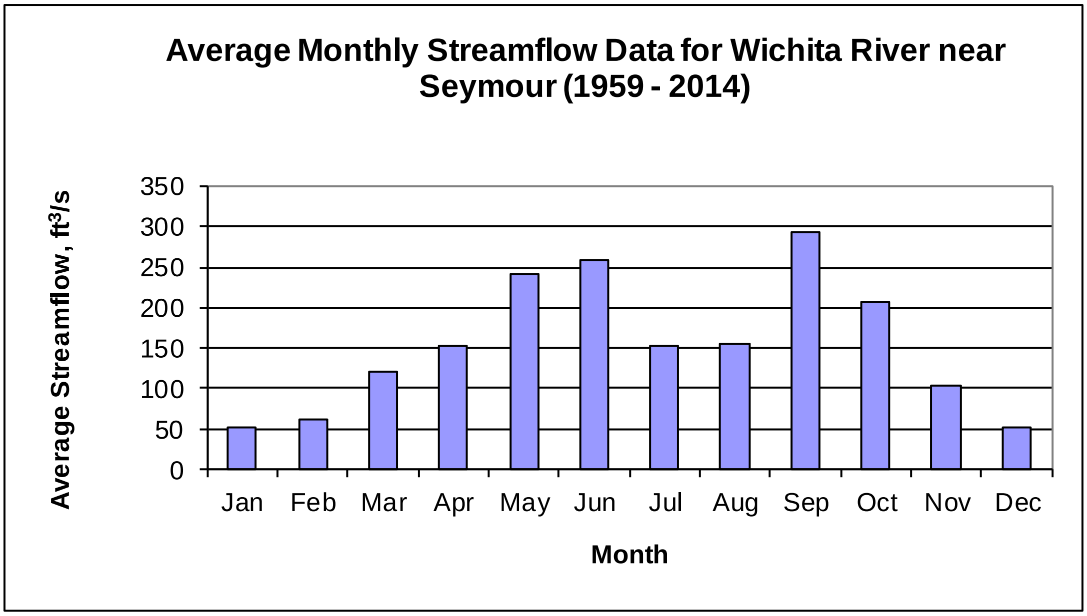
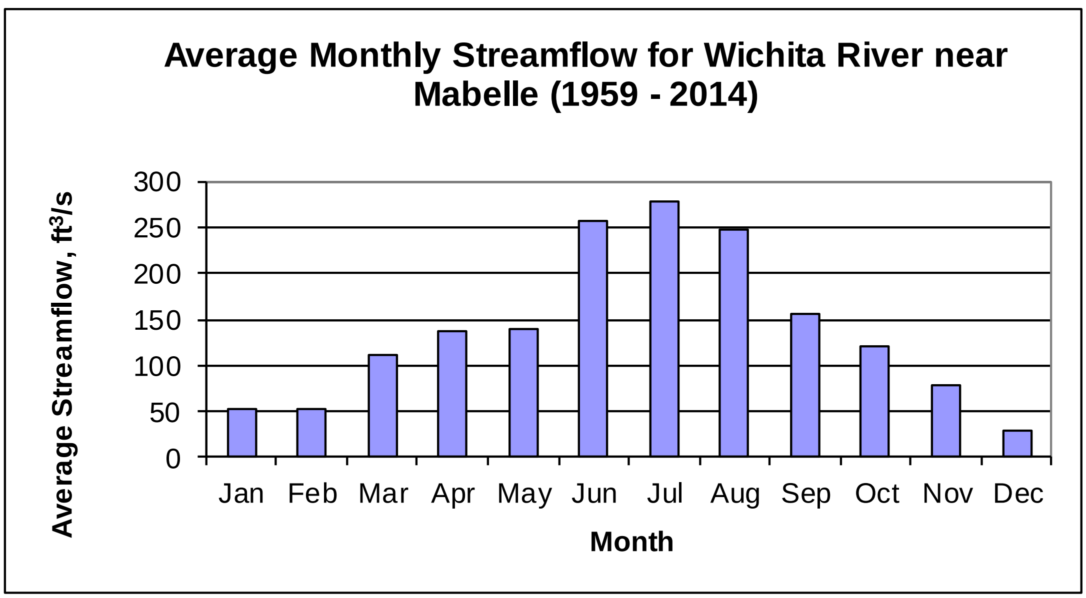


Chart-2:

Streamflow Data – Site 2



Note: Streamflows at this site are influenced by releases from Lake Kemp for irrigation and industrial diversions.

Chart-3:
Streamflow Data – Site 3

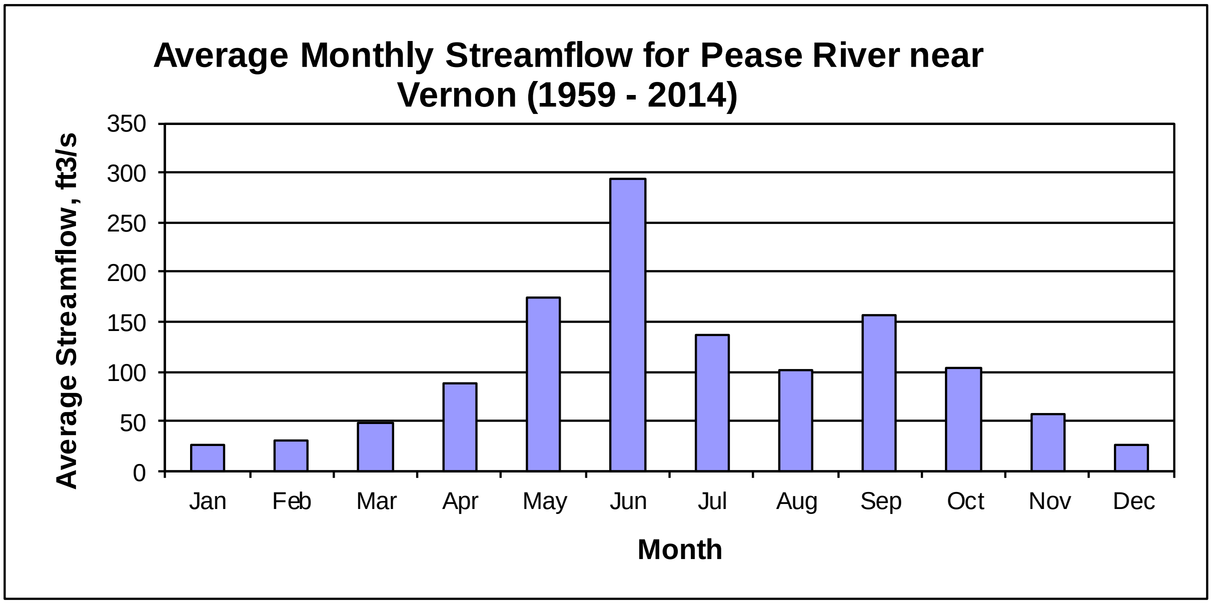


Chart-4:
Streamflow Data – Site 4

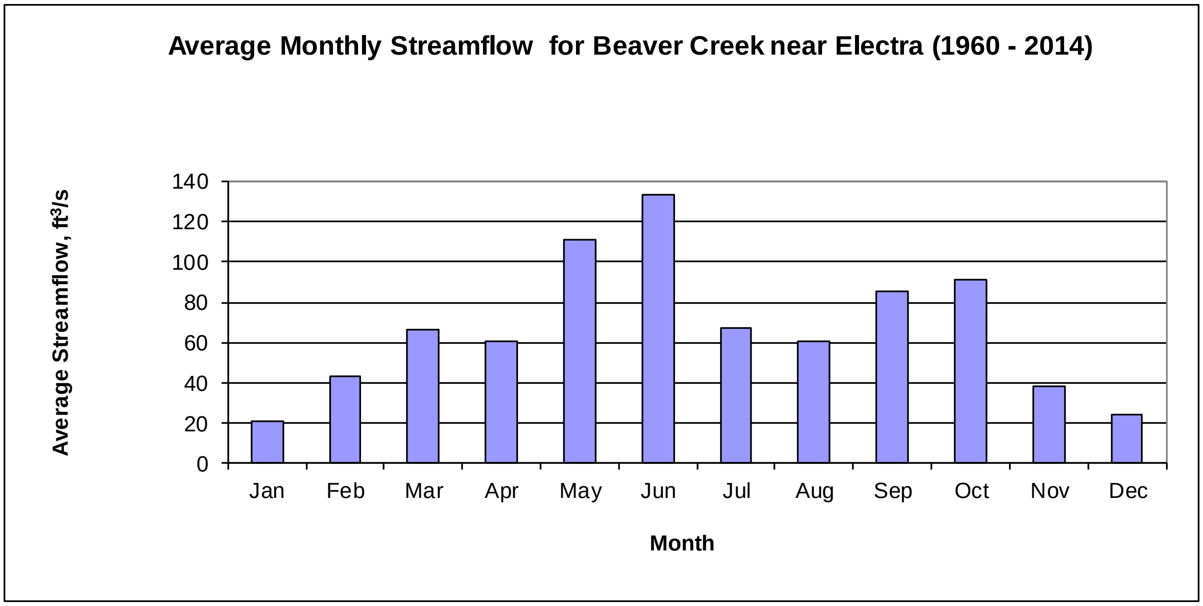


Chart-5:
Streamflow Data – Site 5

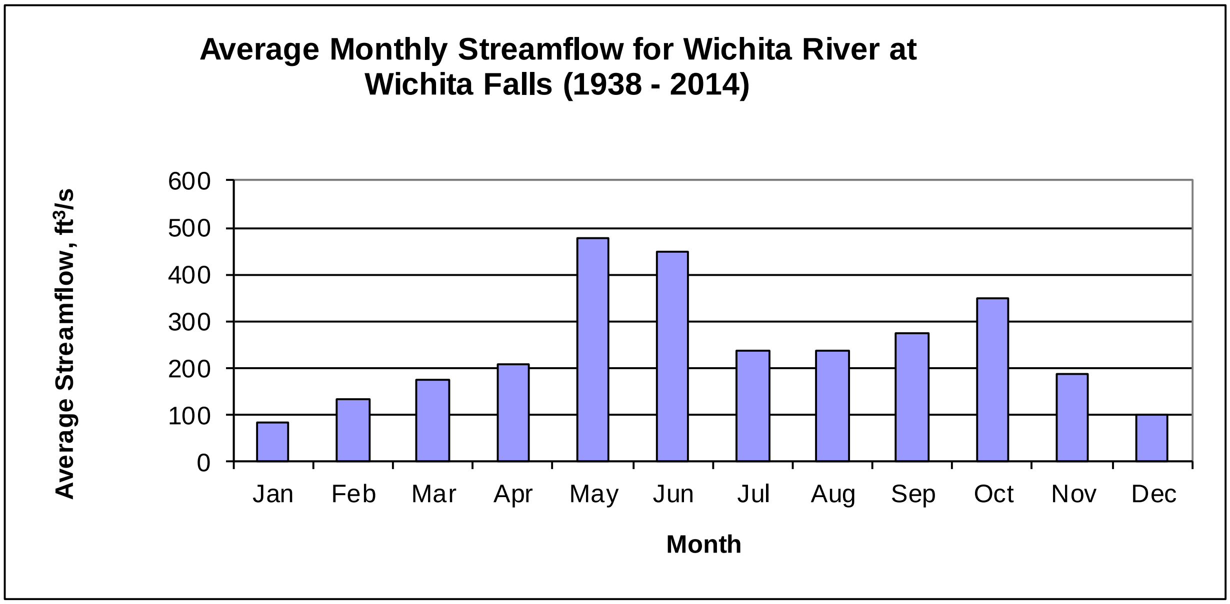


Chart-6:
Streamflow Data – Site 6

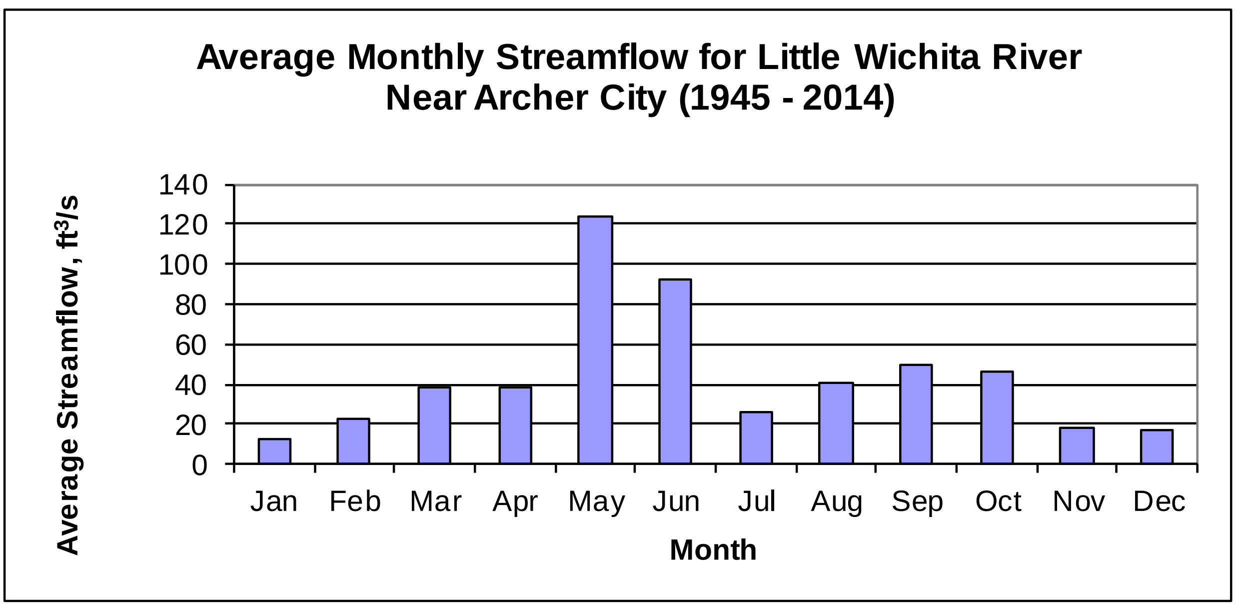


Chart-7:
Streamflow Data – Site 1

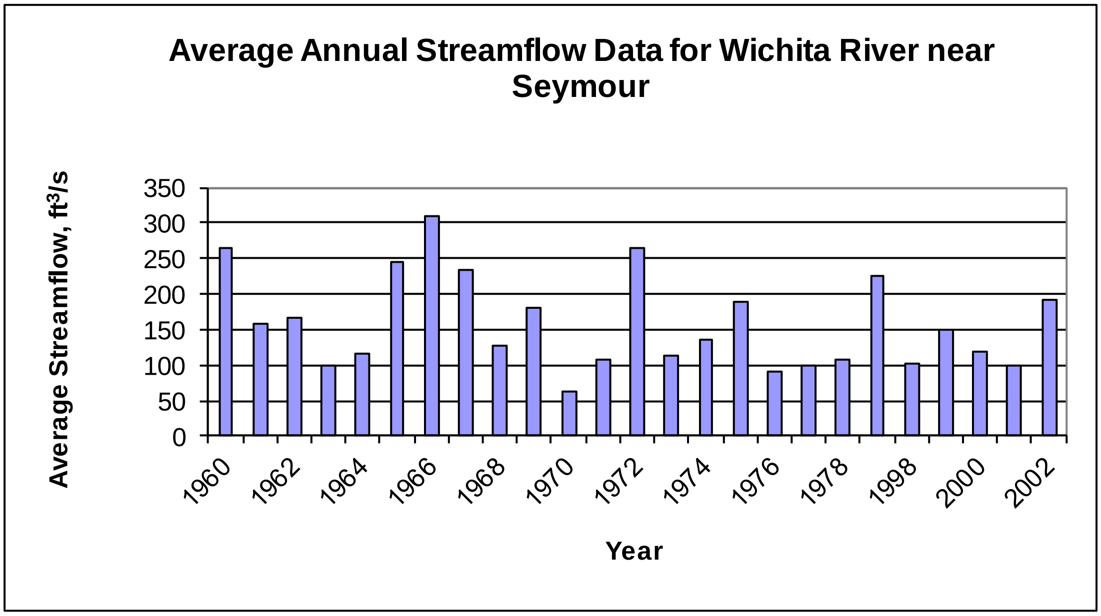


Chart-8:
Streamflow Data – Site 2

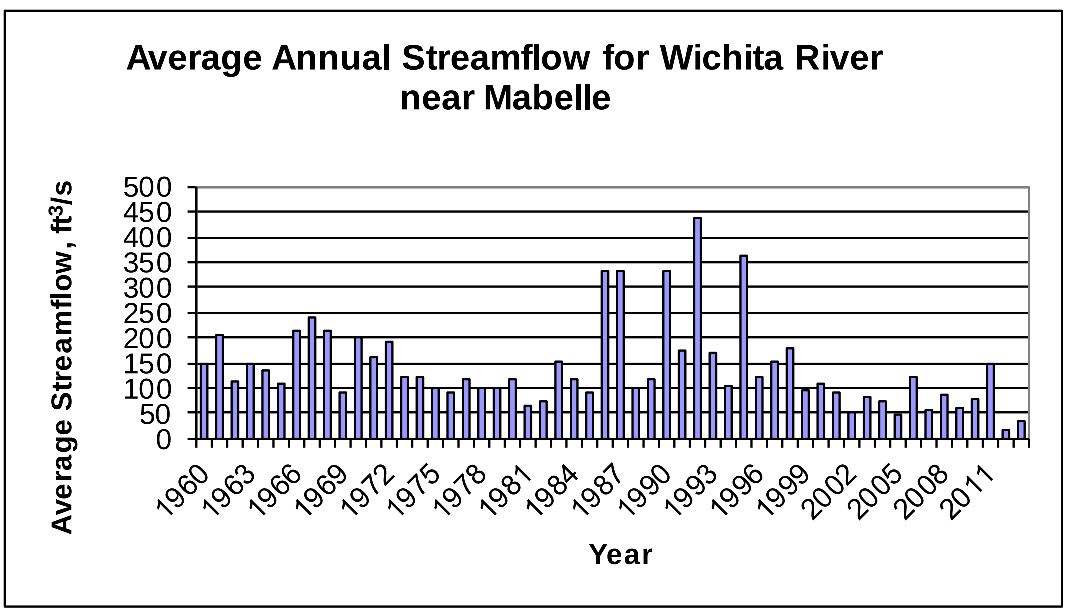


Chart-9:
Streamflow Data – Site 3

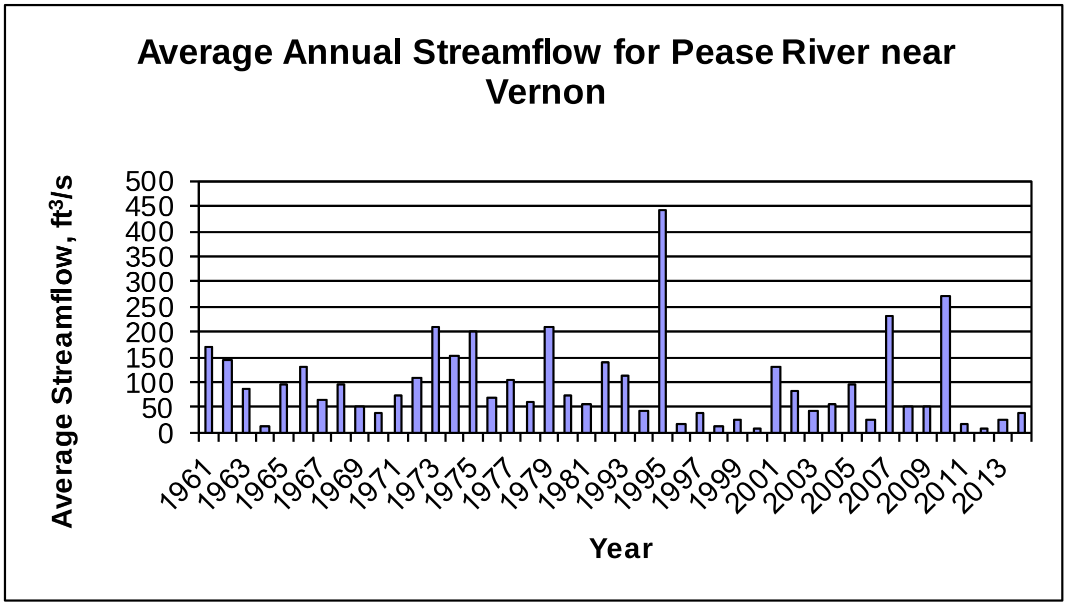


Chart-10:
Streamflow Data – Site 4

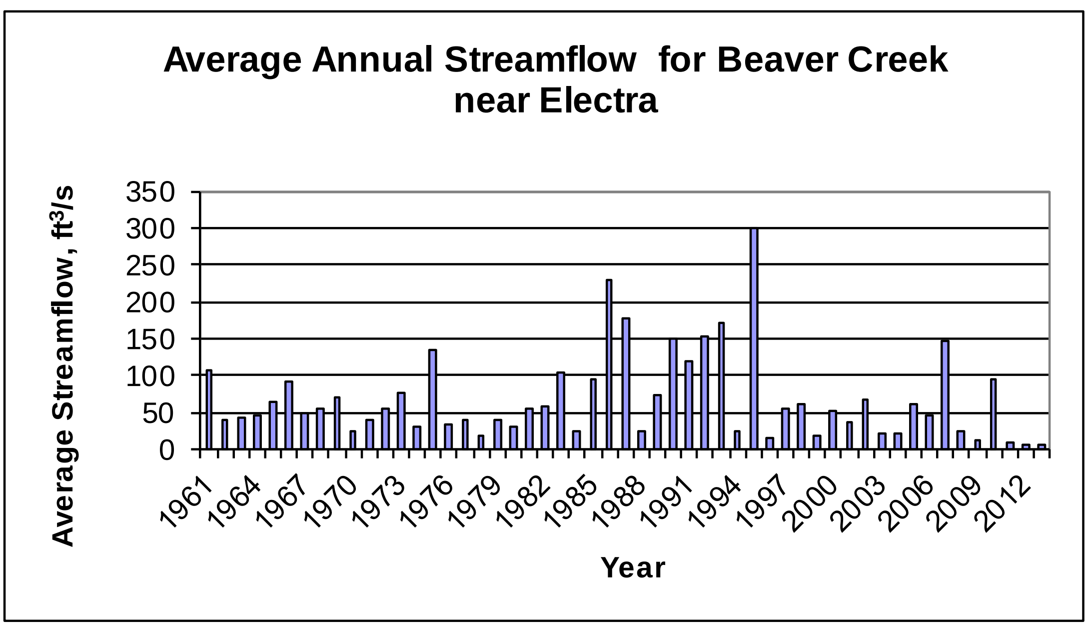


Chart-11:
Streamflow Data – Site 5

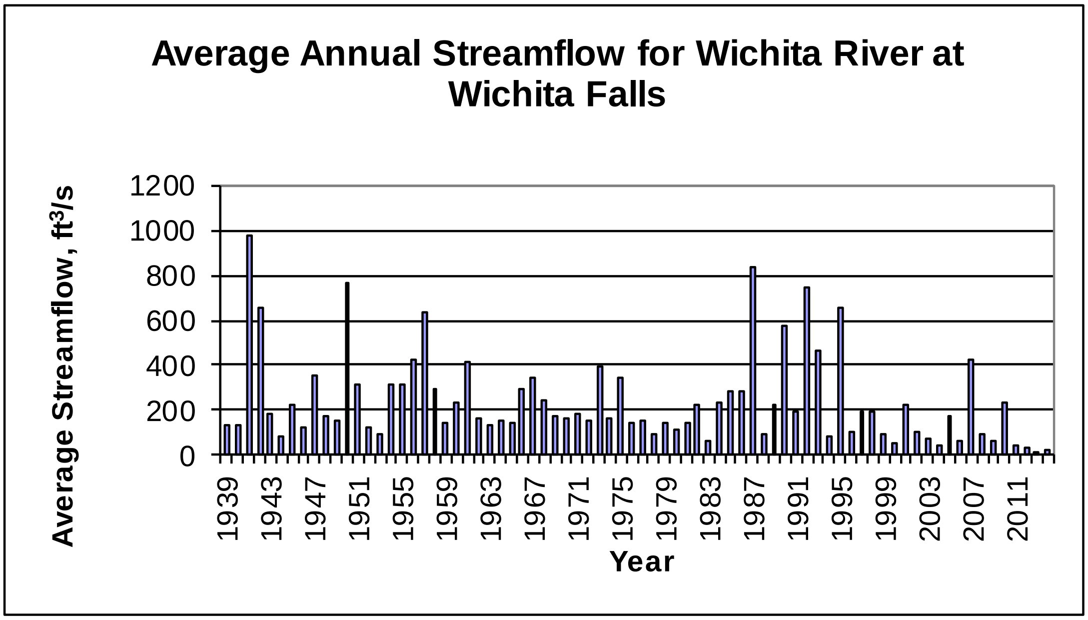
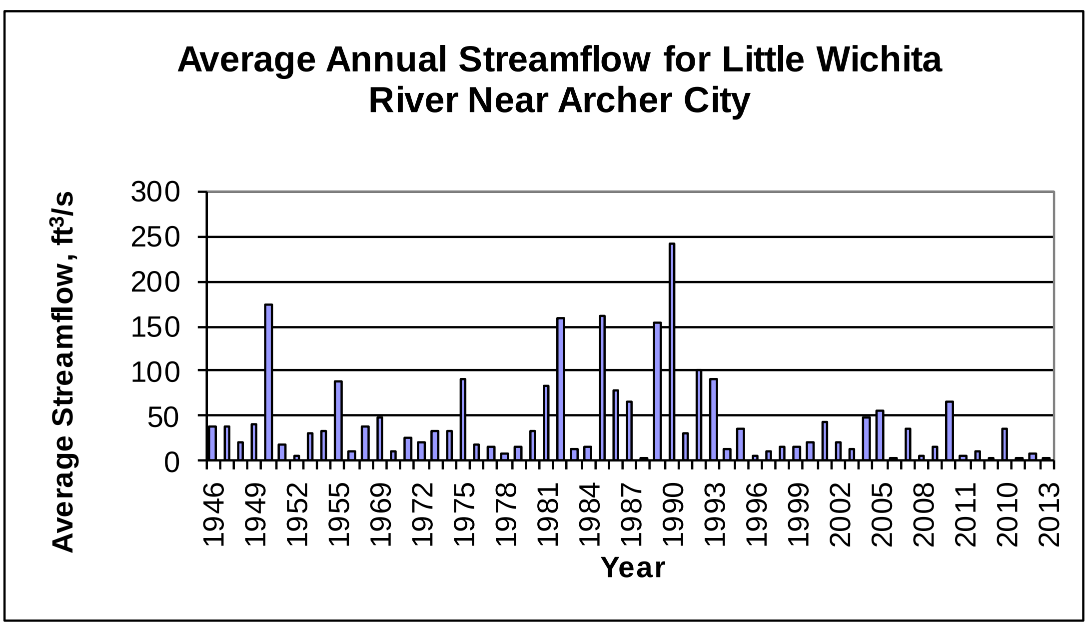


Chart-12:
Streamflow Data – Site 6



There are two major aquifers (Seymour and Trinity) and one minor aquifer (Blaine) in Region B. The Seymour Aquifer, found in the western portions of the region, is utilized for irrigation purposes in addition to being pumped for municipal use by the cities of Vernon, Burkburnett, and Seymour as well as rural water supply corporations and rural communities.

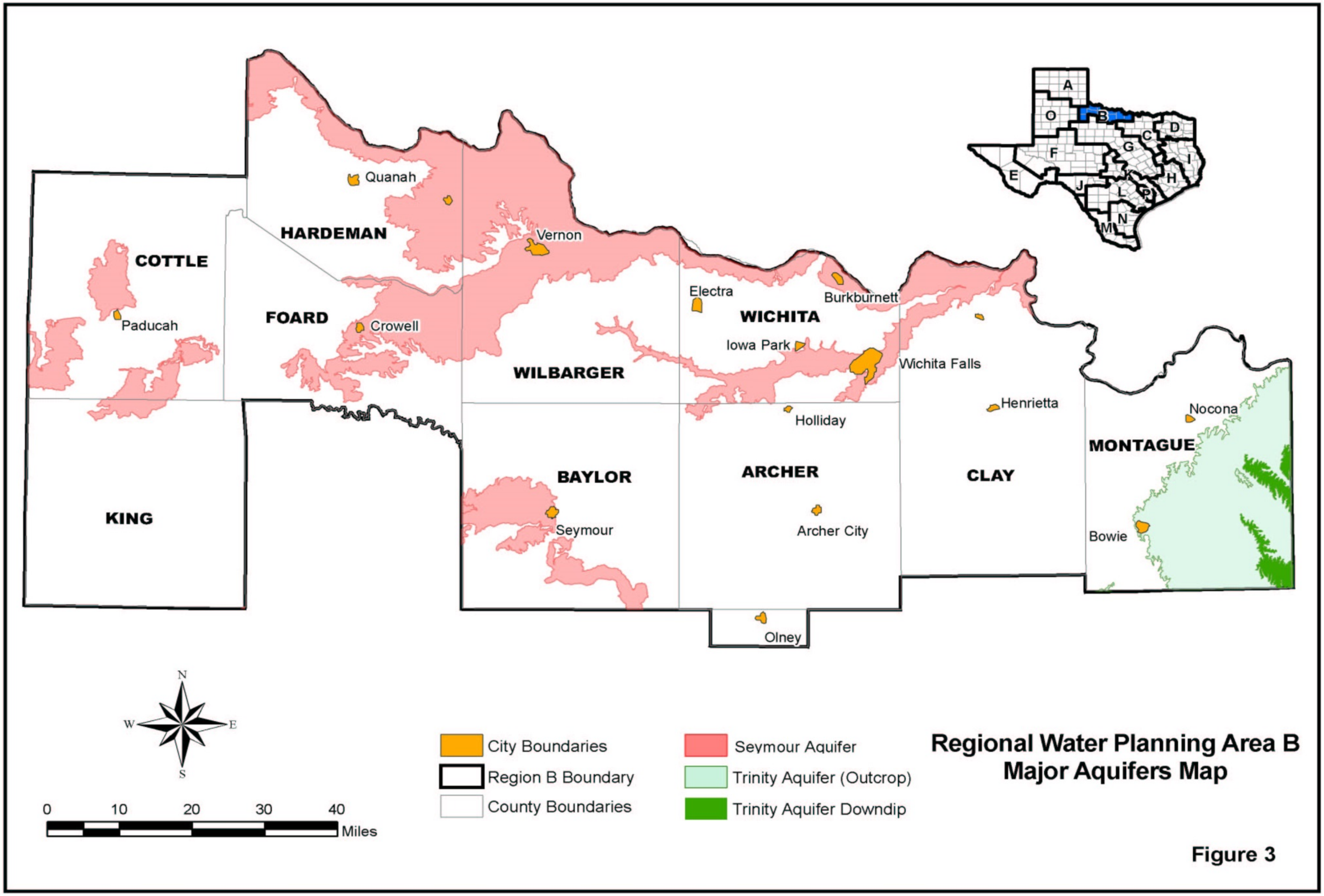
Extreme northern reaches of one of the state's most expansive aquifers, the Trinity Aquifer, lies in southeastern Montague County, the easternmost county in Region B. Water from this area of the aquifer is used for irrigation and domestic water supply purposes. Figure 3 shows the location of the major aquifers within Region B.

Figure 4 shows the location of the only minor aquifer in Region B, known as the Blaine Aquifer. The Blaine Aquifer is found only in Cottle, Foard, Hardeman, Knox, and King Counties of Region B, and the large majority of the water pumped from this aquifer is used for agricultural purposes. The water pumped from this aquifer is high in dissolved solids from natural halite dissolution. In addition to the natural contamination, significant pollutants are also present in the aquifer as a result of human activities such as oil and gas production and agriculture.

At one time, nearly 150 natural springs and seeps across the area were known to exist within Region B. While some continue to produce water today, many of these springs have dried up over time due to over-pumping of the groundwater for municipal, agriculture, industrial, and mining use. A few small producing springs feed natural ponds and creeks that are habitat for many plants and animals. It should be recognized that any future development of underground sources of water, as well as the overuse of existing surface water supplies, may cause a decline in the viability of existing springs.

Agriculture irrigation is the main component of regional water use, accounting for approximately 61 percent of all water used. Irrigation water is currently provided from Lakes Kemp and Diversion through a distribution system of canals and pipe by the Wichita County Water Improvement District, the major irrigation provider in the region. A significant amount of irrigation is also provided from groundwater. Irrigation use in the region is expected to decline throughout the planning period from approximately 99,614 acre-feet (ac-ft) per year to 92,614 ac-ft per year as more efficient pumping and irrigation techniques are implemented across the region. Municipal use is expected to increase from approximately 32,553 ac-ft per year to 33,818 ac-ft per year due mainly to the increase in population. In addition, manufacturing water use is expected to increase from 4,158 to 5016 ac-ft per year, however, mining water use is expected to decrease from 5,203 to 1,701 ac-ft per year. Finally, both steam electric power water use at 10,360 ac-ft per year and livestock water use at 10,761 ac-ft per year are expected to remain constant throughout the planning period.

The overall water use in the region is projected to decrease from approximately 162,649 ac-ft per year to 154,270 ac-ft per year throughout the planning period and Figure 5 shows the actual water use by category for Region B in the years 2000, 2010 and 2070. The 2070 projections are taken from Chapter 2 of this report.


COTTLE
HARDEMAN
FOARD
WILBARGER
WICHITA
CLAY
MONTAGUE
KING
BAYLOR
ARCHER
Quanah
Vernon
Paducah
Crowell
Electra
Burkburnett
Iowa Park
Wichita Falls
Henrietta
Nocona
Holliday
Seymour
Archer City
Bowie
Olney
A
B
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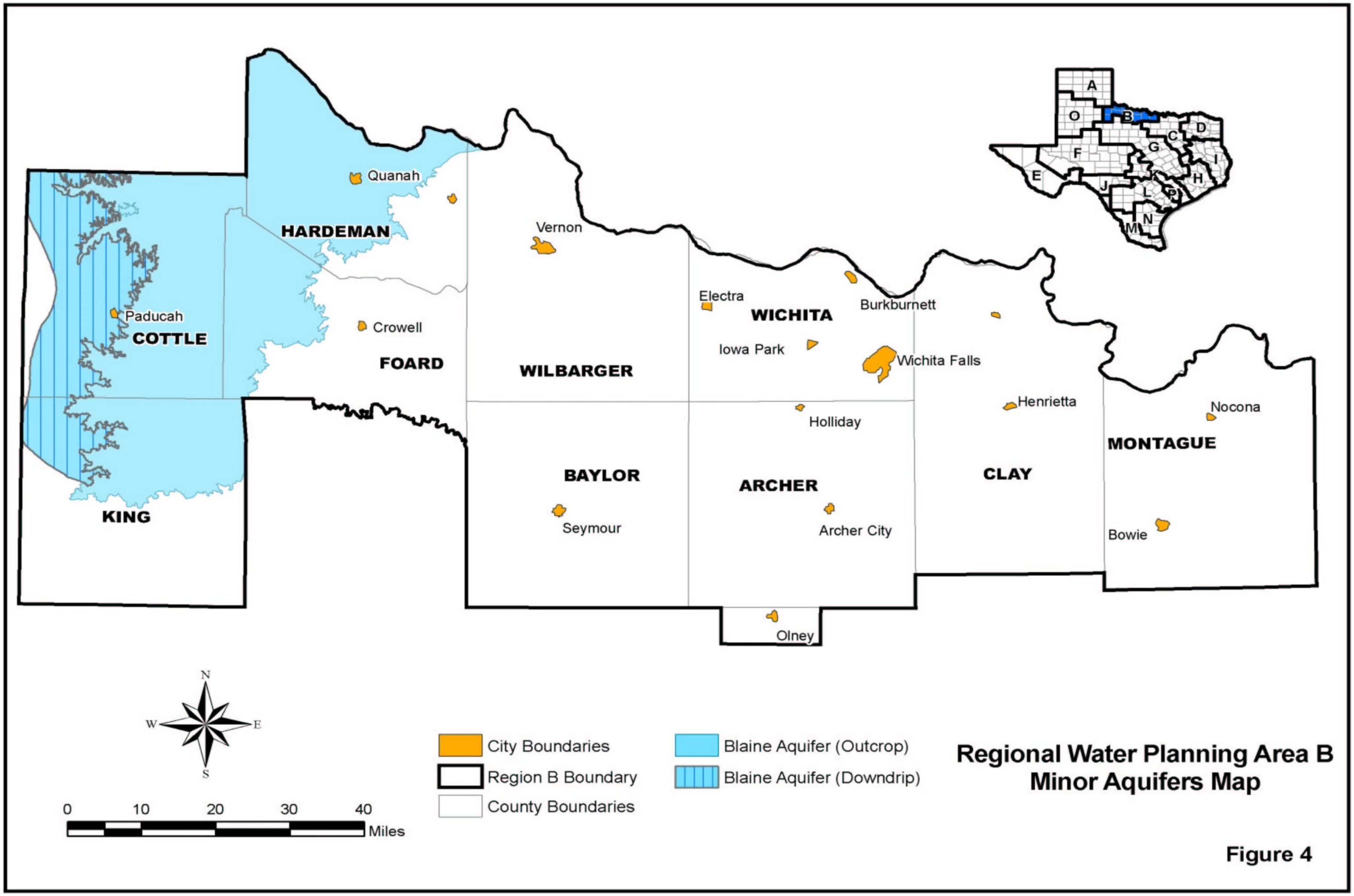
S
0
10
20
30
40
Miles
City Boundaries
Region B Boundary
County Boundaries
Seymour Aquifer
Trinity Aquifer (Outcrop)
Trinity Aquifer Downdip
Regional Water Planning Area B
Major Aquifers Map
Figure 3



Quanah
HARDEMAN
Vernon
Paducah
COTTLE
Crowell
FOARD
WILBARGER
Electra
WICHITA
Burkburnett
Iowa Park
Wichita Falls
Henrietta
Nocona
Holliday
MONTAGUE
CLAY
BAYLOR
ARCHER
KING
Seymour
Archer City
Bowie
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10
20
30
40
Miles
City Boundaries
Region B Boundary
County Boundaries
Blaine Aquifer (Outcrop)
Blaine Aquifer (Downdrip)
Regional Water Planning Area B
Minor Aquifers Map
Figure 4

Figure 5

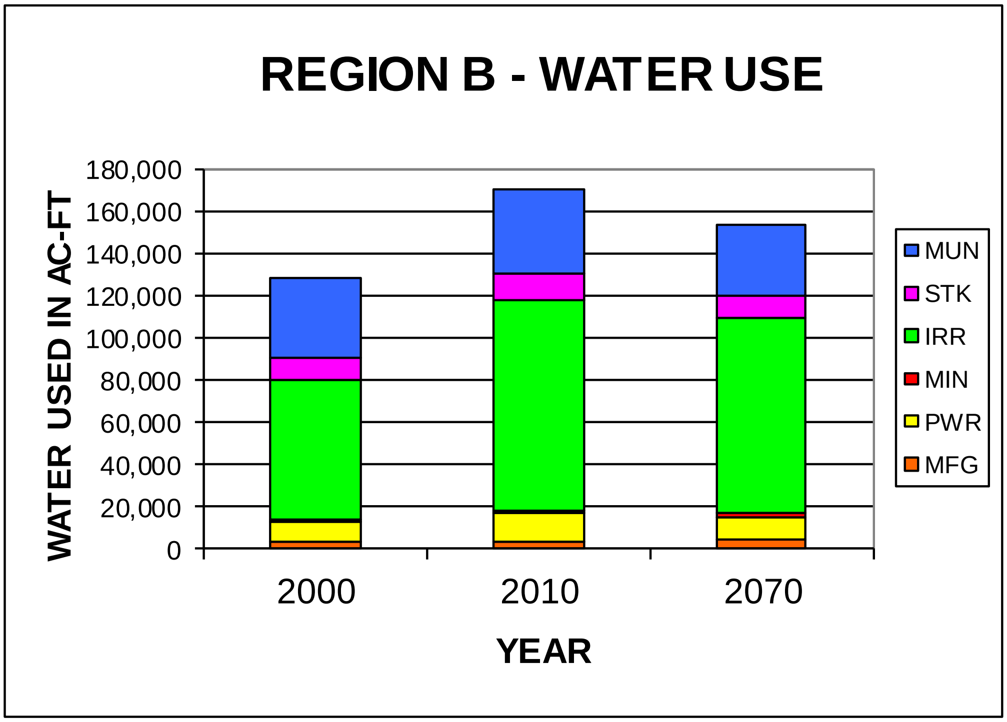

Table 1-8 shows the water rights holders of Region B and their permitted and actual usage.

Table 1-8:
Surface Water Rights Holders and Their Usage

Rights Holder	Water Supply	Permitted Use (ac-ft)	Reported Use			
			2009	2010	2011	2012
A.L. Rhodes	Little Wichita River	3,600	3,075	561	1,555	0
City of Bowie	Amon G. Carter	5,000	985	1,120	1,084	1,043
N. Montague Co. MWA	Lake Nocona	1,260	0	0	0	0
Red River Authority	South Wichita River	8,780	408	430	595	524
Lonnie D. Allsup	Trib. Of Wichita River	2,150	0	0	0	0
City of Wichita Falls	Lake Wichita	7,961	0	0	0	0
Wichita County WID #2	Ls. Kemp & Diversion	193,000	33	4,625	83,342	0
W.T. Waggoner Estate	Ls. Santa Rosa & Wharton	3,070	154	217	655	250
City of Electra	Lake Electra	1,400	0	0	0	0
City of Wichita Falls	Lake Kickapoo	40,000	2,170	9,061	4,530	2,865
City of Olney	Ls. Olney & Cooper	1,260	428	424	579	367
City of Wichita Falls	Lake Arrowhead	45,000	20,732	9,783	19,778	18,613
City of Wichita Falls	Little Wichita River	2,352	0	0	0	0
City of Henrietta	Little Wichita River	1,560	633	472	538	491

A more detailed analysis of water use and water use projections is presented in Chapters 2 and 3 of this report.

1.5 Climate Data

The best way to describe the weather of Region B is volatile. It has the ability to change from one extreme to another in a short period of time. Annual precipitation can also vary greatly from year to year. The average annual rainfall for the region is 27.4 inches; however, the extremes range from 47 inches in 1919 to 12 inches in 1896. Table 1-9 shows monthly averages and records for the Wichita Falls area and Table 1-10 lists temperatures and rainfall for each county in the region.

Table 1-9:
Monthly Averages and Records for Wichita Falls

Monthly Avg's	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High Temp.	54	58	67	76	84	91	97	97	88	77	65	55
Low Temp.	30	34	41	49	60	68	72	71	63	52	40	31
Precipitation	1.14	1.75	2.20	2,61	3.92	4.15	1.59	2.50	2.81	3.11	1.65	1.62
Monthly Rec's	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
High Temp.	87	93	100	103	110	117	114	113	111	102	89	86
Low Temp.	-12	-8	6	24	35	50	54	53	38	21	14	-8
Snowfall	9.8	9.0	9.7	1.0	0.0	0.0	0.0	0.0	0.0	1.0	6.3	7.8
Rainfall	2.25	2.97	3.60	5.20	5.12	5.36	3.10	4.52	6.19	4.34	3.15	3.12

Table 1-10:
Temperature Extremes and Average Rainfall

	Temperature (F°)		Annual
	Jan. Mean Min.	July Mean Max.	Rainfall (in)
Archer	29	98	29.3
Baylor	26	97	27.3
Clay	26	97	31.9
Cottle	25	96	22.3
Young	26	96	30.6
Foard	24	97	23.9
Hardeman	23	97	24.5
King	24	98	23.8
Montague	31	96	32.9
Wichita	29	97	28.8
Wilbarger	25	97	25.7

The region is obviously drier in the western areas and has more rainfall in eastern and southern counties.

Since 1930, the entire state has experienced 8 major droughts. Three of these droughts have occurred in the past 8 years, in 2002, 2006 and 2011. It has been predicted that many Texas farmers may quit the business in the near term due to recent droughts. This fact is particularly significant for Region B since agriculture is a major contributor to the economy of the region.

1.6 Economic Aspects of Region B

The 3 main components of the region's economy are farming, ranching, and mineral production. The Texas Railroad Commission reports that Region B has approximately 16,867 regular producing oil wells and 750 regular producing gas wells. Table 1-11 provides a tabulation by county of the current oil and gas wells, as of February, 2014.

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Table 1-11:
Number of Oil and Gas Wells

County	Oil Wells	Gas Wells
Archer	3,188	5
Baylor	167	0
Clay	1,087	22
Cottle	38	78
Foard	63	133
Hardeman	216	0
King	471	34
Montague	2,574	228
Wichita	5,674	0
Wilbarger	991	1
Young	2,398	249
Total	16,867	750

The service infrastructure is also strong. Some of the services offered throughout Region B include agribusiness, oilfield service, grain, fiber, and food processing. Wichita County, the most populous county in the region, is the retail trade center for a large area. Sheppard Air Force Base and medical services also are big contributors to the economy of Wichita County. The region boasts a variety of manufacturing. Some areas of manufacturing include oilfield equipment, clothing, building products, plastics, electronics, wood products, and aircraft equipment.

1.7 Land Use

Region B includes some of the largest ranches in the state, including the Waggoner Ranch in Wilbarger County and the Four Sixes Ranch in King County. It has over 1 million acres of croplands and over 3 million acres of open range. Table 1-12 shows land use percentages for each county in the region (data for Montague County was unavailable). Percentages under the heading of "Conservation" represent lands that had previously been croplands, but have been converted to the Conservation Reserve Program. The Conservation Reserve Program, or CRP, subsidizes farmers and landowners to convert highly erodible farmland to permanent grassland for a period of ten years.

Table 1-12:
Percentage of Land Use by County

County	Crops	Federal	Conservation	Pasture	Range	Urban	Water	Transportation
Archer	16.2%	<0.1%	1.0%	1.6%	77.0%	0.9%	2.2%	1.1%
Baylor	29.0%	-	1.6%	1.7%	61.2%	0.7%	4.9%	0.8%
Clay	19.3%	-	0.6%	6.1%	67.9%	1.6%	3.1%	1.5%
Cottle	14.7%	-	12.7%	0.9%	65.3%	0.3%	2.1%	0.6%
Foard	21.2%	-	14.9%	-	62.4%	-	0.6%	0.9%
Hardeman	37.5%	-	15.4%	0.4%	42.2%	1.2%	1.7%	1.6%
King	9.7%	-	2.3%	0.4%	86.4%	0.0%	0.5%	0.6%
Montague	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wichita	40.5%	1.1%	1.5%	3.8%	38.7%	9.9%	1.5%	3.0%
Wilbarger	37.2%	-	7.3%	6.7%	46.6%	<0.1%	0.9%	1.3%
Young	30.6%	-	0.8%	2.7%	61.0%	1.6%	2.1%	1.3%

Typical crops in Region B include cotton, coastal bermuda, wheat, alfalfa, peanuts, grain sorghum, watermelons, pecans, peaches, and other various fruits. Cattle for beef and dairy production is the major component of the livestock industry, with sheep, swine, and equine also present.

1.8 Navigable Waterways

Navigable waters of the United States are those waters that are subject to the ebb and flow of the tide and/or presently being used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Based on information from the U.S. Army Corps of Engineers, there are no navigable waters within Region B.

1.9 Ecology and Wildlife

Most of Region B lies in the area known as the "Rolling Plains" with the exception of Montague County, which lies in the "Oakwoods and Prairies" area. The Texas Parks and Wildlife Department describes the "Rolling Plains" region as a "gently rolling plain of mesquite and short grass savanna." The open range is generally characterized by its mesquite brush, prairie grasses, and sandstone outcroppings and cottonwood, hackberry, and saltcedar brush can be found near most rivers and streams. This vegetation is important to the survival of both resident and migratory birds. It is evident by the widespread mesquite, however, that over-grazing, soil erosion, and the lowering of the groundwater table have all contributed to the decline of the native grasslands. The topography of the region gently slopes to the east and southeast. The Red River and its major tributaries drain most of the region; however, extreme southern reaches of the region are drained by tributaries of the Brazos and Trinity Rivers.

The Texas Parks and Wildlife Department uses freshwater mussels as water quality indicators because they are usually the first organisms to show their sensitivity to changes in aquatic quality. Recent surveys have determined that 52 separate species of mussels have declined[1]. Another organism used to indicate water quality is the minnow. Since 1950, minnows native to the Big Wichita River System have also shown serious declines. These native minnows include the plains minnow, the silver chub, and several varieties of shiner. The plains minnow is commonly used in support of a significant commercial baitfish industry. The decline of these organisms indicates poor water conservation and management. Runoff and scouring flows have increased with broad increases in over-grazing, highway development, and general land clearing. Scouring flows can cause excessive sedimentation, thus eliminating the natural habitats of these organisms.

The “Rolling Plains” region of Texas is not usually thought of as an area rich in wetland habitats. However, the region is actually very important to both migrating and wintering waterfowl. In fact many species of migrating shorebirds, raptors, and other birds stop over in the region to feed and rest on the available wetlands.

There are over 40 species of water-dependent reptiles, amphibians, and mammals that live in the study area. Some of these include minks, muskrats, beavers, snakes, turtles, salamanders, and frogs. Fish species present in the study area include drum, carp, buffalo, bluegill, sunfish, largemouth and white bass; white crappie; flathead, blue, and channel catfish. Some endangered species are also present across the region. Table 1-13 lists the endangered and threatened species present in the region.

Copper Breaks State Park located 12 miles south of Quanah in Hardeman County contains 1,889 acres, and a 70 acre lake. The park has abundant wildlife and is home for part of the official Texas Longhorn herd.

Table 1-13:
Region B - Endangered/Threatened Species

SPECIES	STATE STATUS	FEDERAL STATUS
Bald Eagle	Threatened	-
American Peregrine Falcon	Threatened	-
Peregrine Falcon	Threatened	-
Whooping Crane	Endangered	Endangered
Golden-Cheeked Warbler	Endangered	Endangered
White-Faced Ibis	Threatened	-
Interior least tern	Endangered	Endangered
Black-capped Vireo	Endangered	Endangered
Texas Fawnsfoot	Threatened	-
Texas Kangaroo Rat	Threatened	-
Black-footed Ferret	-	Endangered
Brazos Water Snake	Threatened	-
Texas Horned Lizard	Threatened	-
Piping Plover	-	Threatened
Gray Wolf	Endangered	Endangered
Red Wolf	Endangered	Endangered
Timber Rattlesnake	Threatened	-
Lesser Prairie Chicken	-	Threatened
Small Eye Shiner	-	Endangered
Sharpnose Shiner	-	Endangered

1.10 Summary of Existing Local or Regional Water Plans

In April, 2009 a Water Conservation Implementation Plan was prepared for Wichita County Water Improvement District No. 2. This plan will be used to meet the irrigation needs in the region by replacing/enclosing selected portions of the canal laterals that have the largest quantities of water loss.

In addition, information was gathered from water providers of Region B to determine, among other things, if they possessed a water conservation plan or a local or regional water plan. Table 1-14 lists the results of those surveys and inquiries.

Table 1-14:
Survey Results Regarding Water Plans
(Municipal Providers)

Water Provider	Existing Drought Contingency Plan?	Existing Water Conservation Plan?	Existing Local or Regional Water Plan?	Special Concerns of the Provider
Archer County MUD	Y	Y	N	Supply
Arrowhead Lake Water System	Y	Y	N	
Arrowhead Ranch Estates Water System	Y	Y	N	
Baylor County WSC	Y	Y	N	Nitrates
Box Community Water System	Y	Y	N	
City of Archer City	Y	Y	N	
City of Bowie	Y	Y	N	
City of Burkburnett	Y	Y	N	Nitrates
City of Byers	N	N	N	Nitrates
City of Charlie	N	N	N	Nitrates
City of Crowell	Y	N	N	Nitrates
City of Dumont	N	N	N	
City of Electra	Y	Y	N	Nitrates
City of Henrietta	Y	Y	Y	
City of Holliday	Y	Y	N	
City of Iowa Park	Y	Y	N	
City of Lakeside City	Y	Y	N	Storage
City of Megargel	Y	N	N	
City of Nocona	Y	Y	N	
Nocona Hills WSC	Y	Y	Y	Nitrates
City of Olney	Y	Y	N	Storage
City of Paducah	N	N	N	
City of Petrolia	N	N	N	
City of Pleasant Valley	N	N	N	
City of Quanah	N	N	N	
City of Saint Jo	Y	Y	N	
City of Scotland	Y	N	N	
City of Seymour	Y	N	N	Nitrates
Sunset Water System	N	N	N	Storage
City of Vernon	Y	Y	Y	Nitrates
City of Wichita Falls	Y	Y	Y	
Dean Dale WSC	Y	Y	N	
Farmers Valley Water System	Y	Y	N	
Foard County Water System	Y	Y	N	
Forestburg WSC	N	N	N	
Goodlett Water System	Y	Y	N	
Hinds Water System	Y	Y	N	
Horseshoe Bend WSC	N	N	N	
Lockett Water System	Y	Y	N	
Medicine Mound Water System	Y	Y	N	
Northside WSC	Y	Y	Y	Nitrates
Quanah NE Water System	Y	Y	N	
Ringgold Water System	Y	Y	N	
South Quanah Water System	Y	Y	N	
Wichita Valley WSC	Y	Y	N	
Windthorst WSC	Y	Y	N	

1.11 Summary of Recommendations

It is anticipated that with the implementation of the recommended Water Management Strategies, Region B will have adequate water supplies throughout the planning period. The main recommendations of the Plan are to implement wastewater reuse projects, pursue a permit to construct Lake Ringgold, and to employ conservation measures to reduce water waste. Also, the heavy dissolved solid and chloride concentrations in the western portions of the region are preventing the full utilization of the available water resources. To reduce this, it is recommended that the Red River Chloride Control Project, sponsored by the Red River Authority of Texas, continue to be funded and operated.

1.12 Identification of Known Threats to Agriculture or Natural Resources

Excessive concentrations of total dissolved solids, sulfate, and chloride are a general problem in most streams of the Red River Basin under low flow conditions. The high salt concentrations are caused, in large part, by the presence of salt water springs, seeps, and gypsum outcrops. Salt water springs are generally located in the western portion of the (Red River) basin in the upper reaches of the Wichita River, the North and South Forks of the Pease River, and the Little Red, which is a tributary to the Prairie Dog Town Fork of the Red River. Gypsum outcrops are found in the area ranging westward from Wichita County to the High Plains Caprock Escarpment.

The excessive amounts of dissolved solids and chlorides in the water present problems to managers, planners, and others concerned with water treatment for municipal use. For this reason, the quality of the available water supply is as much an issue as the quantity for Region B. Water consumers of all kinds, whether municipal, industrial, or agricultural, desire water that is less saline; however, these conditions have existed for many years, and the plants and animals that live with them have adapted well. The Red River Authority of Texas is sponsoring a federal chloride control project to control the natural chloride level in the Red River Basin by impounding high chloride waters from the natural brine springs.

In addition, there are areas in Region B with highly erodible soils that contribute to an accumulation of sediment in the lakes and reservoirs. This sediment over time, can significantly reduce storage capacity and reliable water supplies.

There is limited recent information available with regards to groundwater levels and drawdown data within the region. However, historical use indicates that with the exception of Wilbarger County, much of the groundwater is not fully developed or not currently being used. Therefore, it is anticipated that additional groundwater can be developed to meet the projected water demands through the planning period with no known threats to Agriculture or Natural Resources.

1.13 Water Providers in Region B

Water is provided in Region B by a number of entities. The cities provide most of the municipal and manufacturing water in the region with the City of Wichita Falls providing the majority of the water. Other major providers include the Red River Authority of Texas and the Greenbelt Water Authority. The following Table 1-15 shows a comprehensive listing of the water providers and the municipal use for the year 2010. A more detailed discussion of water use is presented in Chapter 2 of this report. It should be noted that these use figures do not include water for irrigation, manufacturing, electrical power, livestock, or mining.

Table 1-15:

Water Providers and Users in Region B

USER	COUNTY	RIVER BASIN	2010 Water Use AF/YR
Archer City	Archer	RED	333
Holliday	Archer	RED	249
Lakeside City	Archer	RED	166
Seymour	Baylor	BRAZOS	611
Byers	Clay	RED	83
Henrietta	Clay	RED	720
Petrolia	Clay	RED	95
Paducah	Cottle	RED	316
Crowell	Foard	RED	277
Chillicothe	Hardeman	RED	117
Quanah	Hardeman	RED	543
Guthrie	King	RED	68
Bowie	Montague	TRINITY	1,027
Montague	Montague	RED	47
Nocona	Montague	RED	693
Saint Jo	Montague	TRINITY	99
Burkburnett	Wichita	RED	1,843
Electra	Wichita	RED	575
Iowa Park	Wichita	RED	1,210
Wichita Falls	Wichita	RED	23,049
Vernon	Wilbarger	RED	2,671
Olney	Young	BRAZOS	707
Other Rural			5,465
TOTAL			40,964

USER Other Rural	COUNTY	RIVER BASIN	2010 Water Use AF/YR
Baylor WSC	Archer	RED	21
Archer Co. MUD #1	Archer	RED	150
Megargel	Archer	RED	42
Scotland	Archer	RED	226
Windthorst WSC	Archer	RED	234
Wichita Valley WSC	Archer	RED	347
Archer Co. Other	Archer	RED	24
Archer Co. Other	Archer	TRINITY	20
Archer Co. Other	Archer	BRAZOS	30
Baylor WSC	Baylor	BRAZOS	187
Baylor Co. Other	Baylor	RED	17
Baylor Co. Other	Baylor	BRAZOS	73
Bellevue	Clay	RED	38
Bluegrove WSC	Clay	RED	7
Charlie WSC	Clay	RED	10
Dean Dale WSC	Clay	RED	230
Arrowhead Lake Water System	Clay	RED	90
Arrowhead Ranch Water System	Clay	RED	87
Friberg-Cooper WSC	Clay	RED	81
Clay Co. Other	Clay	RED	532
Clay Co. Other	Clay	TRINITY	69
King-Cottle WSC	Cottle	RED	74
Cottle Co. Other	Cottle	RED	5
Foard Co. WSD	Foard	RED	47
Margaret WSD	Foard	RED	17
Thalia WSC	Foard	RED	34
Foard Co. Other	Foard	RED	18

USER Other Rural	COUNTY	RIVER BASIN	2010 Water Use AF/YR
Goodlet Water System	Hardeman	RED	16
Medicine Mound Water System	Hardeman	RED	17
Quanah NE Water System	Hardeman	RED	56
S Quanah Water System	Hardeman	RED	18
Hardeman Co. Other	Hardeman	RED	65
King-Cottle WSC	King	RED	17
Dumont Water System	King	RED	35
King Co. Other	King	RED	4
King Co. Other	King	BRAZOS	3
Forestburg	Montague	RED	26
Montague Water System	Montague	RED	32
Nocona Hills WSC	Montague	RED	144
Oak Shores Water System	Montague	RED	6
Sunset Water System	Montague	RED	20
Ringgold WSC	Montague	RED	24
Montague Co. Other	Montague	RED	167
Montague Co. Other	Montague	TRINITY	735
Friberg Cooper WSC	Wichita	RED	110
Horseshoe Bend Water System	Wichita	RED	14
Pleasant Valley	Wichita	RED	100
Wichita Valley WSC	Wichita	RED	366
Dean Dale WSC	Wichita	RED	134
Box Com. Water System	Wilbarger	RED	18
Farmers Valley Water System	Wilbarger	RED	22
Harrold WSC	Wilbarger	RED	28
Hinds Com Water System	Wilbarger	RED	25
Lockett Water System	Wilbarger	RED	91
Northside WSC	Wilbarger	RED	35
Odell Water System	Wilbarger	RED	15
Oklaunion WSC	Wilbarger	RED	39
Wilbarger Co. Other	Wilbarger	RED	206
Young Co. Other	Young	BRAZOS	83
Young Co. Other	Young	TRINITY	1

1.14 Wholesale Water Providers

Each regional water planning group is required to designate its “Wholesale Water Providers” (WWP). According to the rules, a WWP is any person or entity, including river authorities and irrigation districts, which have contracts to sell more than 1,000 acre-feet of water wholesale in any one year during the five years immediately preceding the adoption of the last Regional Water Plan. The only two “Wholesale Water Providers” in Region B are the City of Wichita Falls and Wichita County Water Improvement District No. 2.

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CHAPTER 2

POPULATION AND WATER DEMAND PROJECTIONS

2016 FINAL PLAN

REGION B

DECEMBER 2015

POPULATION AND WATER DEMAND PROJECTIONS
2016 FINAL PLAN
REGION B

2.1 Region B Overview

The eleven North Central Texas counties of Region B contain only one city larger than 100,000, which is Wichita Falls. The other communities are smaller and more rural in nature with incomes that are dependent on agriculture and, to a lesser extent, the oil industry. Consequently, the population for the region is projected to have only a moderate increase for the next fifty years from 206,307 people in 2020 to 228,973 in 2070, or 11 percent. Population projections for the region through the year 2070 as adopted by the Regional Water Planning Group (RWPG) are provided in Appendix G. These projections were made by the Texas State Data Center (TSDC) and the Office of State Demographer using the most recent population information, including the 2010 census.

Per capita municipal water use is predicted to gradually decline over the planning period from 149 gallons per capita per day (gpcd) in 2020 to 141 gpcd in 2070 based on water use and population projections. Region B's municipal water use is currently in-line with the average gpcd of similar areas. According to the 2012 Texas Water Plan published by the Texas Water Development Board, municipal use for the 40 largest cities in the state was evaluated on the basis of gpcd. The water demand varied from a high of 254 gpcd to a low of 86 gpcd in 2008, with projected 2060 demand for these cities varying from 283 gpcd to 169 gpcd. Average gpcd for a city is dramatically affected by the mix of industrial and residential demands, climatic conditions, and many other factors. Therefore, significant effort is being focused statewide on separating residential per capita use from industrial use to provide for a more consistent basis of comparison between cities. In the more densely populated areas where new construction is progressing at a faster pace than some rural areas, more water conserving measures can be implemented by requiring the newer plumbing fixtures and maintaining tighter controls on overall water use. The projected water demands through the year 2070 as adopted by the RWPG with all revisions being approved by the Texas Water Development Board are provided in Appendix G.

2.2 Population Growth

The Region B projected total population growth is shown in Figure 2-1. The projections were:

- Developed by TSDC and the Office of the State Demographer for 2011 to 2050 utilizing a cohort approach for county-level population.
- Based on Recent and Projected Demographic trends, including birth rates, survival rates, and net migration rates of population groups defined by age, gender and race/ethnicity
- Developed for 2060 and 2070 projections based on the trend of average annual growth rates of the 2011 to 2050 projections.
- Developed for 2060 and 2070 for counties that showed a decline in population from 2011 to 2050, by retaining the population at the highest population attained prior to the decline.

Figure 2-1 Projected Population for Region B

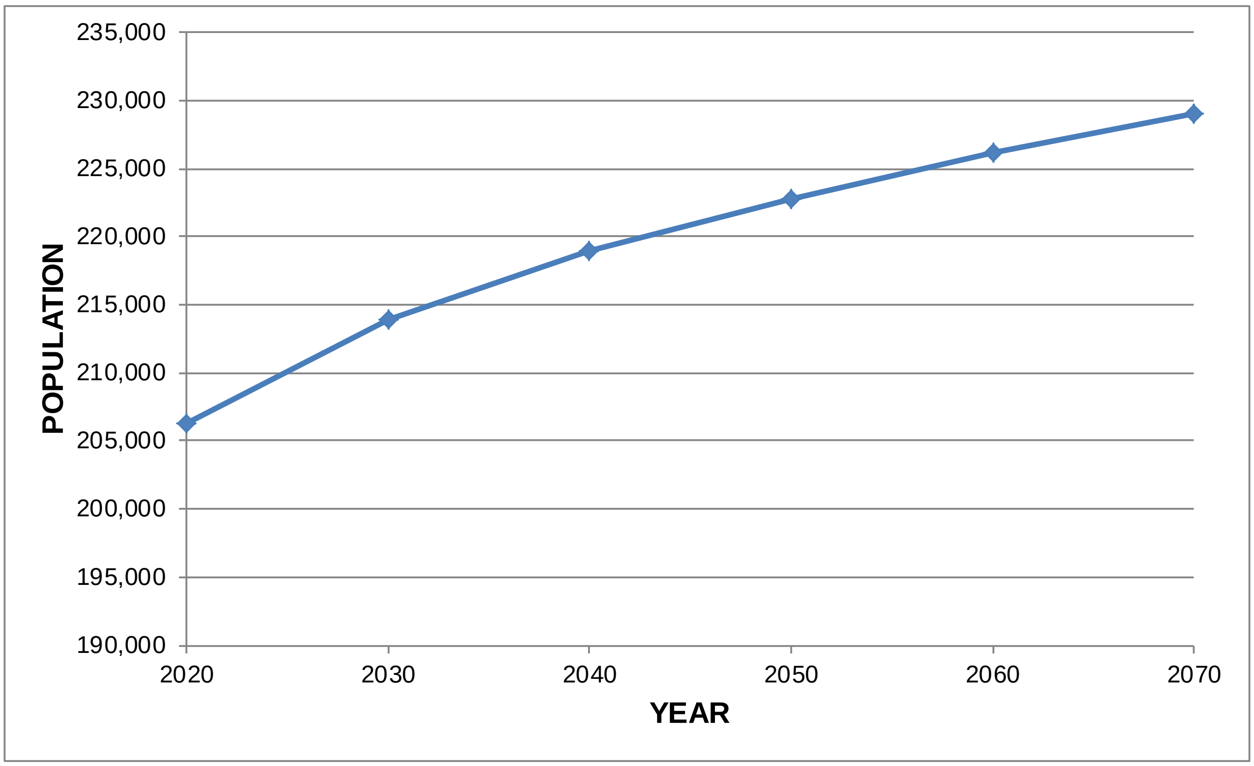


Table 2-1 Projected Population Data Points

YEAR	2020	2030	2040	2050	2060	2070
POPULATION	206,307	213,930	218,928	222,760	226,142	228,973

The city with the highest projected growth rate is Wichita Falls. It is expected to grow by approximately 12 percent in the next fifty years. While agriculture and the oil and gas industry remain cornerstones of the regional economy, Wichita Falls has emerged as a regional hub for all forms of commerce ranging from the strong presence of manufacturing to regional health care services and regional retail centers. During the last few years almost 1,700 new jobs were derived from location of the WDS Global and AT&T call centers in Wichita Falls. Other towns that may experience some growth include Bowie, Burkburnett, Electra, Iowa Park, and Vernon.

2.3 Water Uses

2.3.1 Total Region B Water Use

The water use for Region B has been divided into several categories for analysis purposes. The various uses analyzed include water for municipal use (MUN), industrial or manufacturing (MFG), power cooling (PWR), mining (MIN), agricultural irrigation (IRR), and livestock watering (STK). Figure 2-2 shows the amounts of water predicted to be required for these categories through the year 2070. The water use is shown in acre-feet per year (Ac-Ft/Yr.) units with one acre-foot being equivalent to 325,851 gallons of water.

Figure 2-2 Projected Water Use for Region B

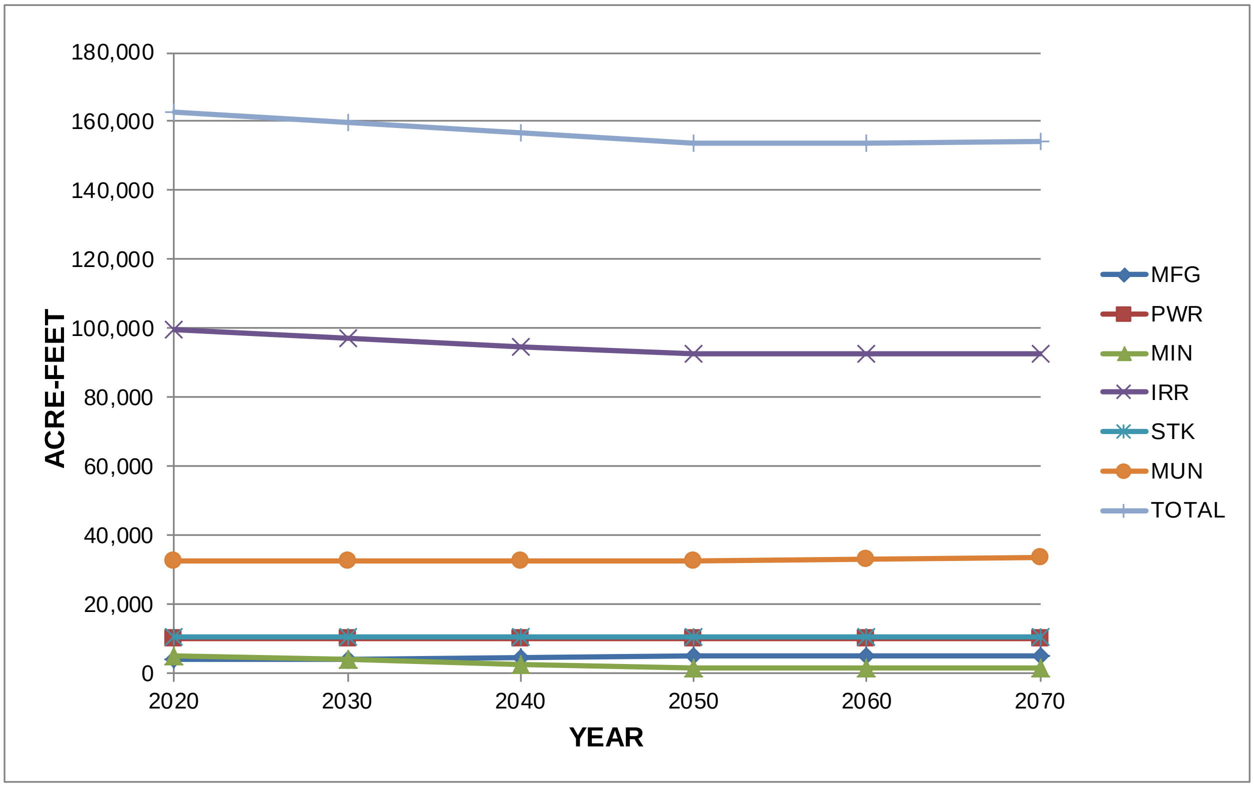


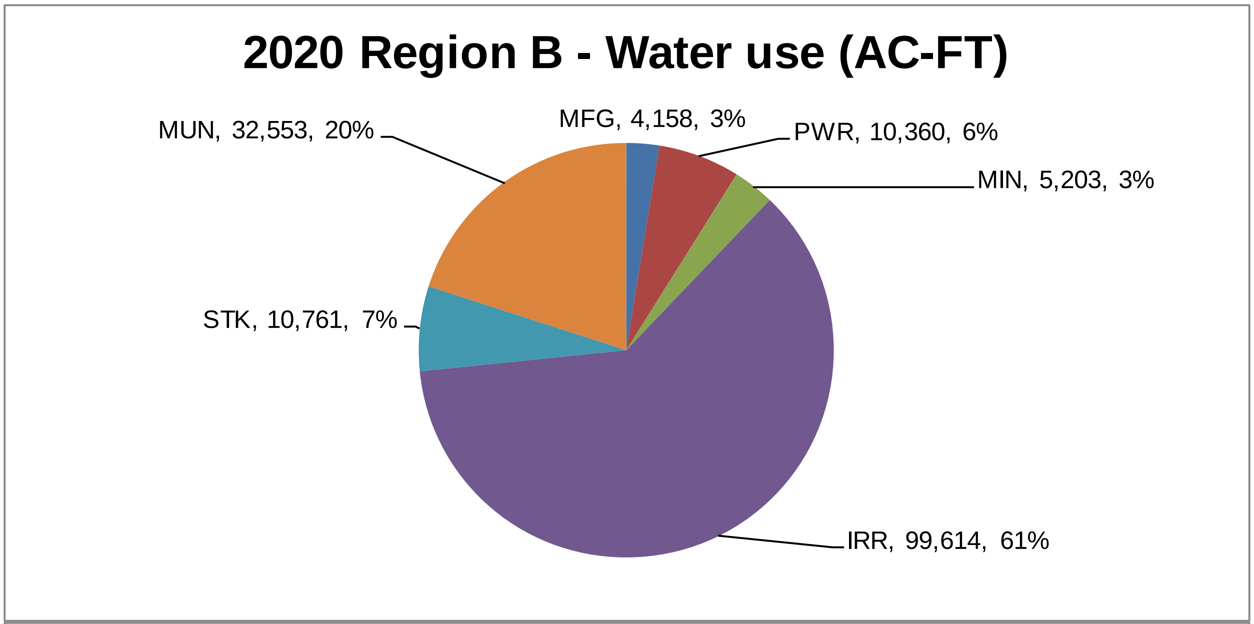
Table 2-2 Projected Water Use Data Points (Acre-Feet/Yr.)

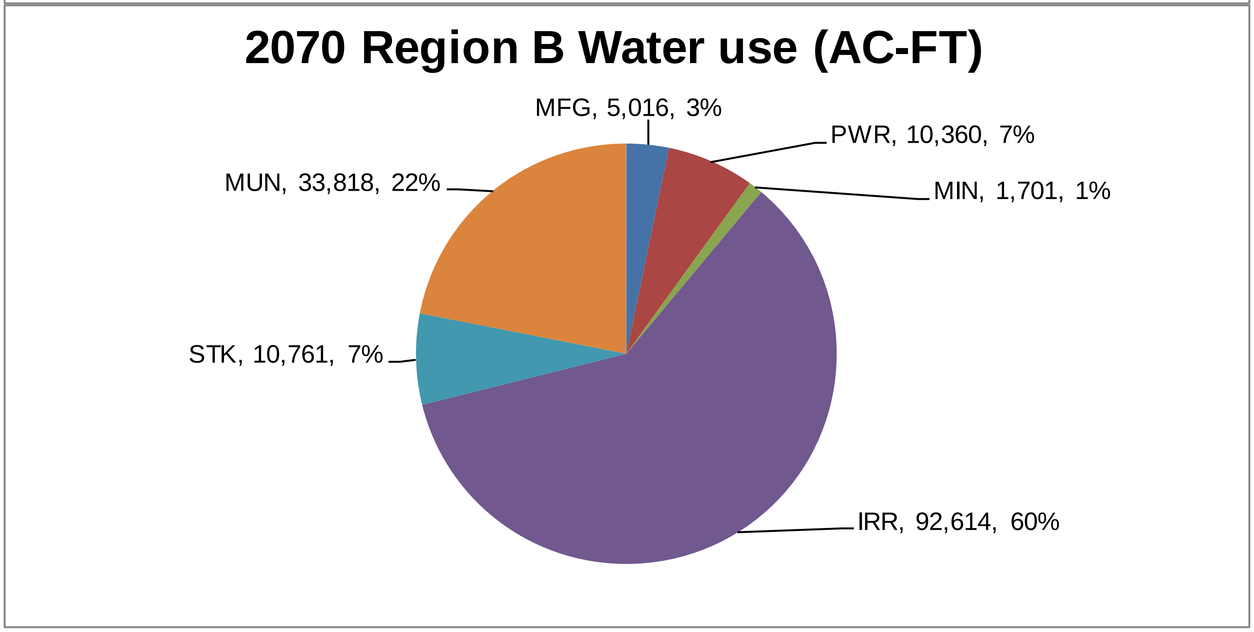
YEAR	2020	2030	2040	2050	2060	2070
MFG	4,158	4,392	4,720	5,016	5,016	5,016
PWR	10,360	10,360	10,360	10,360	10,360	10,360
MIN	5,203	4,342	2,978	1,837	1,701	1,701
IRR	99,614	97,236	94,902	92,614	92,614	92,614
STK	10,761	10,761	10,761	10,761	10,761	10,761
MUN	32,553	32,773	32,784	32,987	33,405	33,818
TOTAL	162,649	159,864	156,505	153,575	153,857	154,270

Total water consumption for the region is predicted to remain approximately level from 2020 to 2070. Figure 2-3 compares the water uses of 2020 to the projected water uses for 2070.

The two scenarios in Figure 2-3 show that the composition of water use for this region is not anticipated to change much.

Figure 2-3 Composition of Projected Region B Water Use





2.3.2 Municipal Water Use

Municipal water use is defined by the TWDB as residential and commercial water use. Residential use includes single and multi-family household water use. Commercial use includes water used by business establishments, public offices, and institutions, but does not include industrial water use. Residential and commercial water uses are categorized together because they are similar types of uses, for example, each category uses water primarily for drinking, cleaning, sanitation, cooling and landscape watering. Water use data are compiled for the water users of the region by the TWDB and the TCEQ.

The total municipal water use for Region B is shown to increase from 32,553 Ac-Ft in the year 2020 to 33,818 Ac-Ft in 2070, a demand increase of about 4 percent, which corresponds to a population increase of nearly 11 percent. The smaller percent increase in demand is anticipated because, as previously mentioned, the per capita water use is expected to decrease over the next fifty years. Decreases in per capita water use are expected due to water savings from more efficient plumbing fixtures as required by the State Plumbing Code.

2.3.3 Manufacturing Water Use

Manufacturing, or industrial, water use has been defined as water used in the production process of manufactured products, including water used by employees for drinking and sanitation purposes. Water use for manufacturing products (MFG) in Region B is a small percentage, approximately 3 percent, of the overall water use in this region.

The majority of the MFG water use is in Wichita County by the industrial facilities in and around Wichita Falls. Over 66 percent of the MFG water for the region is consumed in Wichita County. Wilbarger, Hardeman, and Montague Counties also have facilities that require water in the MFG category. The top MFG facilities in Wichita County include: Ameron Fiberglass Pipe, Cameron Natco, Covercraft Industries, Cryovac Division of Sealed Air Corporation, Howmet Corporation, PPG Industries, Tranter Inc., United Electric-Magicaire, and Wichita Falls Refurbishment-Pratt Whitney. Wilbarger County has Rhodia Inc., Speed Leather, Tyson Foods, and Vernon Dr. Pepper Bottling Co. as the major industrial users for that area. There are numerous other small industrial users in Region B.

Based on the increasing trend of water required for MFG in Region B, an increase from 4,158 Ac-Ft in 2020 to 5,016 Ac-Ft in 2070 has been projected, for a 21 percent increase in this category. Figure 2-4 shows the projections for manufacturing water use in Region B.

Region B will probably have some growth in the number of industrial facilities that locate in the area. The anticipated growth can be attributed to reasonable land prices, a good labor market, favorable business climate, and sufficient power supplies. While water resources have been a concern during the recent drought years, Wichita Falls has demonstrated leadership in developing short term solutions to sustain water supplies for existing and new industries.

Figure 2-4 Projected Industrial Water Use for Region B

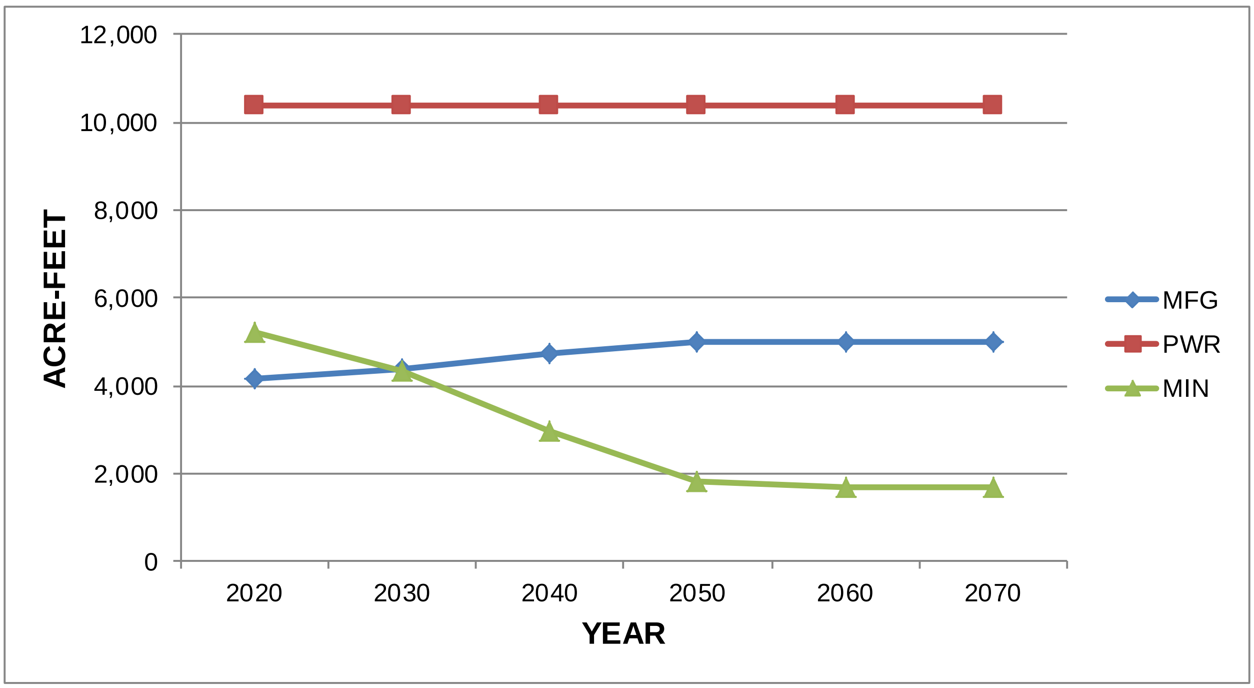


Table 2-3 Projected Industrial Water Use Data Points

YEAR	2020	2030	2040	2050	2060	2070
MFG	4,158	4,392	4,720	5,016	5,016	5,016
PWR	10,360	10,360	10,360	10,360	10,360	10,360
MIN	5,203	4,342	2,978	1,837	1,701	1,701

2.3.4 Steam-Electric Power Generation Water Use

The total water use required for steam-electric power generation for Region B is projected to be 10,360 Ac-Ft in the year 2020 and is expected to remain at 10,360 Ac-Ft through the year 2070. American Electric Power (AEP) currently has a power generating plant in Wilbarger County and AEP formerly owned a facility in Hardeman County. The Hardeman County Facility has been sold and based on information provided by AEP, this facility will not be put back in service. This demand was removed from Hardeman County. The percentage of water used for power generation in Region B will increase from 6 percent in 2020 to 7 percent in 2070. The projections for water use for steam-electric power generation are also shown in Figure 2-4.

2.3.5 Mining Water Use

The oil and gas industry has played a large role in the history and development of the North Central Texas area and is essentially the only "mining" activity in the region. Fresh water has been used in the past to drill wells and in some cases to water flood oil fields. However, as the fields in this area are mature and will not see much more development, water required for production will decline as well. Based on current status of the oil industry and recent trends in water required for mining in this region, a decrease from 5,203 Ac-Ft required in the year 2020 to 1,701 Ac-Ft in the year 2070 is projected and is shown in Figure 2-4.

2.3.6 Agricultural Irrigation Water Use

The largest water use in Region B is irrigated agriculture. Irrigated crops in the region include cotton, wheat, peanuts, alfalfa, hay-pasture, vegetables, orchards, and others. The total acreage irrigated varies from year to year depending on weather, crop price, government programs, and other factors. Agricultural irrigation use accounted for approximately 61 percent of the water used in 2020 and is projected to be 60 percent of all the water used in 2070. Figure 2-5 shows the projected agricultural irrigation water use.

A portion of the water used for irrigation in Region B is from groundwater, but the majority of the water used is surface water, which is delivered through unlined open canals and distribution laterals. The existing canal system is known to have large water losses due to overflows out the end of many of the laterals. These water losses will remain in the total volume of water required for irrigation until the earthen laterals are converted to pipe.

Figure 2-5 Projected Agricultural Water Use for Region B

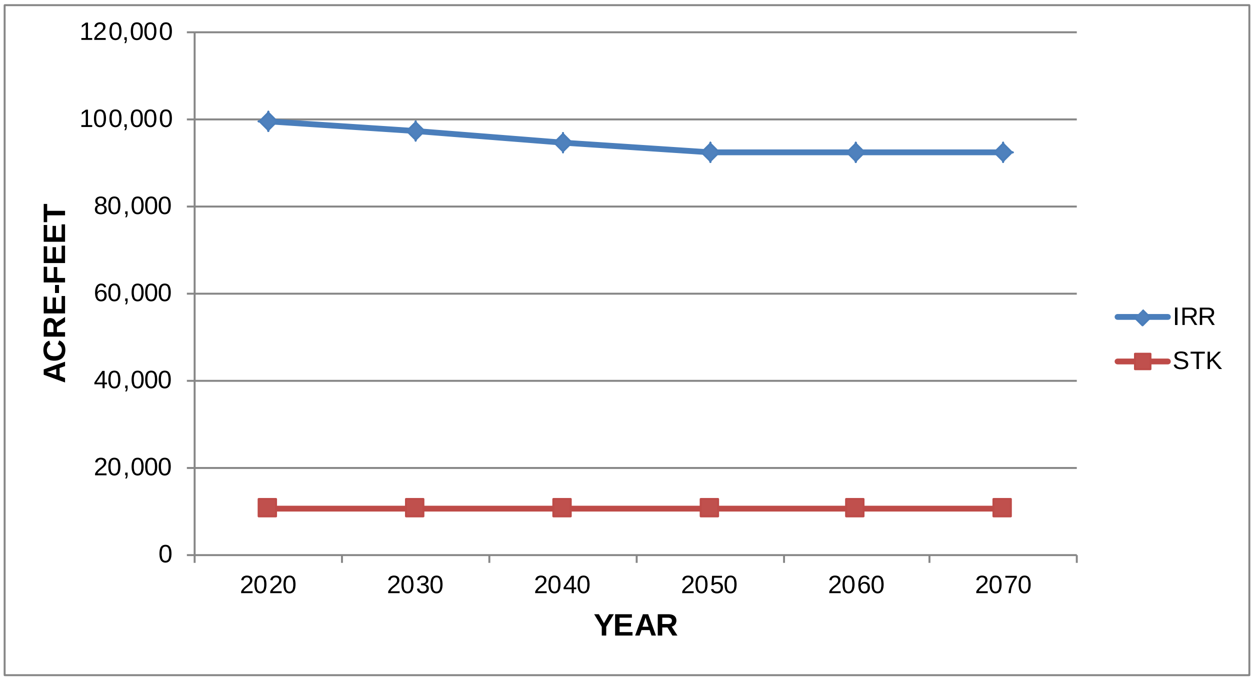


Table 2-4 Projected Agricultural Water Use Data Points

YEAR	2020	2030	2040	2050	2060	2070
IRR	99,614	97,236	94,902	92,614	92,614	92,614
STK	10,761	10,761	10,761	10,761	10,761	10,761

2.3.7 Livestock Water Use

Livestock production is an important part of the economy in Region B. In 2020, the total water used in the region for livestock is projected to be 10,761 Ac-Ft, and the use is projected to stay the same through 2070. The livestock water use projections are shown in Figure 2-5.

2.3.8 Wholesale Water Providers

Two Wholesale Water Provider (WWP) are identified in Region B. The WWPs in Region B are the City of Wichita Falls and Wichita County Water Improvement District Number 2 (WCWID#2). The wholesale water demands for the Wichita Falls water system are shown in Table 2-5, and the wholesale water demands for the WCWID#2 system are shown in Table 2-6.

Table 2-5 Wholesale Water Demands for the Wichita Falls Water System

CUSTOMERS	CONTRACT (MGD)	CONTRACT (AF/Yr)	Demands (Acre-Feet per Year) 2020	2030	2040	2050	2060	2070
Wichita Falls	No contract amt use 20% increase of demands		20,828	20,969	21,053	21,182	21,506	21,821
Archer City	0.6	336	336	336	336	336	336	336
Archer Co. Mud #1	0.15	84	84	84	84	84	84	84
Holliday	No contract amt use 20% increase of demands		342	377	382	378	377	377
Lakeside City	0.4	224	224	224	224	224	224	224
Scotland	0.367	206	206	206	206	206	206	206
Windthorst WSC	0.75	420	420	420	420	420	420	420
Dean Dale WSC (Clay County)	0.825	462	308	307	305	303	301	300
Red River Auth. (Clay County Other)	0.533	299	299	299	299	299	299	299
Red River Auth. (Lake Arrowhead)	No contract amt use 20% increase of demands		see above					
Texas Parks & Wildlife (Lake Arrowhead)			see above					
Burkburnett	4	2242	2,242	2,242	2,242	2,242	2,242	2,242
Dean Dale WSC (Wichita County)			154	155	157	159	161	162
Friberg Cooper WSC	0.35	196	196	196	196	196	196	196
Iowa Park	2.5	1401	1,401	1,401	1,401	1,401	1,401	1,401
Electra	1.5	841	841	841	841	841	841	841
Wichita Valley WSC	1.205	675	675	675	675	675	675	675
Pleasant Valley	0.21	118	118	118	118	118	118	118
Wichita Valley WSC	1.867	1046	1,046	1,046	1,046	1,046	1,046	1,046
Olney	1	561	561	561	561	561	561	561
Manufacturing	No contract amt. assume 60% of Wichita County Demands		1,646	1,724	1,822	1,897	1,897	1,897
Steam Electric		360	360	360	360	360	360	360
Total Demand			32,287	32,541	32,727	32,929	33,251	33,566

Table 2-6 Wholesale Water Demands for the WCWID#2 System

CUSTOMERS	CONTRACT (AF/Yr)	Demands (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
Archer County Irrigation		1,214	1,178	1,142	1,106	1,106	1,106
Clay County Irrigation		100	100	100	100	100	100
Wichita County Irrigation		44,316	43,536	42,756	41,976	41,976	41,976
Wilbarger Stream Electric	20,000	10,000	10,000	10,000	10,000	10,000	10,000
TPWD Dundee Fish Hatchery		2,200	2,200	2,200	2,200	2,200	2,200
TOTAL		57,830	57,014	56,198	55,382	55,382	55,382

NOTE: Wholesale water provider water demands by county and river basin are provided in Appendix G.

2.3.9 Region B Water Plan

This chapter has been updated in accordance with the Texas Water Development Board requirements and all updated population and water use projections were adopted by the Region B RWPG in 2013.

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CHAPTER 3

EVALUATION OF CURRENT WATER SUPPLIES

2016 FINAL PLAN

REGION B

DECEMBER 2015

CHAPTER 3

EVALUATION OF CURRENT WATER SUPPLIES
2016 FINAL PLAN
REGION B

Under Regional Water planning guidelines, each region is to identify currently available water supplies to the region by 1) source and 2) user. The supplies available by source are based on the water available during drought of record conditions. For surface water reservoirs, this is the equivalent of firm yield supply or permitted amount (whichever is lower). For diversions directly from a stream or river (run-of-the-river), this is the minimum supply available in a year over the historical record. Groundwater supplies are defined by availability by county and aquifer. Generally, groundwater supply is the supply available with acceptable long-term impacts as determined through the Groundwater Joint Planning Process.

In addition to surface water and groundwater supplies, there are available supplies from reuse and local supplies. The available supply from reuse is based on permitted authorizations and facilities. Currently, the majority of reuse in Region B is limited to municipal irrigation and/or use at the wastewater treatment facilities; however, the City of Bowie sells nearly all of its wastewater effluent for mining purposes. The City of Wichita Falls has recently implemented an emergency direct potable reuse project and is using up to 5 million gallons per day (MGD) of treated wastewater effluent. Since this project is temporary, it is not considered "available supply" in 2020. Other entities are looking to develop reuse projects, but these projects will not be on line by 2015. Local supplies generally include stock ponds for livestock.

3.1 Existing Surface Water Supply

Water users in the Region B planning area receive surface water from sources in the Brazos, Trinity and Red River Basins. There are six major reservoirs in Region B that are used for water supply and several smaller reservoirs that were previously used for water supply or supply very small amounts of water. Brief descriptions of reservoirs in the region are included in Section 3.1.1.

Special Water Resources as designated by the TWDB include surface water resources that are located in one region and used in whole or in part in another region. Millers Creek Lake is partially located in Region B, but used by the North Central Texas MWD in the Brazos G Region. A small amount of water is sold by the North Central Texas MWD to users in Baylor County. Greenbelt Lake is located in the Panhandle Planning Area (Region A) and is used in both Regions A and B. Only Greenbelt Lake is designated as a Special Water Resource by the TWDB. Descriptions of both Millers Creek Lake and Greenbelt Lake are included in Section 3.1.1.

3.1.1 Existing Water Supply Reservoirs

Greenbelt Lake

Greenbelt Lake is located in the Panhandle Planning Area (Region A), and water from the lake is used to supply several cities in Region B. The lake is owned and operated by the Greenbelt Municipal and Industrial Water Authority, and is located on the Salt Fork of the Red River in Donley County near the City of Clarendon. Construction of Greenbelt Lake was completed in 1968, and the lake had an initial conservation capacity of 60,400 acre-feet. Greenbelt Municipal and Industrial Water Authority has a diversion right of 12,000 acre-feet per year from the lake to provide municipal, industrial, mining and irrigation water supply. The firm yield of the reservoir in based on hydrology through June 2011 is estimated to be 5,720 acre-feet per year (FNI, 2011).

Lakes Kemp and Diversion

Lake Kemp is located on the Wichita River, immediately upstream of State Highway 183 in Baylor County. The lake is authorized to store 318,000 acre-feet of water. Lake Diversion was constructed approximately 20 miles downstream of Lake Kemp for secondary storage with an authorized capacity of 45,000 acre-feet. The reservoir lies in both Archer and Baylor Counties.

Lake Diversion is operated in conjunction with Lake Kemp to provide water supply for municipal, industrial, irrigation, mining and recreational purposes. The City of Wichita Falls and Wichita County Water Control and Improvement District (WCID) No. 2 own the water rights in

Lake Kemp and Lake Diversion. Water released from Lake Kemp travels to Lake Diversion for distribution. Irrigation water is diverted into canal systems that distribute water to customers in Archer, Clay and Wichita Counties. Municipal water is diverted from the canal system to a pipe for transmission to Wichita Falls. American Electric Power has a contract to divert up to 20,000 acre-feet per year for the Oklaunion Power Plant in Wilbarger County. This water is diverted directly from Lake Diversion.

Due to high salinity loads in the tributaries that flow to Lake Kemp, most of the water use from Lake Kemp historically has been limited to irrigation and industrial purposes. In 2008 the City of Wichita Falls completed a reverse osmosis water treatment plant and infrastructure to utilize water from Lake Kemp for municipal purposes.

To improve the water quality of the Wichita River, the Red River Authority sponsors a chloride control project that diverts saline water from the South Wichita River above Lake Kemp to Truscott Brine Reservoir in Knox County. Evaluations of the effectiveness of the project found these diversions reduce the total chloride load to Lake Kemp by approximately 25 percent. This results in a lower chloride concentration in the reservoir. However, a significant chloride load to the reservoir system from the North and Middle Wichita Rivers remains. Future proposed low flow diversions from these tributaries should further reduce the chloride loading into Lake Kemp.

The yield of Lake Kemp and Lake Diversion was evaluated as a system with releases made to Lake Diversion with target minimum elevations in Lake Diversion of 1050.0 feet msl in March and 1046.0 feet msl the remainder of the year. The elevation of 1050.0 feet msl is to allow the Dundee Fish Hatchery to divert water during the spring spawning season. The 1046.0 feet target is based in the intake constraints for American Electric Power. The total permitted diversion for the system is 193,000 acre-feet per year. The water right allows the District to divert a portion of the irrigation right (16,660 acre-feet per year) directly from the Wichita River for irrigation purposes. This portion of the water right was evaluated as a run of the river supply. However, there is no infrastructure in place to use the run of river supply.

In 2011, Kemp experienced record low inflows and high demand from the local irrigators. As a result, the lake content dropped to 20 percent of its capacity and the salinity levels increased significantly. Irrigation deliveries were suspended in 2012 and the Fish Hatchery was temporarily closed. It is anticipated that when the lake recovers from the current drought that deliveries to the irrigators and Fish Hatchery will resume.

With the hydrology extended through 2013, the estimated firm yield of the Lake Kemp/Diversion System in 2010 is 61,900 acre-feet per year. If the drought continues for an extended period, the yield would likely be less.

Wichita System

The Wichita System consists of Lake Kickapoo and Lake Arrowhead. These lakes are owned and operated by the City of Wichita Falls for municipal and industrial supply. Water from the lakes is transported to Wichita Falls' water treatment plants for treatment and distribution. Some raw water is sold directly to wholesale customers. The firm yield of the Wichita System in 2013 is estimated at 38,200 acre-feet per year. A brief description of each lake follows:

Lake Kickapoo

Lake Kickapoo was built by the City of Wichita Falls in 1946 for municipal water supply with an initial conservation storage capacity of 106,000 acre-feet. The reservoir is located on the North Fork of the Little Wichita River in Archer County. It is owned and operated by the City of Wichita Falls. The diversion rights from the lake total 40,000 acre-feet per year.

Lake Arrowhead

Lake Arrowhead was built in 1966 by the City of Wichita Falls for municipal, industrial and recreational use. The lake is located on Little Wichita River in Clay County, about 12 miles southeast of Wichita Falls. The lake is owned and operated by the City of Wichita Falls. The diversion rights from Lake Arrowhead total 45,000 acre-feet per year; however, the maximum diversion from both Lake Arrowhead and Kickapoo cannot exceed 65,000 acre-feet per year. This joint diversion limitation was considered in the evaluation of the system yield.

Lakes Olney and Cooper

Lakes Olney and Cooper are a twin-lake system located on Mesquite Creek in Archer County. Lake Olney dam was constructed in 1935 to provide municipal water for the City of Olney. In 1953 the dam for Lake Cooper was built for additional storage. Collectively, the lakes have a conservation storage capacity of 6,650 acre-feet, with diversion rights of 1,260 acre-feet per year. Using an extended hydrology through 2013, the firm yield of these lakes is estimated at 780 acre-feet per year.

Lake Nocona

Lake Nocona is a 25,400 acre-foot reservoir located on Farmers Creek in Montague County, approximately 8 miles northeast of the City of Nocona. Construction was completed in 1960 to provide municipal water supply to the City of Nocona. The lake is owned and operated by the North Montague County Water Supply District. The original permit for Lake Nocona allowed the diversion and use of 4,500 acre-feet per year for municipal, industrial, and mining purposes. In 1984, the final determination of water rights for the Middle Red River segment of the Red River Basin reduced the authorized diversion to 645 acre-feet per year for municipal use only. Subsequent studies reported the firm yield of the reservoir to be 1,260 acre-feet per year through year 2030 (F&N, 1986). The water right permit for diversions from Lake Nocona was amended in 1987 to 1,260 acre-feet per year for municipal, irrigation and recreational uses. The reported firm yield for Lake Nocona using the Red River WAM exceeded the permitted amount. For this plan, the firm supply from Lake Nocona is 1,260 acre-feet per year.

Amon G. Carter

Lake Amon G. Carter is located on Big Sandy Creek in Montague County, about 6 miles south of the City of Bowie, Texas. The lake was originally constructed in 1956 and enlarged in 1979. It has a current storage capacity of approximately 27,500 acre-feet and an estimated firm yield of 2,100 acre-feet per year. The lake is owned and operated by the City of Bowie for water supply. The existing water right permit allows for a diversion of 5,000 acre-feet per year for municipal, industrial and mining water use.

Miller's Creek Reservoir

Miller's Creek Reservoir is located about 7 miles southeast of Bomarton, Texas in the Brazos River Basin. The dam was constructed in 1977 on Miller's Creek in Baylor County, and the reservoir extends southwest into Throckmorton County. It is owned and operated by the North Central Texas MWA. It has a permitted diversion of 5,000 acre-feet per year for municipal, industrial and mining uses. Water from this reservoir is currently used in the Brazos G Region. A small amount of water is sold from the North Central Texas MWD to Baylor WSC in Baylor County. The yield for Miller's Creek Reservoir was determined by the Brazos G Region. Under safe yield analysis, the Brazos G reports a reliable supply of 1,300 acre-feet per year in 2020, reducing to 200 acre-feet per year by 2070.

3.1.2 Other Lakes and Reservoirs in the Region

Santa Rosa Lake

Santa Rosa Lake is located in Wilbarger County on Beaver Creek. It was constructed in 1929 by the Waggoner Estate for irrigation and had an original capacity of 15,755 acre-feet. Current use is for livestock and irrigation. It is permitted for 3,075 acre-feet per year, but recent historical use is much lower. According to a representative of the Waggoner Estate, the lake went totally dry in 1971. Recent reported use from the lake is approximately 40 to 100 acre-feet per year. The Red River Basin Water Availability Model shows a firm yield that exceeds its permitted diversion. However, in light of historical performance, Santa Rosa Lake has little reliable supply, and is not considered a major water supply source for planning purposes.

Lake Electra

Lake Electra is located on Camp Creek near the City of Electra in Wichita County. It is owned and operated by the City of Electra and has a diversion right of 600 acre-feet per year for municipal use. At normal pool elevation (1,111 feet MSL), the storage capacity of Lake Electra is 5,626 acre-feet. However, due to the relatively small drainage area (14.5 square miles), the lake is usually below its normal pool elevation. Previous reports indicate the lake may never have completely filled since construction was completed in 1950.

Due to the poor performance of the lake during drought, the City of Electra has contracted for water from Wichita Falls through the City of Iowa Park. This supply is currently in place and the City is no longer using water from Lake Electra. The lake is currently near empty. For planning purposes, it is assumed that there is no reliable supply from this source.

North Fork Buffalo Creek Reservoir

The North Fork Buffalo Creek Reservoir was constructed in 1964 to provide additional water for the City of Iowa Park. The dam is located below the confluence of North Fork Buffalo Creek and Lost Creek in Wichita County. The reservoir had an original storage capacity of 15,400 acre-feet with a drainage area of 33 square miles. The current permitted water right for the reservoir is 840 acre-feet per year. North Fork Buffalo Creek Reservoir is owned and operated by the City of Iowa Park.

North Fork Buffalo Creek Reservoir is currently in drought of record conditions. The reservoir content is currently less than one percent of its conservation storage. The City stopped using water from North Fork Buffalo Creek in 2002 and is purchasing water from the City of Wichita Falls. Previous studies as well as the Red River WAM report firm yield estimates greater than its permitted diversion volume. Based on the current performance of the lake, the firm yield is most likely much less. Since there have been essentially no diversions from the lake over the past 12 years and the lake is nearly empty, the reliable supply from North Fork Buffalo Creek Reservoir is assumed to be “0” for planning purposes.

Lake Iowa Park

Lake Iowa Park is located on Stevens Creek, northwest of the City of Iowa Park, and has been a source of water for the City of Iowa Park since 1949. The lake has a storage capacity of 2,565 acre-feet and the water right permit allows a diversion of 500 acre-feet per year for municipal use. The lake has recently experienced severe drought conditions and was nearly dry in years 2000 and 2004. The City of Iowa Park is no longer using this lake for water supply.

Lake Wichita

Lake Wichita is located south of the City of Wichita Falls and lies in Archer and Wichita Counties. It was constructed in 1901 on Holliday Creek for irrigation and municipal use, but little water has been used for municipal purposes since Lake Kickapoo water supply became available. Presently, Lake Wichita is used for recreational purposes only. Water from the Lake Kemp/Diversion System, under its recreation permitted use, is released to help maintain the water levels in Lake Wichita.

The Texas Park and Wildlife Department (TPWD), the City of Wichita Falls, the City of Lakeside City, the Wichita Falls Area Community Foundation and Lake Wichita Chapter of Friends of Reservoirs are planning to develop and implement a revitalization project of Lake Wichita that is expected to increase storage capacity, water quality and recreational use.

Lake Pauline

Lake Pauline is located on the upper reaches of Wanderers Creek near Quanah in Hardeman County. The dam was completed in 1928 and the reservoir had a reported conservation capacity of 4,137 acre-feet in 1968 (Bisset, 1999). Lake Pauline was formerly used as cooling water for a steam electric power plant. This facility is now privately owned and is used for recreation.

3.1.3 Reservoir Yields

The amount of supply that can be reliably used during drought of record conditions is often referred to as "firm yield". A firm yield analysis assumes that the reservoir never goes completely empty during the historical hydrological record, but there is little to no reserve supply during the critical period. Most reservoirs are operated with some level of reserved storage to account for minimum intake elevations, reduced water quality or future droughts worse than the historical drought. Safe yield is the amount of water that can be used during the critical drought while leaving a minimum one-year supply in reserve. Many surface water reservoirs in Region B were permitted for safe yield and operate on a safe yield basis. Therefore the firm yield and a more conservative yield analysis (either safe yield or conditional reliability assessments) were conducted for planning purposes for Region B reservoirs.

In accordance with the Texas Water Development Board's (TWDB) established procedures, the surface water supplies for the regional water plans are determined using the TCEQ Water Availability Models. Water Availability Models (WAMs) have been completed for each of the major river basins in Texas. The WAMs were developed for the purpose of reviewing and granting new surface water rights permits. The assumptions in the WAMs are based on the legal interpretation of water rights and in some cases do not accurately reflect current operations. For planning purposes, adjustments were made to the WAMs to better reflect current and future surface water conditions in the region. These adjustments generally included modifications to the reservoir capacities as a result of sediment accumulation over time and operational constraints as appropriate. The development of the data needed for the surface water modeling and descriptions of changes to the WAMs are documented in Appendix A.

The Red River WAM was originally completed in 2002 and includes hydrology through 1998. The TCEQ has continued to update the Red River WAM with the addition of new water right permits and/or changes to permits, but the hydrology has remained the same. Since 1998, the region has experienced several dry periods, including the current drought that began in 2011 and is on-going. Year 2011 had record low inflows to area lakes with record high evaporation rates. Years 2012 and 2013 were also very low inflow years to reservoirs in Region B. Considering the current drought conditions, the hydrology for selected area lakes (including Lakes Arrowhead, Kickapoo, Kemp, Nocona and Olney-Cooper) were extended through 2013. The firm yields were determined using the WAM hydrology through 1998 and the developed extended hydrology.

For Lakes Arrowhead and Kickapoo, the lowest reservoir storage elevations occurred at the end of the simulation, indicating that the on-going drought will continue to impact the reservoir yield. To assess the potential impacts of the drought and provide a more conservative estimate of reservoir yield for planning purposes, a conditional reliability assessment was conducted for the Wichita System (Arrowhead and Kickapoo). A conditional reliability assessment starts with current lake conditions and an expected demand level, and then analyzes the reservoir response under all sequences of available historical hydrology. Based on statistics of the output, a level of risk for each possible outcome is assigned. This method provides a means to assess future reservoir conditions under specific demand levels. For the Wichita System, the recommended demand levels maintain reservoir levels at or above the five percent capacity elevation under the lowest risk level.

The Trinity River WAM was updated by Region C for planning purposes. Region B used this updated version to assess surface water supplies from the Trinity River Basin. There is very little surface water in the Brazos River Basin that is used in Region B. The Brazos WAM developed for planning for the Brazos G Region was used to assess the supplies to users in Region B.

Table 3.1 summarizes the firm yield by reservoir source in Region B in acre-feet per year. Table 3.2 shows the supplies by reservoir that are used for regional water planning. These supply values represent the safe yield of the reservoir or the estimate of reliable supply based on the conditional reliability assessments conducted for the Wichita System and Greenbelt Reservoir. For the smaller reservoirs that are no longer being used, the reliable supplies are assumed to be “0”.

Surface water that is diverted directly from a river (run of the river) was evaluated using the TCEQ WAMs with no extended hydrology. Run of the river supplies and local surface water supplies are presented in Table 3.3. Local supplies shown in Table 3.3 are based on the historical surface water use for livestock or mining as reported by the TWDB. It is assumed that these estimates represent available surface water from stock ponds, which are not required to have a water right and are not included in the WAMs.

Table 3-1
Firm Yield of Reservoirs in Region B
-Values are in Acre-Feet per Year-

	Basin	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WATER SUPPLY SYSTEMS								
Lake Kemp/ Diversion System	Red	61,900	57,667	53,434	49,201	44,968	40,735	36,500
Wichita System								
Kickapoo	Red	12,050	11,867	11,684	11,501	11,318	11,135	10,950
Arrowhead	Red	26,150	25,867	25,584	25,301	25,018	24,735	24,450
TOTAL	*Red*	*38,200*	*37,734*	*37,268*	*36,802*	*36,336*	*35,870*	*35,400*
Subtotal		**100,100**	**95,401**	**90,702**	**86,003**	**81,304**	**76,605**	**71,900**
RESERVOIRS IN REGION B								
Lake Amon Carter	Trinity	2,107	2,014	1,921	1,828	1,735	1,640	1,640
Lake Electra	Red	462	454	446	438	430	420	420
North Fork Buffalo Creek Reservoir	Red	840	840	840	840	840	840	840
Santa Rosa Lake	Red	3,075	3,075	3,075	3,075	3,075	3,075	3,075
Lake Cooper/Olney	Red	780	780	780	780	780	780	780
Lake Nocona*	Red	1,260	1,260	1,260	1,260	1,260	1,260	1,260
Subtotal		**8,524**	**8,423**	**8,322**	**8,221**	**8,120**	**8,015**	**8,015**
RESERVOIRS OUTSIDE REGION B								
Greenbelt Reservoir	Red	5,487	5,362	5,237	5,112	4,987	4,862	4,738
TOTAL		**114,111**	**109,186**	**104,261**	**99,336**	**94,411**	**89,482**	**84,653**

*Yield for Lake Nocona limited by permit amount.

Table 3-2
Reliable Supply for Reservoirs in Region B for Planning Purposes
-Values are in Acre-feet per Year-

	Basin	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WATER SUPPLY SYSTEMS								
Lake Kemp/ Diversion System	Red	46,950	42,875	38,800	34,725	30,650	26,575	22,500
Wichita System								
Kickapoo	Red	3,587	3,587	3,587	3,587	3,587	3,587	3,587
Arrowhead	Red	9,654	9,654	9,654	9,654	9,654	9,654	9,654
TOTAL	*Red*	*13,241*	*13,241*	*13,241*	*13,241*	*13,241*	*13,241*	*13,241*
Subtotal		**60,191**	**56,116**	**52,041**	**47,966**	**43,891**	**39,816**	**35,741**
RESERVOIRS IN REGION B								
Lake Amon Carter	Trinity	1,433	1,366	1,299	1,232	1,165	1,100	1,100
Lake Electra	Red	0	0	0	0	0	0	0
North Fork Buffalo Creek Reservoir	Red	0	0	0	0	0	0	0
Santa Rosa Lake	Red	50	50	50	50	50	50	50
Lake Cooper/Olney	Red	620	620	620	620	620	620	620
Lake Nocona*	Red	1,260	1,260	1,260	1,260	1,260	1,260	1,260
Subtotal		**3,363**	**3,296**	**3,229**	**3,162**	**3,095**	**3,030**	**3,030**
RESERVOIRS OUTSIDE REGION B								
Greenbelt Reservoir	Red	3,850	3,850	3,782	3,714	3,646	3,578	3,440
TOTAL		**67,404**	**63,262**	**59,052**	**54,842**	**50,632**	**46,424**	**42,211**

*Yield for Lake Nocona limited by permit amount.

Table 3-3
Summary of Local Surface Water Supplies for Region B
-Values are in Acre-Feet per Year-

	Use	County	Basin	2010	2020	2030	2040	2050	2060	2070
LOCAL RUN-OF-THE-RIVER SUPPLIES										
Run-of-the-River[1]	Irrigation	Archer	Red	7	7	7	7	7	7	7
Run-of-the-River	Irrigation	Baylor	Red	0	0	0	0	0	0	0
Run-of-the-River	Irrigation	Baylor	Brazos	17	17	17	17	17	17	17
Run-of-the-River	Irrigation	Clay	Red	2,429	2,429	2,429	2,429	2,429	2,429	2,429
Run-of-the-River	Irrigation	Cottle	Red	13	13	13	13	13	13	13
Run-of-the-River	Irrigation	Hardeman	Red	148	148	148	148	148	148	148
Run-of-the-River	Irrigation	Montague	Red	108	108	108	108	108	108	108
Run-of-the-River	Irrigation	Wichita	Red	351	351	351	351	351	351	351
Run-of-the-River WCWID No. 2	Irrigation	Wichita	Red	8,850	8,850	8,850	8,850	8,850	8,850	8,850
Run-of-the-River	Irrigation	Wilbarger	Red	825	825	825	825	825	825	825
Run-of-the-River - Archer City Lake	Municipal -	Archer	Red	278	278	278	278	278	278	278
Run-of-the-River - Petrolia	Municipal -	Clay	Red	107	107	107	107	107	107	107
Run-of-the-River – Henrietta	Municipal	Clay	Red	1,450	1,450	1,450	1,450	1,450	1,450	1,450
Run-of-the-River - Iowa Park/Gordon	Municipal -	Wichita	Red	555	555	555	555	555	555	555
Run-of-the-River	Municipal	Wilbarger	Red	115	115	115	115	115	115	115
Run-of-the-River	Industrial	Clay	Red	127	127	127	127	127	127	127
Run-of-the-River	Mining	Clay	Red	1	1	1	1	1	1	1
Run-of-the-River	Mining	Wilbarger	Red	30	30	30	30	30	30	30
Subtotal				**15,411**	**15,411**	**15,411**	**15,411**	**15,411**	**15,411**	**15,411**

[1] Run-of-the-River supplies were determined based on the TCEQ WAM Run 3 minimum annual diversion. Additional information is included in Appendix A.

Table 3-3 (continued)

	Use	County	Basin	2010	2020	2030	2040	2050	2060	2070
Local Supply	Livestock[2]	Archer	Red	2,049	2,049	2,049	2,049	2,049	2,049	2,049
Local Supply	Livestock	Archer	Brazos	122	122	122	122	122	122	122
Local Supply	Livestock	Archer	Trinity	268	268	268	268	268	268	268
Local Supply	Livestock	Baylor	Red	99	100	100	100	100	100	100
Local Supply	Livestock	Baylor	Brazos	800	799	799	799	799	799	800
Local Supply	Livestock	Clay	Red	1,784	1,784	1,784	1,784	1,784	1,784	1,784
Local Supply	Livestock	Clay	Trinity	198	198	198	198	198	198	198
Local Supply	Livestock	Cottle	Red	449	449	449	449	449	449	449
Local Supply	Livestock	Foard	Red	368	368	368	368	368	368	368
Local Supply	Livestock	Hardeman	Red	400	400	400	400	400	400	400
Local Supply	Livestock	King	Red	437	437	437	437	437	437	437
Local Supply	Livestock	King	Brazos	257	257	257	257	257	257	257
Local Supply	Livestock	Montague	Red	1,165	1,165	1,165	1,165	1,165	1,165	1,165
Local Supply	Livestock	Montague	Trinity	500	500	500	500	500	500	500
Local Supply	Livestock	Wichita	Red	916	916	916	916	916	916	916
Local Supply	Livestock	Wilbarger	Red	1,617	1,617	1,617	1,617	1,617	1,617	1,617
Local Supply	Livestock	Young	Brazos	301	301	301	301	301	301	301
Local Supply	Livestock	Young	Trinity	20	20	20	20	20	20	20
Local Supply	Mining	Hardeman	Red	7	7	7	7	7	7	7
Subtotal				**11,757**	**11,757**	**11,757**	**11,757**	**11,757**	**11,757**	**11,757**

[2] Local Supply is based on TWDB reported historical values.

3.2 Groundwater Supplies

3.2.1 General Description

Groundwater is primarily supplied in Region B by two aquifers, the Seymour and the Blaine. The Seymour is designated a major aquifer and is found in the central and western portions of the region. It is currently used in Hardeman, Wilbarger, Wichita, Clay, Baylor, and Foard Counties. The Blaine is considered a minor aquifer and useable groundwater is limited to the westernmost portion of the region. These aquifers provide a large percentage of available supply in these counties. In addition, the upper portion of the Trinity Aquifer occurs in Montague County in the eastern part of the region. Limited quantities of groundwater are used from the Trinity for municipal and irrigation uses.

There are also other formations within the region that are used for groundwater supply in limited areas. The TWDB identifies these sources as "Undifferentiated Other Aquifer". These formations generally are not well defined in the literature, but still provide substantial quantities of water in Archer, Clay, Cottle, King, Montague, Wichita and Wilbarger Counties. The Upper Trinity GCD has recently sponsored a study of the Paleozoic Aquifer that occurs in Clay and Montague Counties. While the model has been completed, the long-term availability from this source will be addressed in future studies. For this plan, the Paleozoic Aquifer is included in the Other Aquifer category. With little data, the groundwater availability for "Other Aquifers" was determined from the reported historical use.

Seymour Aquifer

The Seymour Formation consists of isolated areas of alluvium that vary in saturated thickness from less than 10 feet to over 80 feet. This aquifer is relatively shallow and exists under water table conditions in most of its extent. Artesian conditions can occur where the water-bearing zone is overlain by clay. The upper portion of the Seymour consists of fine-grained and cemented sediments. The basal portion of the formation has greater permeability and produces greater volumes of water. Yields of wells typically range from 100 gpm to 1,300 gpm, depending on the saturated thickness, and average about 300 gpm.

Recharge to the Seymour is largely due to direct infiltration of precipitation over the outcrop area. Surface streams adjoining the outcrop are at elevations lower than the water levels in the Seymour Aquifer and do not contribute to recharge. Other possible sources of recharge include infiltration from irrigation or upward leakage of water from underlying Permian formations, but these amounts are insignificant.

Natural discharge from the Seymour occurs through seeps and springs, evapotranspiration, and leakage to the underlying Permian formations. It is estimated that a large part of the Seymour’s total natural discharge is from evapotranspiration from plants and is considerably larger than discharges to seeps and springs (TWDB Report 337, 1992).

Water quality of the Seymour is variable throughout the region, and generally ranges from fresh to slightly saline. Brine pollution from earlier oil activities and excessive pumping has caused localized concentrations of minerals in the alluvium, limiting the full utilization of the water resource. In addition, high nitrate concentrations occur in the groundwater over a wide area. These nitrate concentrations are often due to agricultural practices, and can be attributed to nitrogen fertilizer or leaching from areas formerly covered by nitrogen fixing vegetation such as grasses or mesquite groves. Other sources of nitrate include organic matter from poorly functioning septic systems, infiltration of animal wastes or naturally occurring sources.

Blaine Aquifer

The Blaine Formation extends in a narrow outcrop band from Wheeler to King Counties. Groundwater occurs in numerous solution channels and caverns in beds of gypsum and anhydrite. In most places the aquifer exists under water table conditions, but it is also artesian where overlain by the Dog Creek Shale. Saturated thickness of the aquifer approaches 300 feet in its northern extent, and is generally less in the Region B area. Well yields vary considerably from one location to another due to the nature of solution channels. It is common for dry holes to be found adjacent to wells of moderate to high yield. The average well yield is 400 gpm.

The primary source of recharge to the Blaine Aquifer is precipitation that falls on the High Plains Escarpment to the west and the Blaine outcrop area. The solution openings and fractures in the gypsum provide access for water to percolate downward. The Blaine Aquifer may also receive some recharge from the overlying Dog Creek Shale.

Water in the Blaine Aquifer generally moves eastward through the solution channels, dissolving mineral deposits along the way, and discharging to low topographic areas. The dissolved solids concentrations in the aquifer increase with depth and generally range from 1,000 to over 10,000 mg/l. Due to the high mineral content, the TWDB has limited the extent of the Blaine Aquifer to areas with water less than 10,000 mg/l of dissolved solids.

Natural salt springs and seeps from the Blaine formation contribute to increased salinity of surface water. Due to the high mineral content the Blaine Aquifer has been used primarily for irrigation of salt tolerant crops.

Trinity Aquifer

The Trinity Group consists of three formations, the Travis Peak, Glen Rose and Paluxy. In the northern part of its extent, the Glen Rose thins out and the Travis Peak and Paluxy coalesce into a single geologic unit known as the Antlers Formation. In Region B, the Trinity Group outcrops in the eastern portion of Montague County. The thickness of the Trinity Aquifer ranges from less than 10 feet to 600 feet. Water table conditions occur in outcrop area, while artesian conditions exist in the downdip formation. Well yields in the Trinity Aquifer range from moderate to low. The effective recharge for the entire Trinity Aquifer as determined by the Texas Department of Water Resources (TDWR) is 1.5 percent of the mean annual precipitation over the outcrop area (TDWR, 1982).

Limited amounts of good quality water can be obtained from the Trinity in Montague County. Groundwater is generally used for municipal, mining, irrigation and livestock purposes. Water level declines have been recorded in heavily pumped areas to the south and southeast of Montague County.

3.2.2 Modeled Available Groundwater

The State of Texas initiated a Joint Planning program to assist in determining groundwater supplies for both regulatory and planning purposes. One of the results of this planning effort was the development of groundwater availability values to be used for regional water planning. The TWDB, which oversees this initiative, divided the state into Groundwater Management Areas (GMA) based on locations of major and minor groundwater aquifers. The planning effort within each GMA is directed by the Groundwater Conservation Districts (GCDs) that fall within the GMA. Each GMA was tasked with adopting desired future conditions (DFC) of each aquifer that falls within the GMA. Based on these conditions, the TWDB developed modeled available groundwater (MAG) values that are used by the GCDs and the regional water planning groups to effectively manage the state's groundwater resources.

Most of the counties in Region B are in GMA 6, with Montague County included in GMA 8. Desired Future Conditions and the supporting MAG values were determined for each major and minor aquifer in the region. These values are reported by county and basin and are shown in Table 3-4. Table 3-5 shows the estimated supplies for Other Aquifer, which is based on historical water use from these formations as reported by the TWDB. The values for Montague County were reviewed and confirmed based on data collected for the Upper Trinity GCD.

Table 3-4
Modeled Available Groundwater Values –Region B

County Name	Basin	Aquifer Name	MAG (ac-ft/yr) (2020)
Archer	Red	Seymour	35
Baylor	Brazos	Seymour	3,168
Baylor	Red	Seymour	642
Clay	Red	Seymour	787
Cottle	Red	Blaine	4,469
Foard	Red	Seymour	4,906
Foard	Red	Blaine	23
Hardeman	Red	Seymour	430
Hardeman	Red	Blaine	5,198
King	Red	Blaine	3,863
King	Brazos	Blaine	6,977
Montague	Red	Trinity	129
Montague	Trinity	Trinity	2,545
Wichita	Red	Seymour	2,295
Wilbarger	Red	Seymour	29,421

Table 3-5
Other Aquifer Groundwater Availability – Region B

County	Basin	Groundwater Availability (ac-ft/yr)
Archer	Red	523
Archer	Brazos	33
Archer	Trinity	69
Baylor	Red	35
Baylor	Brazos	25
Clay	Red	1,625
Clay	Trinity	375
Cottle	Red	1,800
Foard	Red	200
Hardeman	Red	50
King	Red	455
King	Brazos	195
Montague	Red	2,280
Montague	Trinity	1,720
Wichita	Red	840
Wilbarger	Red	4,600
Young	Brazos	700

Note: Region B also receives 86 acre-feet per year of groundwater from Dickens County in Region O.

3.2.3 Springs in Region B

The most comprehensive source of information on major springs in Texas was published in 1981 (Brune, 1981). This work identified six major springs in Region B that are listed in Table 3-6. Some of these springs had historical significance as water supplies for nomadic Indians and western travelers. None of these springs are currently used for water supply, and at least one is no longer flowing.

Table 3-6
Major Springs in Region B

County	Spring	Location	Status
Baylor	Buffalo Springs	3 miles west of Seymour	Flow at 25 gpm in 1969
Clay	Buffalo Springs	At Buffalo Springs	Uncertain
Montague	Barrel Springs		No longer flowing
Wichita	China Springs	2 miles west of Haynesville	Brackish water flow at 100 gpm in 1970
Wilbarger	Doans Springs	1 mile northwest of Doans	Flowing in 1970. Impounded in a recreational lake.
	Condon Springs	3 miles northwest of Vernon	Flowing in 1969

3.2.4 Groundwater Conservation Districts

There are three groundwater conservation districts located in Region B. The Rolling Plains Groundwater Conservation District covers Baylor, Knox and Haskell Counties. Only Baylor County is in Region B, which uses water from the Seymour Aquifer. The Gateway Groundwater Conservation District covers Cottle, Foard and Hardeman Counties in the northwestern part of Region B. Both the Blaine and Seymour Aquifers are present in this District. The Upper Trinity Groundwater District includes Montague County in the eastern part of the region, which manages the Trinity Aquifer.

3.2.5 Priority Groundwater Management Areas

In areas, where no there is no GCD, the state may designate a Priority Groundwater Management Area (PGMA). The Priority Groundwater Management Area (PGMA) process is initiated by the TCEQ, who designates a PGMA when an area is experiencing critical groundwater problems, or is expected to do so within 50 years. These problems include shortages of surface water or groundwater, land subsidence resulting from groundwater withdrawal, or contamination of groundwater supplies. Once an area is designated a PGMA, landowners have two years to create a Groundwater Conservation District (GCD). Otherwise, the TCEQ is required to create a GCD or to recommend that the area be added to an existing district. The TWDB works with the TCEQ to produce a legislative report every two years on the status of PGMAs in the state. The PGMA process is completely independent of the current Groundwater Management Area (GMA) process and each process has different goals. The goal of the PGMA process is to establish GCDs in these designated areas so that there will be a regulating entity to address the identified groundwater issues.

In February 2009, Montague County was identified as part of the North – Central Texas Trinity and Woodbine Aquifers PGMA. Since that time all the counties in the PGMA with the exception of Dallas County have been included in a GCD. As of this time, no county commissioner's court has promulgated groundwater regulations or availability values for Montague County, which is currently regulated by the Upper Trinity GCD.

3.3 Wastewater Reuse Supplies

The City of Bowie sells treated wastewater to oil and gas customers within Montague county. It is anticipated that these sales will continue through 2040 when the demand is expected to diminish as shown in Table 3-7. There are no other permanent reuse projects online in Region B at this time, although Wichita Falls does have a temporary direct potable reuse project which is providing approximately 5 MGD. Wichita Falls intends to continue to use their reuse supply by constructing a permanent indirect reuse project which is discussed in further detail in Chapter 5.

Table 3-7
Water Reuse Supplies Region B
-Values are in Acre-feet per Year-

Seller	Recipient	2020	2030	2040	2050	2060	2070
City of Bowie	Mining, Montague County	324	327	325	0	0	0

3.4 Inter-Basin Transfers and Inter-Region Transfers

There is only one known inter-basin transfer in Region B. This is from Lake Kickapoo in the Red River Basin to the City of Olney in the Brazos Basin. The City of Olney has a contract with the City of Wichita Falls to provide 1 MGD of water during peak demands. Most years this additional supply is not used or minimally used.

Inter-regional transfers occur from the Panhandle Planning Area to Region B through the Greenbelt Municipal and Industrial Water Authority. In addition, a small amount of groundwater from Dickens County in Region O is supplied to Guthrie in King County.

3.5 Allocation of Existing Supplies

3.5.1 Water User Groups

To assess the projected water shortages in the region, the amount of water that is available to each water user is determined. This allocation process considers water rights, contracts, the reliable supply from the source, and current infrastructure capacities (well fields, transmission and treatment). The amount allocated to a user is restricted to the most restraining limitation. Obligations to provide water to other users through sales is also considered during the allocation process. Surface water use reported to TWDB for livestock watering was assumed supplied by on farm stock ponds.

In cases where there is insufficient water to meet the users' demands, the supplies were generally shorted equally among the entities. There were several counties that required reductions of groundwater supplies due to the MAG limitations. In Baylor, Hardeman and Wilbarger Counties, the Seymour Aquifer was fully allocated to water users. In Foard and Hardeman Counties, the Blaine Aquifer was fully allocated. This means that there is no available groundwater supplies from these sources in these respective counties for new water management strategies without the transfer of water from another entity.

The supplies to each water user are shown in the Water User Group Summary Tables in Appendix B. A summary of the currently available supplies by county is presented in Table 3-8.

Table 3-8
Summary of Currently Available Supplies to Water Users by County
-Values are in Acre-feet per Year-

County	2020	2030	2040	2050	2060	2070
Archer	4,754	4,615	4,454	4,295	4,140	3,984
Baylor	4,933	4,910	4,882	4,852	4,823	4,791
Clay	6,364	6,345	6,142	6,023	5,903	5,885
Cottle	5,292	5,192	5,089	4,985	4,982	4,982
Foard	5,145	5,141	5,139	5,138	5,137	5,137
Hardeman	7,021	7,031	7,044	7,070	7,074	7,077
King	1,083	1,034	992	954	922	922
Montague	8,849	8,785	7,716	7,024	7,059	7,059
Wichita	44,373	41,522	38,683	35,844	33,001	30,167
Wilbarger	44,095	43,040	41,996	40,827	39,411	38,366
Young (P)	998	988	990	981	972	963
TOTAL	**132,907**	**128,603**	**123,127**	**117,993**	**113,424**	**109,333**

3.5.2 Wholesale Water Providers

There are two wholesale water providers in Region B: the City of Wichita Falls and the Wichita County Water Improvement District No. 2. Both of these entities are considered wholesale providers because they provide more than 280 acre-feet per year in wholesale contracts. Wichita Falls currently receives water from three primary sources: Lake Arrowhead, Lake Kickapoo and Lake Kemp. The City has completed a reverse osmosis water treatment plant that allows the City to treat and use up to 10 MGD of water from Lake Kemp. Wichita Falls also has water rights for Lake Wichita, but this lake is currently used only for recreational purposes. The total available supply to Wichita Falls is shown in Table 3-9.

Table 3-9
Available Supply to Wichita Falls
-Values are in Acre-feet per Year-

Reliable Supply[1]	2020	2030	2040	2050	2060	2070
Kickapoo	3,587	3,587	3,587	3,587	3,587	3,587
Arrowhead[2]	8,754	8,754	8,754	8,754	8,754	8,754
Wichita System	***12,341***	***12,341***	***12,341***	***12,341***	***12,341***	***12,341***
Kemp Municipal[3]	4,248	3,845	3,440	3,037	2,633	2,229
Total – Wichita Falls	**16,589**	**16,186**	**15,781**	**15,378**	**14,974**	**14,570**

1. The reliable supply for the Wichita System is based on a conditional reliability analysis.
2. Supply from Lake Arrowhead to Wichita Falls is the reliable supply less releases to Henrietta (900 acre-feet/year)
3. Supply from Lake Kemp is limited by the proportional safe yield for municipal use and assuming a 25 percent loss during treatment.

Wichita County Water Improvement District (WID) No. 2 owns and operates water in Lake Kemp jointly with the City of Wichita Falls. Wichita County WID No. 2 supplies irrigation water to users in Archer, Clay and Wichita Counties. The City of Wichita Falls and WID No. 2 administer a contract with American Electric Power for 20,000 acre-feet per year for the Oklaunion Power Plant. Table 3-10 shows the amount of supply available to WID No. 2 based on the proportional available supply from Kemp/Diversion System for irrigation and industrial use. For simplicity, the entire amount of supply for American Electric Power is shown with WID No. 2.

Table 3-10
Available Supply to Wichita County Water Improvement District No. 2
-Values are in Acre-feet per Year-

Reliable Supply	2020	2030	2040	2050	2060	2070
Kemp - Irrigation	27,025	24,457	21,889	19,320	16,750	14,184
Kemp - Industrial	8,886	8,041	7,197	6,352	5,508	4,663
Kemp – Livestock[1]	489	442	396	349	303	256
Total – WID No. 2	**36,400**	**32,940**	**29,482**	**26,021**	**22,561**	**19,103**

1. The water for livestock is for the Dundee Fish Hatchery.

3.6 Summary of Currently Available Supplies

The total amount of supply currently available to Region B is approximately 171,000 acre-feet per year, as shown on Table 3-11. This includes all groundwater in place and reliable supplies from surface water and reuse. By 2070, the supply to Region B decreases by about 20,000 acre-feet per year. This is mostly due to the reduced storage capacities of existing reservoirs due to sediment accumulation.

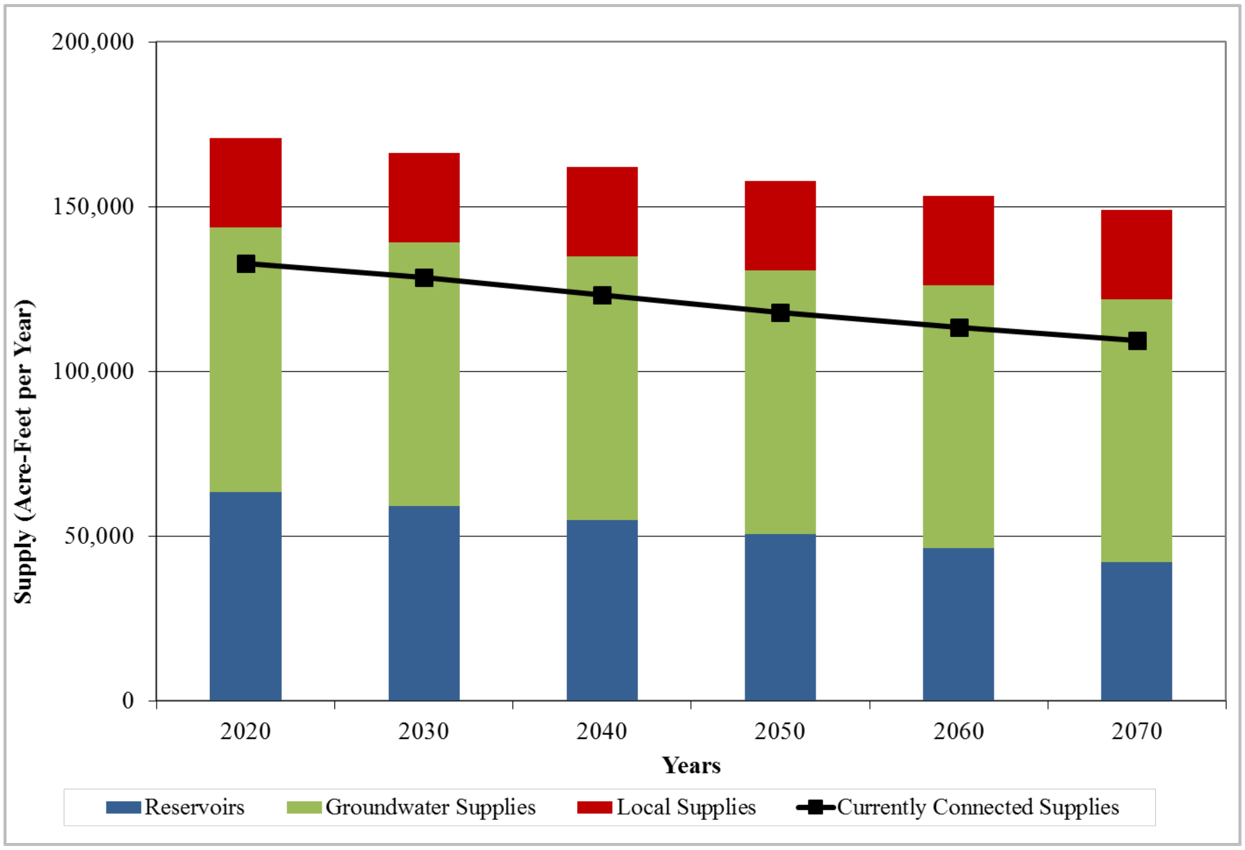
The supply to water users totals approximately 132,000 acre-feet per year, which is less than the total available regional supply due to operational and contractual constraints, infrastructure limitations and water treatment capacities. A comparison of the regional supply to the supply available to the water users is shown on Figure 3-1.

Table 3-11
Summary of Reliable Supplies to Region B
-Values are in Acre-feet per Year-

	2020	2030	2040	2050	2060	2070
Reservoirs in Region B	59,412	55,270	51,128	46,986	42,846	38,771
Reservoirs outside Region B[1]	3,850	3,782	3,714	3,646	3,578	3,440
Run-of-the-River Supplies	15,411	15,411	15,411	15,411	15,411	15,411
Local Supplies	11,757	11,757	11,757	11,757	11,757	11,757
Groundwater Supplies	80,413	80,175	80,140	80,019	79,676	79,676
Reuse	324	327	325	0	0	0
Total	**171,167**	**166,722**	**162,475**	**157,819**	**153,268**	**149,055**

1. The supply reported for reservoirs outside of Region B is only the amount of water that is supplied to water users in Region B.

Figure 3-1
Comparison of Reliable Supplies to Supplies Available to Water Users



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CHAPTER 4

IDENTIFICATION OF WATER NEEDS

2016 FINAL PLAN

REGION B

DECEMBER 2015

CHAPTER 4

IDENTIFICATION OF WATER NEEDS
2016 FINAL PLAN
REGION B

4.1 Introduction

Water needs are identified by calculating the difference between currently available supplies and the projected demands. This chapter outlines water needs based on the quantity of water that is currently available to a user, the quality of water for its intended use, and the reliability of existing supplies as assessed by a safe supply analysis. The water needs are also discussed for first and second tier water needs scenarios, where the first tier needs are based on all supply limitations identified in Chapter 3 and second tier needs are those needs after conservation and direct reuse strategies have been implemented.

This comparison of developed water supply to demands is made for the region, county, basin, wholesale water provider, and water user group. If the projected demands for an entity exceed the developed supplies, then a shortage is identified (represented by a negative number in Appendix B). For some users, the supplies may exceed the demands (positive number). For groundwater users, this water is not considered surplus, but a supply that will be available for use after 2070.

A comparison of current supply to demand was performed using the projected demands developed in Chapter 2 and the allocation of existing supplies developed in Chapter 3 as evaluated under drought of record conditions. As discussed in Chapter 3, allocations of existing supplies were based on the most restrictive of current water rights, contracts, and available yields for surface water and historical use and and/or modeled available groundwater (MAG) for groundwater. The allocation process did not directly address water quality issues such as nitrates. Salinity was addressed to some extent by not assigning supplies with known high salinity levels for municipal use. This included most of the Blaine Aquifer. Further discussion of water quality issues and the effect on supply is presented in Section 4.3.

4.2 First Tier Water Needs Analysis

The First Tier water needs represent the water quantity needs without consideration of conservation or direct reuse. On a regional basis, there is a projected shortage of 29,753 acre-feet in 2020 and a maximum project shortage of 44,943 acre-feet in 2070, as shown in Table 4-1 and Figure 4-1. These needs are calculated by subtracting the regional demand from the total regional water supply. It includes both shortages for some water users and surpluses for others. Considering only the shortages, a summary of the need by county is presented in Table 4-2.

Table 4–1
Comparison of Supplies and Demands for Region B
-Values are in Acre-Feet per Year-

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Supply	132,907	128,603	123,127	117,993	113,424	109,333
Demand	162,659	159,875	156,514	153,584	153,866	154,279
Surplus/Storage	**-29,752**	**-31,272**	**-33,387**	**-35,591**	**-40,442**	**-44,946**

Figure 4-1
Region B Supplies and Demands (ac-ft/yr)

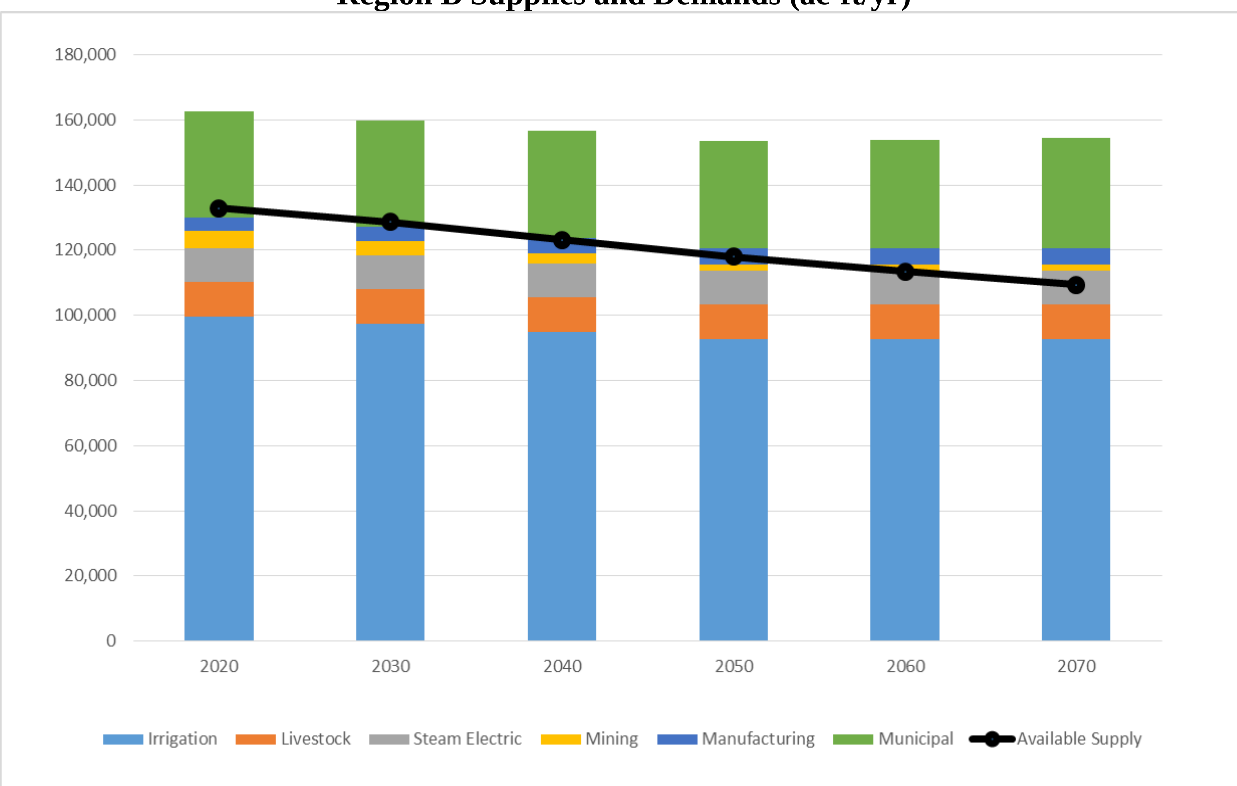

Table 4-2
Comparison of Supply and Demand by County
-Values are in Acre-feet per Year-

County	2020	2030	2040	2050	2050	2070
Archer	-1,278	-1,475	-1,401	-1,385	-1,406	-1,496
Baylor	-518	-442	-343	-249	-249	-249
Clay	-45	-49	-47	-52	-59	-64
Cottle	0	0	0	0	0	0
Foard	0	0	0	0	0	0
Hardeman	-2,491	-2,253	-2,022	-1,798	-1,798	-1,798
King	0	0	0	0	0	0
Montague	-1,315	-250	-281	0	0	0
Wichita	-26,978	-29,263	-31,519	-33,783	-36,883	-39,970
Wilbarger	-2,196	-2,303	-2,880	-3,914	-4,797	-5,674
Young (P)	0	0	0	0	0	-5
Total	**-34,821**	**-36,035**	**-38,493**	**-41,181**	**-45,192**	**-49,256**

4.2.1 Identified Shortages for Water User Groups

A shortage occurs when developed supplies are not sufficient to meet projected demands. In Region B, there are twenty-four water user groups with identified water quantity shortages during the planning period.

Total shortages for all water user groups are projected to be approximately 35,804 acre-feet per year in 2020, increasing to 39,612 acre-feet per year in 2040 and approximately 50,444 acre-feet per year by the year 2070. Table 4-3 lists the water user groups with projected water shortages. The comparison of supply versus demands by user group for Region B is presented in the Water User Group Summary Tables in Appendix B.

A summary of when the individual water user group shortages begin by county and demand type is presented in Table 4-4.

Table 4-3
Projected Water Shortages for Water User Groups
-Values are in Acre-feet per Year-

Water User Group	2020	2030	2040	2050	2060	2070
Archer City	-128	-124	-122	-122	-126	-131
Holliday	-110	-127	-135	-139	-145	-151
Lakeside City	-44	-46	-47	-48	-50	-53
Scotland	-112	-161	-174	-177	-179	-183
Windthorst WSC	-172	-190	-195	-200	-206	-212
Irrigation - Archer	-488	-528	-567	-604	-670	-736
Mining - Archer	-255	-333	-195	-131	-67	-67
Irrigation - Baylor	-388	-312	-213	-119	-119	-119
Livestock - Baylor	-130	-130	-130	-130	-130	-130
Dean Dale SUD	-21	-22	-20	-24	-34	-42
Irrigation - Hardeman	-2,491	-2,253	-2,022	-1,798	-1,798	-1,798
Mining - Montague	-1,315	-250	-281	0	0	0
County-Other - Wichita	-51	-66	-80	-91	-102	-114
Electra	-315	-348	-375	-405	-436	-464
Iowa Park	-424	-449	-472	-498	-525	-553
Wichita Falls	-6,683	-7,074	-7,427	-7,797	-8,275	-8,746
Irrigation - Wichita	-18,069	-19,777	-21,485	-23,196	-25,694	-28,188
Manufacturing - Wichita	-1,254	-1,361	-1,486	-1,595	-1,640	-1,686
Steam Electric Power - Wichita	-175	-181	-187	-193	-199	-204
Vernon	0	0	-45	-151	-174	-194
Irrigation - Wilbarger	-1,082	-344	0	0	0	0
Manufacturing - Wilbarger	0	0	-32	-115	-131	-143
Steam Electric Power - Wilbarger	-1,114	-1,959	-2,803	-3,648	-4,492	-5,337
County-Other - Young	0	0	0	0	0	-5
Total	**-34,821**	**-36,035**	**-38,493**	**-41,181**	**-45,192**	**-49,256**

Table 4-4
Decade Shortage Begins by County and Category

County	Irrigation	Municipal	Manufacturing	Mining	Steam Electric Power	Livestock
Archer	2020	2020	-	2020	-	-
Baylor	2020	-	-	-	-	2020
Clay	-	2020	-	-	-	-
Cottle	-	-	-	-	-	-
Foard	-	-	-	-	-	-
Hardeman	2020	-		-	-	-
King	-	-	-	-	-	-
Montague	-	-	-	2020	-	-
Wichita	2020	2020	2020	-	2020	-
Wilbarger	2020	2040	2040	-	2020	-
Young	-	2070	-	-	-	-

Irrigation

Irrigation shortages are identified for Archer, Baylor, Clay, Hardeman, Montague, Wichita, and Wilbarger Counties. The shortages for Archer and Wichita counties are associated with reduced supplies from Lake Kemp. Irrigation in Baylor, Hardeman and Wilbarger is predominantly supplied by groundwater, which is limited by the MAG. Wilbarger County is projected to have shortages only in 2020 and 2030.

Table 4-5
Projected Irrigation Shortages in Region B
-Values are in Acre-feet per Year

County	2020	2030	2040	2050	2050	2070
Archer	-488	-528	-567	-604	-670	-736
Baylor	-388	-312	-213	-119	-119	-119
Hardeman	-2,491	-2,253	-2,022	-1,798	-1,798	-1,798
Wichita	-18,069	-19,777	-21,485	-23,196	-25,694	-28,188
Wilbarger	-1,082	-344	0	0	0	0
Total	**-22,518**	**-23,214**	**-24,287**	**-25,717**	**-28,281**	**-30,841**

Municipal

Municipal shortages are identified in Archer, Clay, Wichita, Wilbarger and Young Counties. Many of the municipal water users in these counties are provided supplies through Wichita Falls, which is shown to have shortages associated with reduced surface water supplies. Shortages in Wilbarger County are projected to begin in 2040 due to competition for groundwater supplies.

Table 4-6
Projected Municipal Shortages in Region B
-Values are in Acre-feet per Year

County	2020	2030	2040	2050	2050	2070
Archer	-535	-614	-639	-650	-669	-693
Clay	-45	-49	-47	-52	-59	-64
Wichita	-7,480	-7,944	-8,361	-8,799	-9,350	-9,892
Wilbarger	0	0	-45	-151	-174	-194
Young	0	0	0	0	0	-5
Total	**-8,060**	**-8,607**	**-9,092**	**-9,652**	**-10,252**	**-10,848**

Manufacturing

There are two counties with manufacturing shortages identified in Region B. Most manufacturing interests buy water from retail providers or develop their own groundwater supplies. For each of the counties, much of the shortages is associated with wholesale water providers.

Table 4-7
Projected Manufacturing Shortages in Region B
-Values are in Acre-feet per Year

County	2020	2030	2040	2050	2050	2070
Wichita	-1,254	-1,361	-1,486	-1,595	-1,640	-1,686
Wilbarger	0	0	-32	-115	-131	-143
Total	**-1,254**	**-1,361**	**-1,518**	**-1,710**	**-1,771**	**-1,829**

Mining

Mining shortages are identified for Archer and Montague Counties. Shortages for Montague County are identified for 2020, 2030, and 2040 and are associated with the increased oil and gas mining activities.

Table 4-8
Projected Mining Shortages in Region B
-Values are in Acre-feet per Year

County	2020	2030	2040	2050	2050	2070
Archer	-255	-333	-195	-131	-67	-67
Montague	-1,315	-250	-281	0	0	0
Total	**-1,570**	**-583**	**-476**	**-131**	**-67**	**-67**

Steam Electric Power

Steam Electric Power shortages are identified for Wichita and Wilbarger Counties. These shortages are associated with shortages of the wholesale water providers.

Table 4-9
Projected Steam Electric Power Shortages in Region B
-Values are in Acre-feet per Year

County	2020	2030	2040	2050	2050	2070
Wichita	-175	-181	-187	-193	-199	-204
Wilbarger	-1,114	-1,959	-2,803	-3,648	-4,492	-5,337
Total	**-1,289**	**-2,140**	**-2,990**	**-3,841**	**-4,691**	**-5,541**

Livestock

A shortage for livestock water is identified for Archer, Baylor, Clay and Montague Counties due to competition for groundwater supplies.

Table 4-10
Projected Livestock Shortages in Region B
-Values are in Acre-feet per Year

County	2020	2030	2040	2050	2050	2070
Baylor	-130	-130	-130	-130	-130	-130

4.2.2 Comparison of Supply and Demand for Wholesale Water Providers

Region B has two wholesale water providers: City of Wichita Falls and Wichita County Water Improvement District (WID) No. 2. The City of Wichita Falls is a regional provider for much of the water in Wichita, Archer, and Clay Counties. The City also provides water to customers as far away as the City of Olney in Young County. Considering current customer contracts and City demands, Wichita Falls has an immediate need of nearly 12,000 acre-feet per year, which increases to over 15,000 acre-feet per year by 2070. When applying the safe supply requirements of 20 percent above the firm demands for the City and customers without a specified contract amount (Holliday and Wichita County Manufacturing), the safe supply need for Wichita Falls increases to over 15,700 acre-feet per year in 2020. A summary of the supply and demand comparison for Wichita Falls is shown in Table 4-11. A more detailed analysis is included in Appendix G.

Table 4-11
Projected Water Shortages for the City of Wichita Falls
-Values are in Acre-feet per Year-

	2020	2030	2040	2050	2060	2070
Total Firm Demand	28,508	28,732	28,904	29,084	29,353	29,615
Total Supplies	16,589	16,186	15,781	15,378	14,974	14,570
Supplies Less Current Customer Demand	-11,919	-12,546	-13,123	-13,706	-14,379	-15,045
Required Safe Supply for Customers	32,365	32,635	32,840	33,057	33,380	33,694
Customer Safe Supply Surplus/ Shortage	-15,776	-16,449	-17,059	-17,679	-18,406	-19,124

Wichita County WID No. 2 provides irrigation water to users in Archer, Clay, and Wichita counties. The City of Wichita Falls and Wichita County WID No. 2 jointly provide water from Lake Kemp/Diversion system to the AEP steam electric power plant in Wilbarger County and the Dundee Fish Hatchery near Lake Diversion. For simplicity, the contracts for both of these customers and associated supplies are shown only on the WID. Based on this analysis, the needs for the Wichita County WID No. 2 are over 21,000 acre-feet per year in 2020 and increase to over 36,000 acre-feet per year by 2070.

Table 4-12
Projected Water Shortages for the Wichita County WID No. 2
-Values are in Acre-feet per Year-

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Total Firm Demand	57,830	57,015	56,200	55,385	55,386	55,387
Total Supplies	36,400	32,939	29,482	26,021	22,561	19,102
Supplies Less Current Customer Demand	-21,430	-24,076	-26,718	-29,364	-32,825	-36,285

4.2.3 Summary of First Tier Water Needs

On a water user group basis, the total demands exceed the total developed supply starting in 2020. Most of the shortages are associated with reductions in surface water supplies for the wholesale water providers. Other shortages are due to limitations of available groundwater and increased mining demands. The evaluation of regional water supplies indicates that there is little fresh groundwater that could be further developed, and options for new surface water are limited in the western part of the region due to high salinity levels. The First Tier water needs report provided by TWDB is provided in Appendix G. Further review of the region's options and strategies to meet shortages is explored in more detail in Chapter 5 and the impacts of these strategies on water quality are discussed in Chapter 6.

4.3 Evaluation of Reliable Supply

While many water user groups were not identified with a water quantity shortage, several were found to have little to no supplies above the projected demands, and thus water reliability concerns. The Region B Regional Water Planning Group recognized that these entities were likely to need to develop new supplies to provide a safe level of supply. To determine which entities may be impacted, a safe supply was defined as being able to meet the projected demands plus 20 percent of the demand. This was applied only to municipal and manufacturing water user groups. Using these criteria, twenty-eight municipal and manufacturing water users were identified with safe supply shortages. Of these users, sixteen are also shown to have firm supply shortages. Table 4-13 lists these users and the safe supply shortages over the planning horizon.

Table 4-13
Water Users with Safe Supply Shortages
-Values are in Acre-feet per Year-

	2020	2030	2040	2050	2060	2070
Archer City	-184	-178	-175	-174	-178	-183
Holliday	-167	-190	-198	-202	-208	-214
Lakeside City	-71	-73	-74	-74	-76	-79
Scotland	-156	-213	-228	-231	-233	-237
Wichita Valley WSC	0	0	0	0	-9	-34
Windthorst WSC	-249	-269	-274	-279	-285	-291
County-Other - Baylor	0	0	0	0	0	0
County-Other - Clay	-50	-53	-39	-35	-40	-47
Dean Dale SUD	-72	-72	-68	-71	-82	-90
County-Other - Foard	-5	-3	-1	-1	-1	-1
Crowell	-28	-27	-26	-26	-26	-26
County-Other - Hardeman	-16	-15	-12	-15	-16	-17
Quanah	-79	-78	-78	-79	-79	-80
Manufacturing - Hardeman	-55	-59	-63	-66	-66	-66
Bowie	0	0	-13	-86	-161	-171
County - Other - Montague	-191	-191	-175	-177	-188	-199
Burkburnett	0	-2	-36	-77	-133	-190
County-Other - Wichita	-156	-172	-187	-197	-208	-219
Electra	-504	-541	-571	-604	-638	-670
Iowa Park	-602	-628	-652	-677	-707	-736
Wichita Falls	-10,153	-10,569	-10,936	-11,328	-11,859	-12,385
Manufacturing - Wichita	-1,802	-1,935	-2,092	-2,227	-2,273	-2,317
County-Other - Wilbarger	-1	-6	-16	-38	-46	-53
Vernon	-173	-310	-432	-547	-578	-604
Manufacturing Wilbarger	-227	-243	-304	-417	-433	-445
County-Other - Young	0	0	0	-7	-16	-26
Total	**-14,941**	**-15,827**	**-16,650**	**-17,635**	**-18,539**	**-19,380**

4.4 Effect of Water Quality on Supply

Water quality is a significant issue in Region B. Due to limited resources, some user groups are using water of impaired quality or having to install additional treatment systems to utilize existing sources. An implied assumption of the supply analysis is that the quality of existing water supplies is acceptable for the listed use. In other words, water supplies that are currently being used are assumed to continue to be available, regardless of the quality. Senate Bill 1 requires that water quality issues be considered when determining the availability of water during the planning period. For this report, evaluations of source water quality are generally confined to waters used for human consumption. The effect of water quality of Lake Kemp on agricultural use is also reviewed.

4.4.1 Municipal Water Systems with Existing or Potential Quality Concerns

To determine whether the quality of specific sources of supply imposes a potential limitation on their use, the quality of the major sources of supply was compared to current and proposed drinking water standards. Pursuant to the Federal Safe Drinking Water Act, the U.S. Environmental Protection Agency (EPA) has adopted maximum contaminant levels (MCLs) for a list of organic and inorganic contaminants of drinking water. This list constitutes the primary drinking water standards, and water used for human consumption is to comply with the MCLs established by this list.

The Texas Commission on Environmental Quality (TCEQ) identifies systems that are not compliant with current and proposed primary drinking water standards. This information was reviewed for water users in Region B. Compliance with secondary drinking water standards was not evaluated since the secondary standards do not have the same regulatory and public health implications. Also, compliance with the bacteriological standards (total coliform and fecal coliform) was not evaluated since violations of these standards, when they occur, are typically associated with operational techniques and not the quality of the raw water supply. The water systems in Region B that have existing or potential non-compliances are identified in Table 4-14, along with the parameter of concern.

Table 4-14
Water Systems Not Compliant with Primary Drinking Water Quality Standards

Water System	County	Water Source	CURRENT STANDARD NO_3 MCL = 10 mg/L
Northside WSC	Wilbarger	Seymour Aquifer	X
Hinds-Wildcat Water System	Wilbarger	Seymour Aquifer	X

The TCEQ records indicate that the only primary drinking water standard (other than bacteriological) currently exceeded by water users in Region B is the nitrate criterion. Three water users have water supplies that exceed the MCL for nitrate.

Nitrate Concerns

The nitrate MCL is 10 mg/L. Consumption of water with nitrate levels in excess of 10 mg/L by infants can cause methemoglobinemia or “blue baby syndrome”, a potentially fatal condition. Additionally, pregnant women are urged not to drink water with a high concentration of nitrates because of the potential health effects on the unborn fetus.

In Region B, moderate to high nitrate levels are found in water from the Seymour Aquifer. These concentrations are partly attributed to agricultural activities in the area. Long-standing practices associated with fertilizing crops are believed to have caused an increase in nitrates in the groundwater. Not all water produced from the Seymour Aquifer has excessive nitrates, but the water users shown in Table 4-14 have historically exhibited nitrate concentrations above the MCL of 10 mg/L. Other users of Seymour water with high nitrates have implemented advanced treatment, such as the City of Vernon, and are not identified with water quality concerns.

Removal of nitrates requires advanced treatment, such as reverse osmosis or a comparable advanced membrane technique. Nitrates can also be reduced by blending the water with another water source with low nitrate levels, if such a source is available and otherwise of acceptable quality. The TCEQ currently is urging all water systems in the region using water with high nitrate levels to reduce the nitrate concentration by treatment, by blending, or by securing an alternate source of water. Most of the systems have complied with the standards through one of these means.

4.4.2 Salinity Concerns for Lake Kemp and Diversion Lake

Waters in the Wichita River Basin have historically exhibited high dissolved solids and chloride concentrations. Previous studies, dating back to 1957, have documented that the salt concentrations in the area significantly limit the use of these waters for municipal, industrial, and irrigation purposes.

The U.S. Army Corps of Engineers (USACE) determined that an average of over 3,600 tons per day of chlorides were being discharged to the Red River system from natural and man-made sources. A project, known as the Chloride Control Project, has been designed to reduce the amount of salt contamination from eight of the Red River Basin's natural salt sources; three of which lie within the Wichita River Basin. To date, only one of the proposed chloride control facilities has been constructed and is operational. This low-flow dam structure on the South Wichita River (within the Lake Kemp drainage basin) retains low flows that are high in salts, and diverts them via a pump station and pipeline to Truscott Brine Reservoir. Low-flow diversion dams are also planned for the Middle and North Wichita Rivers. When constructed, high chloride water that would normally flow to Lake Kemp and Lake Diversion would be diverted to Truscott Brine Reservoir.

Recent water quality data of the Lake Kemp/Diversion system indicate that chloride levels have reduced since completion of the first chloride control project, but they still limit the water use. The primary uses impacted by the lakes' salt content are potable water supplies and irrigation. Water quality criteria established pursuant to the Safe Drinking Water Act considers high salt content aesthetically undesirable, and is regulated under the secondary drinking water standards. Chloride, sulfate, and total dissolved solids concentrations are subject to the secondary standards. The TCEQ established criteria for these parameters that are somewhat higher than EPA criteria, and water systems in Texas are subject to the state criteria. Both the TCEQ and EPA standards and typical Lake Kemp levels for these parameters are presented in Table 4-15.

Table 4-15
Secondary Drinking Water Standards and Salinity Levels for Lake Kemp

Parameter	TCEQ Criteria	EPA Criteria	Lake Kemp/Diversion Typical concentration
Chloride (mg/L)	300	250	800 – 1,200
Sulfate (mg/L)	300	250	550 - 800
Total Dissolved Solids (mg/L)	1,000	500	2,000 – 3,500

The salinity of irrigation water from Lake Kemp can also limit the crops to which it can be applied. There are several systems for classifying the salinity of waters that characterize the suitability of the water for various types of crops. One classification system developed by the U.S. Department of Agriculture (USDA) in 1954 identifies four classes of water, based on the chloride concentration of the water, and describes the suitability of each class for irrigation. The water in Lake Kemp and Diversion Lake is generally Class III - High Salinity Water (Chloride > 750 mg/L, but < 2,150 mg/L). Therefore, its use for irrigation is limited to plants with high salt tolerance. The USDA Plant Sciences Group has performed research on the salt tolerance of various herbaceous crops, and examples of salt tolerant crops include cotton, barley, sugar beet, Bermuda grass, and asparagus.

Following the drought of 2011, the water quality of Lake Kemp further deteriorated and the water was determined to be unsuitable for irrigation use. Water has not been released from Lake Kemp-Diversion for irrigation use since the summer of 2011. Wichita Falls has constructed a reverse osmosis water treatment facility to treat water from the Lake Kemp-Diversion system. Even with this facility, there were concerns that the high salinity levels during drought would impact the City's ability to use this source.

4.5 Summary of Needs

In Region B, water supply needs were identified for three different categories: quantity, quality, and reliability. As shown on Table 4-16, a total of 36 water user groups were identified with one or more of these need categories. Twenty-four water user groups were identified with firm quantity needs. An additional 12 water user groups have projected safe supply shortages (reliability), and two municipal suppliers in Wilbarger County and two irrigation users were found to have water quality concerns.

Table 4-16
Water Users with Identified Needs

Water User	Quantity	Quality	Reliability
Archer City	X		
Bowie			X
Burkburnett			X
County - Other - Archer			X
County-Other - Baylor			X
County-Other - Clay			X
County-Other - Foard			X
County-Other - Hardeman			X
County-Other - Wichita	X	X	
County-Other - Wilbarger		X	X
County-Other - Young	X		
Crowell			X
Dean Dale SUD	X		
Electra	X		
Holliday	X		
Iowa Park	X		
Irrigation - Archer	X	X	
Irrigation - Baylor	X		
Irrigation - Hardeman	X		
Irrigation - Wichita	X	X	
Irrigation - Wilbarger	X		
Lakeside City	X		
Livestock - Baylor	X		
Manufacturing - Hardeman			X
Manufacturing - Wichita	X		
Manufacturing - Wilbarger	X		
Mining - Archer	X		
Mining - Montague	X		
Quanah			X
Scotland	X		
Steam Electric Power - Wichita	X		
Steam Electric Power - Wilbarger	X		
Vernon	X		
Wichita Falls	X		
Wichita Valley WSC			X
Windthorst WSC	X		

4.6 Second Tier Water Needs Analysis

The second tier water needs analysis compares currently available supplies with demands after reductions from conservation and direct reuse. Conservation and direct reuse are both considered water management strategies and are discussed further in Chapter 5. The second tier needs report is provided in Appendix G.

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CHAPTER 5

WATER MANAGEMENT STRATEGIES

2016 FINAL PLAN

REGION B

DECEMBER 2015

CHAPTER 5

WATER MANAGEMENT STRATEGIES
2016 FINAL PLAN
REGION B

Chapter 5 identifies and discusses the water management strategies to meet identified water needs as outlined in Chapter 4. These needs are met through a variety of strategies that have been developed through coordination with the water users.

This chapter is divided into four main sections. Section 5.1 discusses the types of potentially feasible water management strategies. Section 5.2 discusses the process used to develop the strategies, and the factors considered in evaluating the strategies. Section 5.3 discusses the water conservation strategies that were considered and recommended for users in Region B. This includes the identification and evaluation for municipal, irrigation and mining conservation measures. Section 5.4 presents the recommended water management strategies for the two wholesale providers in Region B. Section 5.5 addresses the recommended strategies for each water user group with identified shortages and summarizes the water management plans by county.

Over the planning period there may be additional water users that will need to upgrade their water supply systems or develop new supplies, but are not specifically identified in this plan. For aggregated water users, such as "County-Other", the identification of needs can be challenging due to the nature of the data evaluation. It is the intent of this plan to include all water systems that may demonstrate a need for water supply. This includes established water providers and new water supply corporations formed by individual users that may need to band together to provide a reliable water supply. In addition, Region B considers water supply projects that do not impact other water users but are needed to meet demands or to meet regulatory requirements are consistent with the regional plan even though not specifically recommended in the plan.

This plan assumes that management strategies to meet any identified shortages are employed or implemented by the respective water user. The Region B Water Planning Group (RWPG) does not take responsibility in planning or implementing the strategies.

5.1 Potentially Feasible Strategies

This section provides a review of the types of water management strategies (WMS) considered for Region B and the approach for identifying the potentially feasible water management strategies for water users with shortages. Once a list of potential feasible strategies has been identified, the most feasible strategies are recommended for implementation. Alternative strategies can also be identified, in case the recommended strategies become unfeasible. These strategies are discussed in more detail in later sections. This section identifies the potentially feasible strategies for water users that were found to have a projected need in Chapter 4.

5.1.1 Identification of Potentially Feasible Strategies

In accordance with TWDB rules, the Region B RWPG has adopted a standard procedure for identifying potentially feasible strategies. This procedure classifies strategies using the TWDB's standard categories developed for regional water planning. These strategy categories include:

- Water Conservation
    - Precipitation Enhancement
- Drought Management Measures
- Wastewater Reuse
- Management and/or Expanded Use of Existing Supplies
    - System Operation
    - Conjunctive Use of Groundwater and Surface Water
    - Reallocation of Reservoir Storage
    - Voluntary Redistribution of Water Resources
    - Voluntary Subordination of Existing Water Rights
    - Yield Enhancement
    - Water Quality Improvement

- New Supply Development
    - Surface Water Resources
    - Groundwater Resources
    - Brush Control
    - Desalination
    - Water Right Cancellation
    - Aquifer Storage And Recovery (ASR)
- Interbasin Transfers
- Emergency Transfers of Water

One of the purposes of this chapter is to provide a big picture discussion on the various strategy types that were identified to potentially reduce the identified shortages, the applicability of these strategies for users in Region B, and provide documentation of the strategy types that are not appropriate for Region B.

While each of these strategy types were considered by the RWPG, not all were determined as viable options for addressing shortages in the region. Region B did not consider drought management as a feasible strategy to meet long-term growth in demands. This strategy is considered a temporary strategy to conserve available water supplies during times of drought or emergencies and acts as means to minimize the adverse impacts of water supply shortages during drought. Drought management will be employed in the region through the implementation of local drought contingency plans. Region B is supportive of the development and use of these plans during periods of drought or emergency water needs.

The RWPG also did not consider water right cancellation to be a feasible strategy. Instead, Region B recommends that a water right holder consider selling water under their existing water right to the willing buyer. Emergency transfers of water are considered in Chapter 7. Similar to drought management, this strategy is an emergency response to drought or loss of water supplies, and is not appropriate for long-term growth in demands.

Other strategies considered but dismissed as potentially feasible are aquifer storage and recovery (ASR) and reallocation of reservoir storage. The key components of ASR are the availability of suitable geologic formation for storage of the water and the infrastructure to place the water into the aquifer and then recover the water when needed. ASR was not considered for any entities in Region B due to the lack of suitable geologic formations. The opportunities for reallocation of reservoir storage is very limited in Region B. Due to a limited surface water supply in Region B, reallocation would not result in additional reliable supply. Lake Kemp has been studied as a potential source for reallocation, and studies have indicated reallocation of this supply would not result in additional reliable supply. As such, this strategy type is not considered in Region B.

The strategy types (and associated subcategories) that were determined as potentially feasible strategies for entities within Region B are: 1) water conservation 2) wastewater reuse 3) expanded use of existing supplies (system operation, conjunctive use, voluntary redistribution, and water quality improvements), 4) new supply development (new surface water, new groundwater, brush control, and desalination), and 5) precipitation enhancement.

A brief discussion of each of these strategy types and the specific application to the users in Region B is presented in the following subsections.

5.1.2 Water Conservation

Water conservation is defined as methods and practices that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses. Water conservation is typically viewed as long-term changes in water use that are incorporated into daily activities.

Water conservation is a valued water management strategy in Region B because it helps extend the water resources in the region. It is recommended for all municipal and irrigation water users, whether the user has a defined shortage or not. It is recommended for all mining users that are shown to have a shortage, and it is encouraged for manufacturing, livestock, and steam electric users.

5.1.3 Wastewater Reuse

Wastewater reuse utilizes treated wastewater effluent as either a replacement for a potable water supply (direct reuse) or utilizes treated wastewater that has been returned to a water supply resource (indirect reuse). Currently, the majority of reuse in Region B is limited to municipal irrigation and/or use at the wastewater treatment facilities; however, the City of Bowie sells nearly all of its wastewater effluent for mining purposes. The City of Wichita Falls has recently implemented an emergency direct potable reuse project and is using up to 5 million gallons per day (MGD) of treated wastewater effluent. There may be potential to expand wastewater reuse in Region B. Entities considering new or additional wastewater reuse include the cities of Olney, Wichita Falls, and Vernon.

5.1.4 Expanded Use of Existing Supplies

Expanded use of existing supplies includes seven subcategories ranging from selling developed water that is not currently used to enhancing existing supplies through operations, storage, treatment or other means. In Region B, four of the seven subcategories were determined potentially feasible. These include system operations, conjunctive use of groundwater and surface water, water quality improvements and voluntary transfer (sales or contracts for developed water).

System Operation

System operation involves the management of two or more water supplies to maximize the supplies from these sources, which can result in increased water supplies. Wichita Falls owns and operates multiple surface water systems that do not benefit from system operation. In previous planning, system operation analyses of these systems found minimal increases in water supplies from system operation. While this strategy is employed by Wichita Falls and supported by Region B, this strategy type was considered and dismissed for purposes of additional supply in Region B.

Conjunctive Use of Groundwater and Surface Water

Conjunctive use is the operation of multiple sources of water to optimize the water resources for additional supply. Wichita Falls is considering the development of new groundwater sources that they may operate conjunctively with existing surface water sources. This will help reduce evaporative losses associated with the surface water reservoirs, while still meeting demands with groundwater when less surface water is available.

Water Quality Improvements

Water quality improvements allow for the use of impaired water for municipal or other uses. In Region B, there are considerable amounts of brackish surface water and groundwater. Water quality improvement for these sources are typically accomplished through desalination. This discussion is under the strategy type “Desalination”. This strategy type would apply to treatment of other water quality parameters.

In addition to the treatment of existing sources the Corps of Engineers has a Red River Chloride Control Project to control natural chloride brine emissions at ten major source areas to improve water quality. The Wichita Basin portion was completed May 2004. It is a federally funded and directed project.

Voluntary Redistribution

Voluntary redistribution is transfer of existing water supplies from one user to another through sales, leases, contracts, options, subordination or other similar types of agreements. Typically, the entity providing the water has determined that it does not need the water for the duration of the transfer. The transfer of water could be for a set period of years or a permanent transfer. Redistribution of water makes use of existing resources and provides a more immediate source of water. In Region B, there is little to no existing developed water that is available for redistribution without the development of additional strategies. This strategy is used to represent sales and contracts between a water provider and its customers. It can include current contractual obligations and potential future customers.

5.1.5 New Supply Development

New supply development utilizes water that is not currently being used or generates new supplies through aquifer storage and recovery of water that otherwise would not have been available. This strategy type typically includes substantial infrastructure improvements to development the new source, transport the water and, if needed, treat the water for its ultimate end use. The subcategories for this strategy type include new surface water development, new groundwater development, and brush control.

Surface Water Development

The opportunity for new surface water development is limited in Region B. The Water Availability Model for the Red River Basin shows water available for new appropriations in the Wichita River Basin. There are existing water rights that are currently not being used but could potentially be further developed such as run-of-river supplies from Lake Kemp. Lake Ringgold has been a recommended strategy for Wichita Falls in past plans and remains a recommended strategy for Region B in this plan.

Groundwater Development

Groundwater accounts for approximately 50 percent of the total water use in Region B. The only part of the region where there is considerable amounts of groundwater for future development is the Blaine Aquifer in King County, with lesser amounts available in the Trinity Aquifer in Montague County. The challenges with using water from the Blaine Aquifer in King County are that the water tends be brackish and the source in not near areas with need. In other areas, the groundwater is limited or of poor quality. Table 5-1 shows the amount of groundwater that is available for new groundwater development by county and by aquifer.

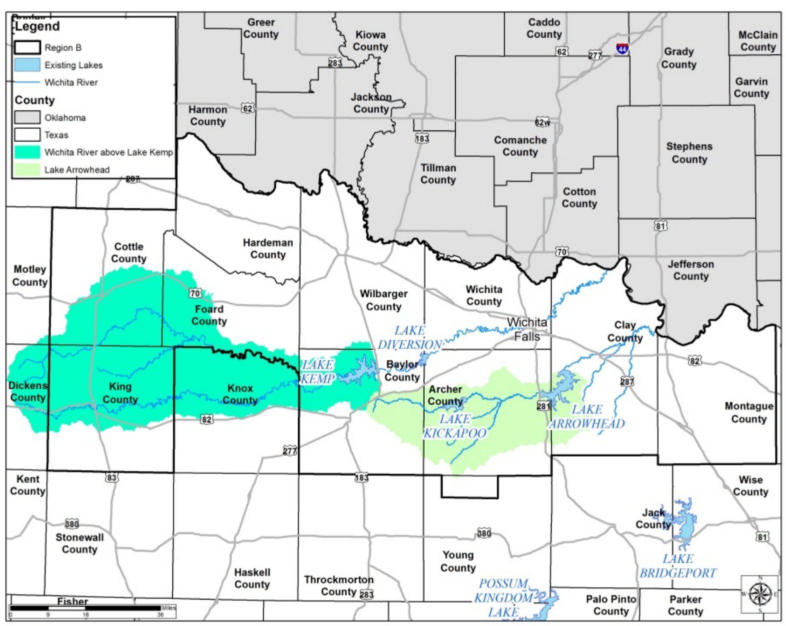
Table 5-1 Available Groundwater Supplies for Strategies

Aquifer	County	2020	2030	2040	2050	2060	2070
Blaine	Cottle	1,284	1,284	1,287	1,291	1,294	1,294
Blaine	King	10,522	10,522	10,522	10,522	10,522	10,522
Other	Archer	38	38	39	40	42	42
Other	Clay	40	40	225	325	425	425
Other	Cottle	0	100	200	300	300	300
Other	Foard	188	188	188	188	189	189
Other	Hardeman	3	3	3	3	3	3
Other	King	135	184	226	264	296	296
Other	Montague	900	900	1,900	2,200	2,100	2,100
Other	Wichita	200	200	200	200	200	200
Other	Wilbarger	590	790	990	1,190	1,390	1,590
Seymour	Archer	35	35	35	35	35	35
Seymour	Clay	182	182	182	182	182	182
Seymour	Foard	352	137	108	108	137	137
Seymour	Hardeman	0	0	1	1	1	1
Seymour	Wichita	795	796	795	804	809	809
Seymour	Wilbarger	0	10	10	10	10	10
Trinity	Montague	1,648	1,648	1,648	1,648	1,648	1,648

1. This is the amount of groundwater that is available for strategies.

Brush Control

In 1985, the Texas Legislature authorized the Texas State Soil and Water Conservation Board (TSSWCB) to conduct a program for the "selective control, removal, or reduction of brush species that consume water to a degree that is detrimental to water conservation." In 1999 the TSSWCB began the Brush Control Program. In 2011, the 82nd legislature replaced the Brush Control Program with the Water Supply Enhancement Program (WSEP). The WSEP's purpose is to increase available surface and groundwater supplies through the selective control of brush species that are detrimental to water conservation.



WSEP considers priority watersheds across the state, the need for conservation within the territory of a proposed projection based on the State Water Plan and if the Regional Water Planning Group has identified brush control as a strategy in the State Water Plan as part of their competitive grant, cost sharing program. Feasibility studies have been conducted for two watersheds in Region B. These studies indicate there is potential for water loss reduction from brush, but these losses have been difficult to quantify during periods of drought.

Desalination

Desalination is the removal of excess salts from either surface water or groundwater for beneficial use. In Region B, most of the fresh groundwater supplies have been developed and are currently being used. The region has brackish water that potentially could be desalinated and used for municipal use. This process tends to require considerable energy and is more costly than conventional treatment. It also produces a waste stream that can vary from less than 20 percent to nearly 50 percent of the raw water, depending upon the level of salts. Since this strategy is fairly expensive, it is not an economically viable option for agricultural use. This strategy is considered for the municipal development of brackish water.

Precipitation Enhancement

Precipitation enhancement introduces seeding agents to stimulate clouds to generate more rainfall. This process is also commonly known as cloud seeding or weather modification. In Region B, there is one ongoing weather modification program that is being funded by Wichita Falls. This strategy was considered for Wichita Falls.

5.1.6 Summary of Potentially Feasible Strategies

There are five potentially feasible water management strategies that were identified for water users and wholesale water providers in Region B. These strategies include a wide assortment of strategy types, which were carefully reviewed for entities with identified needs. Strategies were only considered potentially feasible if the strategy:

- Is appropriate for regional planning;
- Utilizes proven technology;
- Has an identifiable sponsor;
- Could meet the intended purpose for the end user, considering water quality, economics, geographic constraints, and others, as appropriate; and
- Meets existing regulations.

A list of the potentially feasible water management strategies considered for Region B is included in Attachment 5-1 at the end of this chapter. The process for strategy development and evaluation is presented in the following sections.

5.2 Strategy Development and Evaluation

Water management strategies were developed for water user groups to meet projected needs in the context of their current supply sources, previous supply studies and available supply within the region. Where site-specific data were available, this information was used. When specific well fields could not be identified, assumptions regarding well capacity, depth of well and associated costs were developed based on county and aquifer. The primary new surface water supplies are associated with the use of unappropriated water in the Wichita River Basin.

Water transmission lines were assumed to take the shortest route, following existing highways or roads where possible. Profiles were developed using GIS mapping software or USGS topographic maps. Pipes were sized to deliver peak-day flows within reasonable pressure and velocity ranges. Water losses associated with transmission systems were assumed to be negligible.

Municipal and manufacturing strategies were developed to provide water of sufficient quantity and quality that is acceptable for its end use. Water quality issues affect water use options and treatment requirements. For the evaluations of the strategies, it was assumed that the final water product would meet existing state water quality requirements for the specified use. For example, a strategy that provided water for municipal supply would meet existing drinking water standards, while water used for mining may have a lower quality. If advanced water treatment was required, associated water losses were assumed to be 25 percent of the treated water. For some strategies, only a portion of the water may require treatment and losses were accounted for accordingly.

5.2.1 Strategy Evaluation Criteria

The consideration and selection of water management strategies for water user groups with needs followed TWDB guidelines and were conducted in open meetings with the Region B RWPG. In accordance with state guidance, the potentially feasible strategies were evaluated with respect to:

- Quantity, reliability and cost;
- Environmental factors, including effects on environmental water shortages, wildlife habitat and cultural resources;
- Impacts on water resources, such as playas and other water management strategies;
- Impacts on agriculture and natural resources; and
- Other relevant factors.

Other relevant factors include regulatory requirements, political and local issues, amount of time required to implement the strategy, recreational impacts of the strategy, third party impacts, and other socio-economic benefits or impacts.

The definition of quantity is the amount of water the strategy would provide to the respective user group in acre-feet per year. This amount is considered with respect to the user's short-term and long-term shortages. Reliability is an assessment of the availability of the specified water quantity to the user over time. If the quantity of water is available to the user all the time, then the strategy has a high reliability. If the quantity of water is contingent on other factors, reliability will be lower.

The assessment of cost for each strategy is expressed in dollars per acre-foot per year for water delivered and treated for the end user requirements. Calculations of these costs follow the Texas Water Development Board's guidelines for cost considerations and identify capital and annual costs by decade. Project capital costs are based on September 2013 price levels and include construction costs, engineering, land acquisition, mitigation, right-of-way, contingencies and other project costs associated with the respective strategy. Annual costs include power costs associated with transmission, water treatment costs, water purchase (if applicable), operation and maintenance, and other project-specific costs. Debt service for capital improvements was calculated over 20 years (40 years for reservoir projects) at a 5.5 percent interest rate. Costs were not assessed for fulfillment of existing contracts if no new infrastructure is needed.

Potential impacts to sensitive environmental factors were considered for each strategy. Sensitive environmental factors may include wetlands, threatened and endangered species, unique wildlife habitats, and cultural resources. In most cases, a detailed evaluation could not be completed because previous studies have not been conducted or the specific location of the new source (such as a groundwater well field) was not identified. Therefore, a more detailed environmental assessment will be required before a strategy is implemented.

The impact on water resources considers the effects of the strategy on water quantity, quality, and use of the water resource. A water management strategy may have a positive or negative effect on a water resource. This review also evaluated whether the strategy would impact the water quantity and quality of other water management strategies identified.

A water management strategy could potentially impact agricultural production or local natural resources. Impacts to agriculture may include reduction in agricultural acreage, reduced water supply for irrigation, or impacts to water quality as it affects crop production. Various strategies may actually improve water quality, while others may have a negative impact. The impacts to natural resources may consider inundation of parklands, impacts to exploitable natural resources (such as mining), recreational use of a natural resource, and other strategy-specific factors.

Infrastructure cost estimates for Region B strategies may be found in Appendix C. Appendix D includes a Strategy Evaluation Matrix and Quantified Environmental Impact Matrix.

5.3 Water Conservation

Water conservation is defined by Texas Water Code §11.002(8) as “the development of water resources; and those practices, techniques and technologies that will reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses.” Water conservation measures are long-term, permanent strategies to reduce water use that apply to all categories of water use and supply sources.

Title 31 of the Texas Administrative Code (31 TAC) §357.34 (g) requires the 2016 Plan to consolidate and present recommendations that may include Best Management Practices (BMPs) appropriate for the region. Some of the demand projections developed for SB1 Planning (Chapter 2) incorporate an expected level of conservation to be implemented over the planning period. Further, for WUGs with identified water needs, conservation WMSs must be included as part of the WUGs list of strategies to meet shortages; or a summary of reasons must be provided in the plan for not including conservation WMSs.

Section 5.3.1 identifies WUGs and WWPs that are required to have conservation plans and plan requirements, provides a review of water conservation plans and practices in Region B, and summarizes water conservation included in the demand projections for each water use category. This will be followed by a discussion in Section 5.3.2 of WUGs with needs and recommendations for BMPs which could be implemented by WUGs with needs. For WUGs with identified needs where conservation WMSs were not recommended, Section 5.3.3 of this chapter includes a discussion of reasons for not making such recommendations.

5.3.1 WUG and WWP Conservation Requirements

The following types of entities are required to develop and submit water conservation plans to the TWDB, the TCEQ, and/or the RWPG, as noted.

- Any entity **applying for a new or an amended water right** is **required to prepare and implement a water conservation plan (WCP)** and a drought contingency plan (DCP) and **submit it to the TCEQ** with the application in accordance with 30 TAC §295.9. The entity may or may not be required to submit this plan to the RWPG depending on the requirements of rules.
- Any entity **holding an existing permit**, certified filing, or certificate of adjudication **for the appropriation of surface water in the amount of 1,000 acre-feet a year or more for municipal, industrial, and other non-irrigation uses** is required to develop, submit, and implement a water conservation plan (30 TAC §288.30). The plan must be submitted to the TCEQ and the RWPG.
- Any entity **holding an existing permit**, certified filing, or certificate of adjudication **for the appropriation of surface water in the amount of 10,000 acre-feet per year or more for irrigation uses** is required to develop, submit, and implement a water conservation plan. (30 TAC §288.30). The plan must be submitted to the TCEQ and the RWPG.
- A **public water system providing potable water service to 3,300 or more connections** is **required to develop a water conservation plan** and submit the plan to the Executive Director of the Texas Water Development Board. (Texas Water Code §13.146)
- Each public water supplier is required to update and submit a Water Conservation Plan (WCP) to the Texas Commission on Environmental Quality (TCEQ) every five years in accordance with 30 TAC §288.2. These plans are to document coordination with the regional water planning group.
- A wholesale water provider shall review and update its water conservation plan every five years to coincide with the regional water planning group. (30 TAC 288.5)

The entities in Region B that are required to develop water conservation plans and submit them to the regional water planning group are identified in Table 5-2.

Table 5-2 Water Users and Types Required to Develop Implement, and Submit Water Conservation Plans

Entity	WUG	3,300 Connections or More	Non-Irrigation Water Right of 1,000 ac-ft/yr or More				Irrigation Water Right of 10,000 ac-ft/yr or More	Wholesale Water Provider
			Municipal/ Domestic	Industrial	Mining	Other		
City of Bowie	Yes	Yes[1]	•	•	•			
City of Burkburnett	Yes	Yes						
City of Henrietta	Yes		•					
City of Iowa Park	Yes	Yes						
City of Olney	Yes		•					
City of Wichita Falls	Yes	Yes	•	•		•	•	•
North Montague County Water Supply District	No		•					
Wichita County WID No. 2	No			•	•	•	•	•
Red River Authority of Texas	No	Yes	•					

1. As of February, 2015, TCEQ records show that Bowie has 3,297 connections.

Requirements vary for each type of water supply entity. A summary of water conservation plan requirements by type of water use follows.

Municipal/Public Water Supply Conservation Plan Requirements

At a minimum each plan must include:

- Utility Profile that describes the entity, water system and water use data.
- Record management system that is capable of recording water use by different types of users.
- Quantified five-year and ten-year water savings goals.
- Metering device with a 5% accuracy to measure the amount of water diverted from the source of supply.
- A program for universal metering (customers and public uses); and a meter maintenance program.
- Measures to determine and control water loss.

- A program of continuing public education and information regarding water conservation.
- A non-promotional water rate structure.
- Reservoir operations plan if appropriate.
- Means of implementation and enforcement.
- Documentation of coordination with regional planning.

If a public water supplier serves over 5,000 people, they are additionally required to the have a conservation oriented rate structure and a program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system.

Industrial or Mining Water Conservation Plan Requirements

At a minimum each plan must include the following elements or an explanation of why the element is not included:

- Description of the source of water and the water use in production, estimates of water consumed, and estimates of discharge.
- Specific quantifiable goals for 5 –year and 10-year water savings and the basis for the goals.
- Description of devices or methods used to measure water use within 5% accuracy.
- Leak detection, repair, and an accounting of water loss.
- Application of state-of-the-art equipment or process modifications to improve water conservation efficiency.
- Other water conservation practices that will enable the water user to achieve the stated goals.
- Update the plan to coincide with the regional water planning group.

Agricultural Water Conservation Plan Requirements

At a minimum each plan must include the following elements or an explanation of why the element is not included:

- For agricultural users other than irrigation, the requirements are essentially the same as those for industrial or mining water conservation plans.
- For individual irrigation users the requirements include:
    - Description of irrigation processes, methods, and crops.
    - Water measurement devices within 5% accuracy.

    - Specific 5-year and 10-year goals.
    - Identification and implementation of water conserving irrigation equipment.
    - Leak detection and control of water losses.
    - Irrigation scheduling to determine timing and volume of irrigation water.
    - Land improvements to improve irrigation efficiency
    - Tailwater recovery and other conservation practices.
- For systems providing irrigation water to multiple users the requirements include:
    - System profile describing the structural facilities, management practices, and user profile.
    - Specific 5-year and 10-year conservation goals.
    - Description of devices or practices used to measure water diverted from source(s).
    - Monitoring and records management to assess deliveries, sales, and losses.
    - Leak detection and water loss control program.
    - A program to assist customers with implementing water conservation plans and/or measures.
    - Record of plan adoption and documentation of coordination with regional water planning.

Water Conservation Plans for Wholesale Water Providers

The requirements of conservation plans for wholesale water providers (WWPs) are essentially the same as those for public water system except that WWPs are required to include provisions in contracts with individual water users requiring them to develop and implement water conservation plans consistent with the goals of the WWP. In addition, the WWP is required to coordinate with the regional water planning group.

5.3.2 Water Conservation Included in the Demand Projections

The adopted water demands as included in Chapter 2, incorporate water conservation. This volume of conservation can be termed "Basic Conservation." The volume of Basic Conservation included for each water use category is provided in Table 5-3.

Table 5-3 Basic Conservation Included in Demand Projections (ac-ft/yr)

Water Use Category	2020	2030	2040	2050	2060	2070
Municipal	2,191	3,265	4,104	4,541	4,686	4,751
Manufacturing	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
Irrigation	2,416	4,794	7,128	9,416	9,416	9,416
Steam Electric	0	0	0	0	0	0

Municipal and Industrial Demands

For municipalities and industries, conservation can reduce demand on existing supplies, resulting in an increase in reliability or extension of service life. For municipal use, the assumed reductions in per capita water use are the result of the implementation of the State Water-Efficiency Plumbing Act. Among other things, the Plumbing Act specifies that only water-efficient fixtures can be sold in the State of Texas. Savings occur because all new construction must use water-efficient fixtures, and other fixtures will be replaced at a fairly steady rate. On a regional basis, the Plumbing Act results in about a seven percent reduction in municipal water use (4,751 acre-feet per year) by year 2070.

Manufacturing Demands

The manufacturing demands do not specifically include a level of basic conservation. There may be opportunities for advanced conservation, but the evaluation of these opportunities would require site specific analyses, which are beyond the scope of this effort. Some manufacturing may be able to take advantage of reclaimed water sources for supply, which would be considered a reuse strategy. Region B did not identify the development or use of reuse supplies specifically for only manufacturing.

Mining Demands

The mining demands do not specifically include a level of basic conservation. Opportunities for advanced conservation for mining are addressed in section 5.3.2.

Livestock Demands

Most of the livestock demand in Region B is for free-range livestock. Region B encourages individual ranchers to adopt practices that prevent the waste of water for livestock. However, savings that results from these practices will be small and difficult to quantify.

Therefore, livestock water conservation is not included in the demand projections and is not considered to provide an opportunity for advanced conservation.

Irrigation Demands

Based on factors developed by the TWDB, irrigation demands are expected to decline approximately 6.9 percent over the planning period (2020 to 2070), primarily due to conservation. This reduction in demand is based on the results of an economic model develop prior to the 2006 regional planning effort. The model considered crop mix and adoption of conservation practices as the basis for developing the demand projections, with on-farm conservation practices having the most significant impact on demand.

Steam Electric Demands

Demands for steam electric power were developed on a state-wide basis and these demands assume that long-term power needs will be met with more water efficient facilities, and that the mixture of generating facilities includes wind and solar, which do not require cooling water. However, the steam electric demands for Region B do not include a component of Basic Conservation.

5.3.3 Water Conservation Strategies for Region B

Water conservation strategies must be considered for all water users with a need. In Region B, this includes municipal, manufacturing, mining, agricultural water, and steam electric power users. Water conservation strategies will help address the needs through adoption of Advanced Conservation strategies. The water users with needs (firm or safe supply) are identified in Table 5-4.

Table 5-4 WUGs with Needs

WUG	County
Archer City	Archer
Holliday	Archer
Lakeside City	Archer
Scotland	Archer
Windthorst WSC	Archer
Irrigation	Archer
Mining	Archer
Irrigation	Baylor
Livestock	Baylor
County Other	Clay
Dean Dale SUD	Clay
County other	Foard
Crowell	Foard
County Other	Hardeman
Quanah	Hardeman
Irrigation	Hardeman
Manufacturing	Hardeman
Bowie	Montague
County Other	Montague
Mining	Montague
Burkburnett	Wichita
County-Other	Wichita
Electra	Wichita
Iowa Park	Wichita
Wichita Falls	Wichita
Wichita Valley WSC	Wichita
Irrigation	Wichita
Manufacturing	Wichita
Steam Electric Power	Wichita
County Other	Wilbarger
Vernon	Wilbarger
Irrigation	Wilbarger
Manufacturing	Wilbarger
Steam Electric Power	Wilbarger
County-Other -	Young
Olney	Young

Conservation strategies to reduce industrial (manufacturing, mining, and steam electric power) water use are typically industry and process-specific and cannot be specified to meet county-wide needs. The region recommends that industrial water users be encouraged to develop and implement site-specific water conservation practices. Wastewater reuse is a more general strategy that can be utilized by various industries for process water, and this strategy will be considered where appropriate.

For municipal and irrigation users, additional conservation savings can potentially be achieved in the region through the implementation of conservation best management practices (BMPs). These additional conservation measures were considered for all municipal and irrigation water user groups in Region B.

Although water conservation and drought management have proven to be effective strategies in Region B, the RWPG believes that water conservation should not be relied upon exclusively for meeting future needs. The region will need to develop additional surface water, groundwater and alternative supplies to meet future needs. However, each entity that is considering development of a new water supply should monitor on-going conservation activities to determine if conservation can delay or eliminate the need for a new water supply project.

The RWPG recognizes that it has no authority to implement, enforce or regulate water conservation and drought management practices. The water conservation practices described in this chapter and elsewhere in this plan are intended only as guidelines. Water conservation strategies determined and implemented by municipalities, water providers, industries or other water users supersede the recommendations in this plan and are considered to be consistent with this plan.

5.3.3.1 Municipal Conservation

Both the water conservation plans and water loss audit reports for water suppliers in Region B were reviewed to help identify appropriate municipal water conservation measures.

Since 2003, retail public water utilities have been required to complete and submit a water loss audit form to the TWDB every five years. The second round of water loss audit reports was submitted to the TWDB by May 1, 2011. The TWDB compiled the data from these reports. The water audit reporting requirements follow the International Water Association

(IWA) and American Water Works Association (AWWA) Water Loss Control Committee methodology.

The primary purposes of a water loss audit are to account for all of the water being used and to identify potential areas where water can be saved. Water audits track multiple sources of water loss that are commonly described as apparent loss and real loss. Apparent loss is water that was used but for which the utility did not receive compensation. Apparent losses are associated with customer meters under-registering, billing adjustment and waivers, and unauthorized consumption. Real loss is water that was physically lost from the system before it could be used, including main breaks and leaks, customer service line breaks and leaks, and storage overflows. The sum of the apparent loss and the real loss make up the total water loss for a utility.

Thirty nine (39) water providers in Region B submitted water loss audits in 2010. Based on these reports, the percentage of real water loss for Region B is approximately 6.6 percent, which is within the accepted range of water loss (less than or equal to twelve percent). This is likely due to the large service areas with low population densities characteristic of rural water supply corporations. For the water suppliers that fall under the water supply corporation category, there may be few cost effective options in reducing water loss.

Water Quantity, Reliability and Cost

The water savings associated with municipal conservation vary depending on the potential of the entity's customers to reduce water use. For most water users in Region B, water that is conserved (i.e., not consumed) will further protect the natural resources for future use. The reliability is moderate because this strategy relies on actions of others (customers) and the willingness to change daily behaviors. The suite of recommended strategies focuses on the actions of the water provider, which have shown to be successful in reducing water consumption. The costs are low to moderate for larger entities and high for smaller entities. Much of the higher costs are associated with the leak detection and repair strategy. For Wichita Falls and Vernon, the leak detection and repair strategy include repair/replacement of raw water lines from current water sources (Kickapoo pipeline for Wichita Falls and

Odell-Winston wellfield pipeline for Vernon.). Both of these pipelines were found to have significant water loss.

For smaller entities, major infrastructure replacement associated with the leak detection and repair strategy may not be cost effective. Table 5-5 shows the total water savings by provider for each decade and Table 5-6 shows the associated costs for each decade.

Table 5-5 Water Savings by Decade for Municipal Conservation (ac-ft/yr)

Provider	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Archer City	0	0	6	15	26	32
Holiday	0	0	7	19	32	39
Lakeside City	0	0	2	6	11	15
Scotland	0	3	8	16	22	28
Windthorst WSC	0	4	10	17	25	34
Baylor - County Other	0	0	0	6	10	14
Clay - County Other	0	0	0	18	43	60
Dean Dale WSC	0	0	0	0	0	7
Foard - County other	0	0	1	4	7	8
Crowell	0	0	2	7	13	16
Hardeman - County Other	0	0	0	4	8	13
Quanah	0	0	5	23	41	48
Bowie	27	43	40	48	64	81
Montague - County Other	0	0	3	47	105	144
Burkburnett	148	305	269	251	251	254
Wichita - County other	0	0	2	15	27	36
Electra	0	8	25	53	82	105
Iowa Park	0	0	5	36	76	91
Wichita Falls	4,484	4,484	4,484	4,484	4,484	4,484
Wichita Valley WSC	0	0	0	0	12	24
Wilbarger County Other	0	0	0	13	31	45
Vernon	0	0	0	51	124	202
Vernon (Pipe Replacement)[1]	313	313	313	313	313	313
Young - County Other	0	0	0	0	3	5
Olney	0	0	0	16	38	59
Total	**4,972**	**5,160**	**5,182**	**5,462**	**5,848**	**6,157**

[1] The Vernon pipe replacement is shown separately because this project has capital cost. Water savings for Vernon's other conservation BMPs do not have capital costs.

Table 5-6 Annual Cost for Advanced Municipal Conservation by Decade ($/yr)

Provider	Capital Cost	2020	2030	2040	2050	2060	2070
Archer City	$0	$0	$123	$4,373	$10,225	$17,700	$22,011
Holiday	$0	$0	$0	$3,934	$11,270	$19,359	$23,538
Lakeside City	$0	$0	$0	$1,097	$3,745	$6,805	$9,085
Scotland	$0	$0	$1,663	$4,841	$9,510	$13,442	$16,969
Windthorst WSC	$0	$0	$2,254	$5,793	$10,228	$15,097	$20,404
Baylor - County Other	$0	$0	$0	$0	$4,414	$8,020	$10,748
Clay - County Other	$0	$0	$0	$0	$13,821	$33,005	$46,384
Dean Dale WSC	$0	$0	$0	$0	$0	$0	$5,616
Foard - County other	$0	$0	$0	$883	$3,027	$5,086	$6,478
Crowell	$0	$0	$0	$1,458	$5,586	$10,244	$12,040
Hardeman - County Other	$0	$0	$0	$0	$2,786	$6,487	$9,846
Quanah	$0	$0	$0	$3,277	$13,843	$24,389	$28,840
Bowie	$0	$16,420	$25,603	$24,220	$28,554	$38,160	$48,678
Montague - County Other	$0	$0	$0	$2,345	$35,997	$80,655	$111,122
Burkburnett	$0	$113,955	$234,570	$207,279	$193,588	$192,999	$195,765
Wichita - County other	$0	$0	$0	$1,597	$11,232	$20,828	$27,844
Electra	$0	$0	$5,049	$15,132	$31,765	$49,046	$63,251
Iowa Park	$0	$0	$0	$3,124	$21,350	$45,722	$54,303
Wichita Falls[1.]	$36,656,000	$3,654,000	$3,654,000	$587,000	$587,000	$587,000	$587,000
Wichita Valley WSC	$0	$0	$0	$0	$0	$7,920	$16,653
Wilbarger County Other	$0	$0	$0	$0	$10,259	$23,872	$34,775
Vernon[1]	$7,807,000	$723,000	$723,000	$70,000	$90,259	$83,872	$104,775
Young - County Other	$0	$0	$0	$0	$0	$2,497	$4,221
Olney	$0	$0	$0	$0	$9,743	$22,532	$35,642

[1]The capital cost for Wichita Falls and Vernon include capital costs for water pipeline replacement to reduce losses. It is assumed that the water conservation strategies for the other municipal water users are not capitalized.

Environmental Factors

Potential environmental impacts associated with municipal conservation should be neutral to positive. Reductions in water use will preserve water for other uses, including potential environmental purposes.

Impacts on Water Resources and Other Water Management Strategies

Impacts to natural resources should be neutral to positive. Conserved water by cities would protect limited groundwater supplies and surface waters for future use. If the water remains in the original source and is not used for other purposes, municipal conservation could help maintain existing water quality of these resources. High use of some water sources can possibly degrade water quality over time.

Impacts on Agriculture and Natural Resources

Impacts to agricultural and natural resources should be neutral to positive. Conserved water by cities could provide additional supplies for agricultural and rural areas.

Other Relevant Factors

There are no known impacts to other water resources and management strategies.

5.3.3.2 Agricultural Conservation

The agricultural water needs in Region B include livestock and irrigated agriculture. New water supply strategies to meet these needs are limited. Water conservation for livestock is not addressed due to the diffuse nature of providing water supply. Livestock producers implement conservation strategies as an essential practice in maintaining the viability of their operations.

For irrigated agriculture, the primary strategies identified to address irrigation shortages are demand reduction strategies (conservation). The agricultural water conservation strategies considered include

- Changes in irrigation equipment
- Crop type changes and crop variety changes
- Conversion from irrigated to dry land farming
- Water loss reduction in irrigation canals

Water loss reduction in irrigation canals was addressed in a special study completed in 2009 as a first phase of the 2011 regional water planning effort. The *Wichita County Water Improvement District No. 2 Water Conservation Implementation Plan* presented the study results. As a wholesale water provider, the details of this effort are addressed in Section 5.4.2. In general, the study indicated that nine of the canal segments with the greatest water loss could be replaced with pipe for a total cost of $8,538,000 (September 2013 cost basis) saving 13,034 acre-feet/year for the full planning period (2020-2070) at a unit cost of $48.68 per acre-ft.

In addition to these practices, the region encourages research into development of drought-tolerant crops and implementation of a region-wide evapotranspiration and soil moisture monitoring network to aid farmers in irrigation scheduling.

Irrigation conservation is a strategy that proactively causes a decrease in future water needs by increasing the efficiency of current irrigation practices throughout the region. The adoption of irrigation conservation will help preserve the existing water resources for continued agricultural use and provides for other demands. However, without technical and financial assistance it is unlikely that aggressive irrigation conservation programs will be implemented. Also, increased efficiencies may lead to increased water application rates or increased acreage to increase crop yields while utilizing the same volume of water, thereby negating the potential for water savings.

Region B recognizes that it has no authority to implement, enforce, or regulate irrigation conservation practices. These water conservation practices are intended to be guidelines. Water conservations strategies determined and implemented by the individual water user group superseded the recommendations in this plan and are considered to meet regulatory requirements for consistency with this plan. For purposes of this plan, it is estimated that irrigators will implement such measures that result in a minimum water saving of 10 percent of the projected water use. These savings, along with the estimated water savings developed for the WCWID No.2, are shown in Table 5-7. The conservation quantities shown in Table 5-7 can be achieved by advances in plant breeding which are estimated to cost $8.30 per acre-foot per year.

Table 5-7 Water Savings by Decade for Irrigation Conservation

WCWID No.2 Water Savings from Converting Canals to Pipelines (ac-ft/yr)						
County	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Archer	368	411	454	494	560	626
Clay	0	0	0	0	0	0
Wichita	12,666	12,623	12,580	12,540	12,474	12,408
Voluntary On-farm Conservation Estimated at 10% of Demand (ac-ft/yr)						
County	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Archer	121	118	114	111	111	111
Baylor	331	321	311	302	302	302
Clay	144	140	136	132	132	132
Cottle	400	388	377	366	366	366
Foard	394	382	371	360	360	360
Hardeman	794	770	747	725	725	725
King	3	3	3	3	3	3
Montague	87	87	87	87	87	87
Wichita	4,527	4,449	4,371	4,293	4,293	4,293
Wilbarger	3,160	3,066	2,974	2,884	2,884	2,884
Total	**22,995**	**22,758**	**22,525**	**22,297**	**22,297**	**22,297**

5.3.3.3 Mining Conservation

Most of the mining water use in Region B is used in gas production, and the decline in projected future use is associated with the current Barnett Shale activities declining. In accordance with §27.0511 of the Texas Water Code, Region B encourages the use of alternatives to fresh water for oil and gas production whenever it is economically and technically feasible to do so. Furthermore, Region B recognizes the regulatory authority of the Railroad Commission and the TCEQ to determine alternatives to fresh water use in the permitting process.

Oil and gas companies have been actively pursuing recycling and reuse of the make-up water. These activities are a form of conservation, which is a demand management strategy that decreases future water needs by treating and reusing water used in mining operations. Mining conservation and recycling is possible for both oil and gas mining as well as sand and gravel mining. Mining recycling and conservation was considered for all mining operations in Region B.

The amount of water than can be reused/recycled is dependent on the amount of water that flows back to the surface during and after the completion of the hydraulic fracturing or oil field flooding. For planning purposes, it is assumed that 25% of water used for mining purposes would be sourced from waters that are not suitable for other demands (such as brackish water) or would be available through flow back and reuse/recycle. The flow back water is of low quality and requires treatment or must be blended with fresh water. Some of the flow back water will be lost during the treatment process.

Mining water conservation could result in savings of 1,300 acre-feet per year, decreasing as the drilling activity decline to savings of 425 acre-feet per year in 2070. The mining water savings by county is provided in Table 5-8.

Table 5-8 Mining Water Conservation by Decade (ac-ft/yr)

County	2020	2030	2040	2050	2060	2070
Archer	101	121	86	70	53	53
Baylor	4	4	3	3	3	3
Clay	153	197	146	118	89	89
Cottle	10	10	10	9	8	8
Foard	3	3	3	3	3	3
Hardeman	4	4	5	5	5	5
King	95	83	72	63	55	55
Montague	910	644	402	173	194	194
Wichita	16	15	14	12	11	11
Wilbarger	5	5	5	5	5	5
Young	-	-	-	-	-	-
Total	**1,301**	**1,086**	**746**	**461**	**426**	**426**

Costs for mining conservation may vary considerably depending upon the proximity to water sources, treatment options available, and other factors. The costs shown in Table 5-9 are based on treating flow back water using different treatment technologies.

Table 5-9 Mining Conservation Costs in Region B by County

County	Capital Cost	Annual Costs					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Archer	$1,004,000	$253,000	$303,000	$215,000	$175,000	$133,000	$133,000
Baylor	$33,000	$10,000	$10,000	$8,000	$8,000	$8,000	$8,000
Clay	$1,635,000	$383,000	$493,000	$365,000	$470,000	$223,000	$223,000
Cottle	$83,000	$25,000	$25,000	$25,000	$23,000	$20,000	$20,000
Foard	$25,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000
Hardeman	$42,000	$10,000	$10,000	$13,000	$13,000	$13,000	$13,000
King	$789,000	$238,000	$208,000	$180,000	$158,000	$138,000	$138,000
Montague	$7,553,000	$2,275,000	$1,610,000	$1,005,000	$433,000	$485,000	$485,000
Wichita	$133,000	$40,000	$38,000	$35,000	$30,000	$28,000	$28,000
Wilbarger	$42,000	$13,000	$13,000	$13,000	$13,000	$13,000	$13,000
Young	0	0	0	0	0	0	0
Total	$11,339,000	$3,255,000	$2,718,000	$1,867,000	$1,331,000	$1,069,000	$1,069,000

5.3.3.4 Steam Electric Power Conservation

Steam Electric Power needs in Region B are located in Wichita and Wilbarger counties. The needs in Wichita County can be met with contractual supplies from Wichita Falls. The needs in Wilbarger County however are associated with growth in demands and a decline in the reliability from Lake Kemp due to the current drought. Options for additional sources of supply in Wilbarger County are limited. Previous investigations into local brackish groundwater found that the quantity was limited and the TDS levels were very high. The most likely option would be to retrofit the facility for alternative cooling technology. Transitioning to this kind of technology is a form of conservation, which is a demand management strategy that decreases future water needs by using alternative sources, such as air for cooling. Table 5-10 shows the projected savings from Steam Electric Power Conservation. Capital costs are estimated at $89.7 million. Further discussion is included in Section 5.5.10.

Table 5-10 Steam Electric Power Conservation Water Savings by Decade (ac-ft/yr)

County	2020	2030	2040	2050	2060	2070
Wilbarger	1,114	1,959	2,803	3,648	4,492	5,337

5.3.4 Water Conservation Summary

Water conservation is a demand management strategy than can reduce projected demands and extend the availability of existing supplies. Water conservation strategies have been specifically identified for municipal, irrigation and mining demands. It is expected that conservation strategies will also be adopted by manufacturing and livestock demands, but these have not been quantified. Table 5-11 provides a summary of the conservation savings by decade.

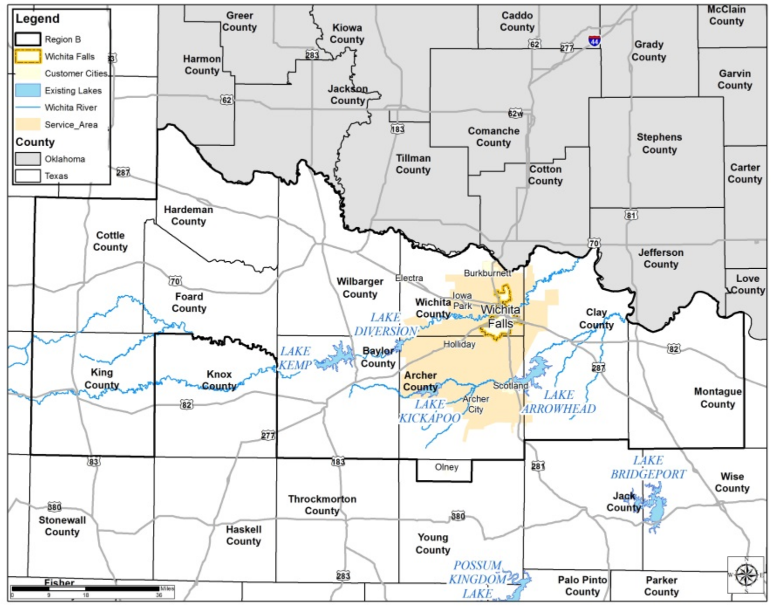
Table 5-11 Summary of Conservation Savings by Water Use (ac-ft/yr)

Use	2020	2030	2040	2050	2060	2070
Municipal	4,972	5,160	5,182	5,462	5,848	6,157
Irrigation	22,995	22,758	22,525	22,297	22,297	22,297
Mining	1,301	1,086	746	461	426	426
SEP	1,114	1,959	2,803	3,648	4,492	5,337
Total	**30,382**	**30,963**	**31,256**	**31,868**	**33,063**	**34,217**

5.4 Wholesale Water Providers

There are two wholesale water providers in Region B. Both wholesale providers are projected to have needs within the planning period. Discussion of the water needs and recommended water management strategies for each of the wholesale water providers follows.

5.4.1 Wichita Falls



The City of Wichita Falls is located in the southeastern portion of Wichita County and has a current population of 104,553. It is the largest city in a radius of about 100 miles, and the nearby communities and towns share economic and cultural ties to Wichita Falls.

The service area of Wichita Falls is approximately 70 percent of the entire Region B population and the municipal water demand on the Wichita Falls system accounts for approximately 88 percent of the total Region B municipal demand. With the majority of the municipal demand being dependent on the City of Wichita Falls for the next 50 years, it is imperative that management strategies be identified and evaluated to increase the system reliability.

Due to recent drought conditions within the region the City of Wichita Falls has recently develop a Long-Range Water Supply Plan. This plan identified 22 potential strategies that were screened for feasibility. Of these strategies, twelve were selected for further evaluations. The potentially feasible strategies for Wichita Falls include:

- Indirect Reuse
- Water Conservation
- Development of Lake Ringgold
- Groundwater From Local Seymour Aquifer
- Groundwater From Seymour Aquifer in Wilbarger County
- Groundwater From Ogallala Aquifer in Roberts County
- Groundwater From Ogallala Aquifer in Donley & Gray Counties
- Wichita River Supply

- Lake Kemp Water Right Amendment
- Groundwater From Trinity Aquifer in Denton County
- Purchase Lake Texoma Water
- Purchase Lake Bridgeport Water

From these strategies, five were recommended. The recommended strategies and strategy evaluations included here were developed in that plan. The costs have been adjusted to be consistent with regional planning requirements. In addition to those five strategies, Wichita Falls is actively pursuing precipitation enhancement within the watersheds of its reservoirs. The city is also supportive of Brush Control which is discussed for Wichita County in in Section 5.5.9. The following strategies were identified as recommended for Wichita Falls:

<u>Recommended Strategies:</u>

- Water Conservation
- Indirect Reuse
- Local Seymour Aquifer
- Wichita River Supply
- Lake Ringgold
- Precipitation Enhancement

<u>Water Conservation</u>

Water Conservation/Efficiency has been a critical drought response strategy for the City of Wichita Falls. Through conservation and drought management, the City has been able to reduce its demand by 50 percent during the current drought. While these measures were critical for demand management during the drought, once the drought has ended some water efficiency measures should be continued, some measures may be discontinued, and additional measures could be implemented. The measures considered in this strategy include:

- Leak detection, repair and pipeline replacement (including Lake Kickapoo raw water pipeline),

- Public education program,
- Water waste ordinance (permanent time of day and day of week restrictions for outdoor watering),
- Landscape ordinance requiring low water use landscapes for new residential construction.

Water Quantity, Reliability and Cost

For the purposes of this plan it was assumed that Wichita Falls could reduce demand by 2,242 acre-feet per year (2 MGD) by actively implementing the identified best management practices. Reducing the water losses associated with the Lake Kickapoo transmission pipeline is estimated to provide another 2,242 acre-feet per year (2 MGD) of water savings during drought. During non-drought periods, the water savings could be greater. With the implementation of these water line replacements and continued water conservation programs, the total water savings for Wichita Falls is estimated at 4,484 acre-feet per year.

The City has an active leak detection, repair and pipeline replacement program and it is expected that the City will continue with this program. The amount of additional water savings can vary depending on how proactive the program is at identifying leaks and replacing pipe. Permanent day of the week irrigation restrictions such as no more than twice per week watering schedules have been shown to have savings of approximately 5 to 8 percent in communities in North Texas. Cities such as Austin, El Paso and San Antonio have implemented water conserving landscape ordinances that have accounted for substantial savings. On a long-term sustainable basis, the water conservations savings are expected to be 4,484 acre feet per year.

The reliability is moderate to moderately high because this strategy relies on actions of others (customers) and the willingness to change daily behaviors. The suite of recommended strategies focuses on the actions of Wichita Falls, which have shown to be successful in reducing water consumption for other entities. It is estimated that the water conservation program could take one year to develop and an additional year to implement. Water savings would be realized over time.

In the cost estimate the replacement of the Lake Kickapoo raw water pipeline and some level of other pipeline replacement were assumed as part of the leak detection, repair and replacement program. Annual costs were also estimated for leak detection and repair personnel, education program, and enforcement of ordinances. As shown in the detailed cost estimate the total capital cost is $36.7 million with an annual cost of $2.50 per thousand gallons with debt service and $0.41 per thousand gallons cost saving after debt service. These costs are actually less if cost savings for deferred pumping and treatment is considered.

Environmental Factors

Potential water quality impacts associated with water conservation should be neutral to positive. Reductions in water use should increase the amount remaining in the lakes and streams potentially improving the water quality.

Impacts on Water Resources and other Water Management Strategies

Potential impacts associated with water conservation should be neutral to positive. Reductions in water use will preserve water for other uses, including potential environmental purposes.

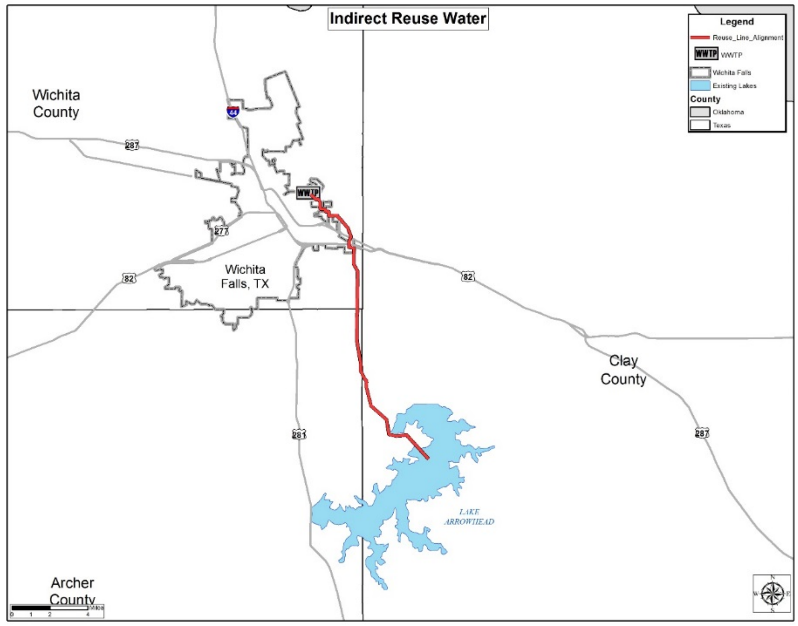
Impacts on Agriculture and Natural Resources

Conserved water by Wichita could provide additional supplies to other users, including agricultural and environmental purposes.

Other Relevant Factors

One potential obstacle is political opposition to permanent water conservation efforts once the current drought ends. There may be a tendency by customers to revert back to water use patterns prior to the drought. It is the goal of this alternative to create a new normal with the same quality of life (reasonable restrictions) while reducing consumption. Water conservation can potentially reduce revenues for the City, which would need to be recovered either through increased rates or other means.

Indirect Reuse



Wichita Falls currently generates approximately 8 MGD of treated wastewater from the River Road WWTP. As an emergency measure, the City has laid 12.5 miles of 32-inch pipeline from the WWTP to the Cypress WTP for advanced treatment and direct reuse with the City's water supplies. The pipeline is not buried, with the intent to reuse this pipeline for the indirect reuse project.

The indirect reuse project would discharge treated wastewater to Lake Arrowhead for diversion by the City for water supply. This would allow the City to fully reuse all of its wastewater effluent. For this strategy, the City would construct a pipeline from the River Road WWTP to Lake Arrowhead to convey 10 MGD of treated wastewater (this amount is the expected amount of wastewater generated when the City is not under extreme drought restrictions). It is assumed that the existing 32-inch pipeline currently being used for the direct potable reuse project would be removed and reinstalled for this strategy. Approximately 5 miles of new 36-inch pipeline would be needed to reach Lake Arrowhead. The water would be discharged directly to the lake.

Water Quantity, Reliability and Cost

The River Road WWTP is currently permitted to discharge up to 19.91 MGD. Historical daily discharges vary from 7 MGD to 12 MGD. At this time the strategy is being planned to provide an additional 10 MGD (11,200 acre-feet per year). One advantage of this project over the direct potable reuse project is that it reduces the treatment losses associated with the direct potable reuse, although it does potentially subject supplies stored in Lake Arrowhead to evaporation. The analysis of Lake Arrowhead with 11,200 acre-feet per year of additional inflow shows an increase of the reliable supply by 11,200 acre-feet per year.

If discharges are less than 11,200 acre-feet per year, then the supply will also be slightly less.

This supply is reliable during drought and should be available in most situations. If water use is restricted, under extreme drought conditions the amount of available reuse supply may be reduced. The other potential impact on reliability is if there is not sufficient supply in Lake Arrowhead with which to blend. It is estimated that design and construction could take approximately three years for this alternative. Since Wichita Falls has already initiated the preliminary stages of this project it is possible that it could be implemented in less time.

The City has obtained financial assistance from the Texas Water Development Board for approximately $33.8 million. As shown in the detailed cost estimate the total capital cost is estimated at $36.4 million with an annual cost of $1.94 per thousand gallons with debt service and an average annual cost of $1.10 per thousand gallons after debt service. Other than water conservation this strategy is the least expensive of the strategies evaluated for Wichita Falls.

Environmental Factors

Environmental impacts associated with the pipeline can likely be avoided during design. The increased inflow to the lake should be a benefit to the environment and aquatic species in the lake. There will be reduced stream flow in the Wichita River, but these impacts are expected to be minimal. There should be minimal impacts to other users since the current wastewater discharges comprise a very small amount of overall flow to the Red River and Lake Texoma.

The project includes advanced treatment at the WWTP to mitigate potential water quality impacts at Lake Arrowhead. Water quality modeling with the advanced treatment shows minimal impacts to the quality in Lake Arrowhead (CDM Smith, 2014).

Impact on Water Resources and Other Water Management Strategies

There should be minimal impacts on water resources or other water management strategies.

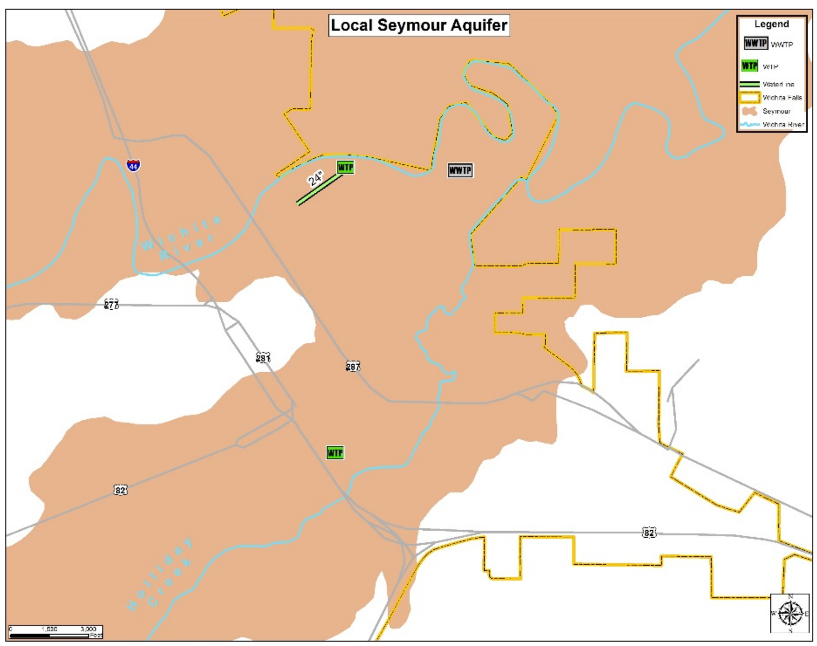
Impacts on Agriculture and Natural Resources

The flow returned to the Wichita River will diminish but this should have minimal impact on agriculture and natural resources.

Other Relevant Factors

While this supply provides some level of independence from current sources, it relies on current sources for its generation. Development of new sources of water will improve the reliability and independence of this water supply. Reductions in indoor City water use due to drought could impact the quantity of water available for reuse. There is currently no competition for this water supply.

Local Seymour Aquifer



This strategy includes the construction and development of 50 groundwater supply wells in the Seymour Aquifer along the Wichita River, on lands owned by private landowners, city-owned properties and others. Based on a study performed by INTERA Geoscience & Engineering, it is anticipated that fifty (50) wells pumping at approximately 35 GPM (0.05 MGD) could potentially provide Wichita Falls with a supplemental potable finished water supply of 2,242 acre-feet per year. The wells would be spaced approximately 1,000 feet apart with collection lines from the well system being pumped into a ground storage tank. This strategy assumes that sufficient property would be acquired to provide the 2,242 acre-foot per year supply. The water would be treated on site by Reverse Osmosis (RO) water treatment on site, and then pumped directly into the water distribution system. The brine waste stream from the RO plant would be discharged to the Wichita River.

Water Quantity, Reliability and Cost

A preliminary study of the existing wells in this area showed that 20 wells spaced 1,000 feet apart could adequately provide for approximately 1 MGD of well water for a period of six (6) months or more, provided sufficient land is available. It is anticipated that additional areas of the Seymour Aquifer along the Wichita River could potentially be utilized to develop additional well fields with similar productivity.

The long term reliability of this water is unknown, if selected, this project should be phased in with continuous onsite evaluations being conducted as additional wells are developed. The Seymour Aquifer is an unconfined aquifer, which means that the water supply is contingent upon direct recharge. During drought conditions, water levels and supplies will likely decline.

To provide 2,242 acre-feet per year of finished water it is estimated the total capital cost would be $19.7 million with an annual cost of $4.91 per thousand gallons with debt service and an average annual cost of $2.66 per thousand gallons after debt service. This strategy could actually be considered short term with the estimated time to complete permitting, design and construction work being approximately three years. This is assuming that some construction may overlap with design.

Environmental Factors

There should be minimal environmental impacts with the construction of the wells, small amount of line work and construction of the treatment plant and pump station. There will also be potential water quality impacts to the Wichita River with the discharge of the reject water from the RO treatment plant. However, if the total discharges to the Wichita River do not exceed the permitted discharges from the Cypress WTP, the impacts should be neutral.

Based on water quality analysis from existing wells on this property, the water will meet all drinking water standards with the exception of Total Dissolved Solids (TDS), Chlorides, Sulfates, and Iron. However, it is anticipated that by constructing a small onsite RO treatment plant this water could be pumped directly into the City's distribution system.

Impacts on Water Resource and Other Water Management Strategies

This strategy may reduce water supplies that are currently being sold for other uses, such as mining and landscape irrigation.

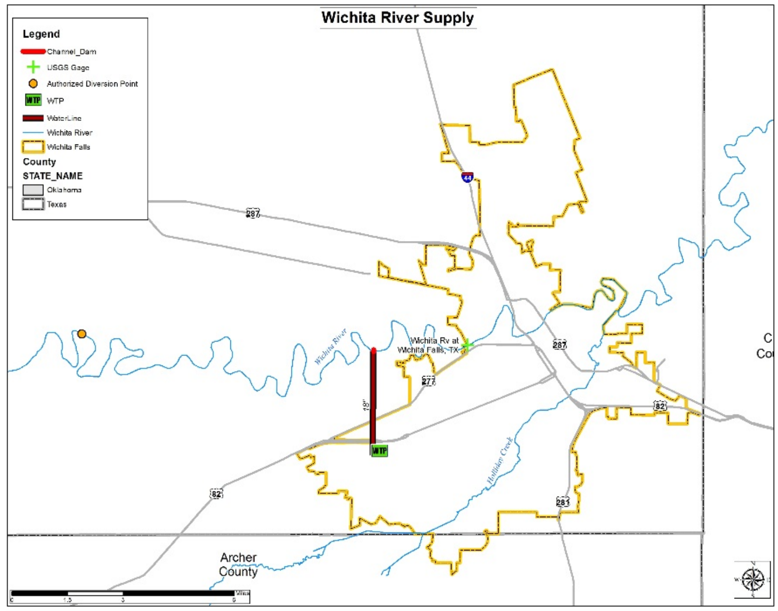
Impacts on Agriculture and Natural Resources

The impact on agriculture and naturals resources should be minimal.

Other Relevant Factors

The City would need to negotiate an agreement with existing landowners for the water rights and then would need to pursue a RO discharge permit with TCEQ (either as a new permit or amendment to the Cypress WTP permit). Also, with additional wells currently being drilled at this site, the City should acquire the pumping and well performance data for further monitoring and site evaluation.

Wichita River Supply



The Wichita River Supply is a direct diversion from the Wichita River at the City of Wichita Falls. The water right for Lake Kemp authorizes diversion and use of up to 16,600 acre-feet per year for irrigation purposes from the Wichita River. This water right has not been used to date and there is no infrastructure to use this supply for irrigation purposes. For this strategy, it is assumed that the Lake Kemp water right would be amended to allow for municipal use from a new diversion point located further downstream from the point currently authorized. The strategy assumes that a small diversion structure is constructed just upstream of the Cypress WTP discharge location. Water would be pumped directly from the river and treated at the Cypress WTP, or blended with existing supplies for conventional treatment.

Water Quantity, Reliability and Cost

The estimated reliable supply from the Wichita River is 2,242 acre-feet per year (2 MGD), but the water right includes the ability to divert over 16,000 acre-feet per year. In order to evaluate the reliability of this diversion, the water authorized under the Kemp water right was assumed to be diverted upstream of the USGS Wichita River at Wichita Falls gage. According to the USGS Gage data an annual diversion of 2,242 acre-feet per year would be available in most years except for the most recent drought years. Prior to 2012, nearly the full authorized diversion of 16,600 acre-feet per year was available.

Based on an analysis of the historical flows at the Wichita Falls gage, it appears that the base flow in the river may be dependent on overflows and return flows from the upstream irrigation district. Curtailment of irrigation use or implementation of irrigation conservation and efficiency strategies may reduce the reliable flows in the river. Also, flows at the Wichita Falls gage after 2009 include discharge flows from the Cypress WTP. This may slightly overestimate the available flow at the proposed diversion point in recent years. However, further review of the flows upstream of the Wichita Falls gage indicate there have been considerable river flows over the past five years that are not dependent upon the WTP discharges or irrigation practices. It is recommended that the City monitor flows in the river before implementing this strategy. Building storage, combining this supply with existing supplies or conjunctive use of groundwater may increase the reliable supply.

The cost estimate assumes that the City will construct a channel dam just upstream of the current Cypress WTP outfall. An intake pump station would be constructed along with an 18" water line to the Cypress WTP for blending. The total capital cost is estimated at $11.2 million. The unit cost with debt service is $2.50 per thousand gallons and $1.22 per thousand gallons after debt service. This cost assumes a 5 MGD pump station at the river. The City could reliably divert more than 5 MGD during normal rainfall periods, but a larger intake pump station would be needed. It is estimated that implementation of this strategy could take three to five years.

Environmental Factors

To access this supply the City would need to build a channel dam to create a pool for diversion. At the channel dam they would need to construct an intake structure. Both of these items along with reduced stream flows due to diversions could impact waters of the U.S. and may require mitigation. Construction of a channel dam would require a Section 404 permit.

Impacts on Water Resources and Other Water Management Strategies

Wichita Falls would need to amend the existing Certificate of Adjudication 02-5123 to move the diversion location downstream on the Wichita River and amend the use type to include municipal use. There is currently an instream flow requirement that the flows may be diverted only when the remaining flow of the river equals or exceeds 10 cfs and 13 cfs at the diversion points.

Impacts on Agriculture and Natural Resources

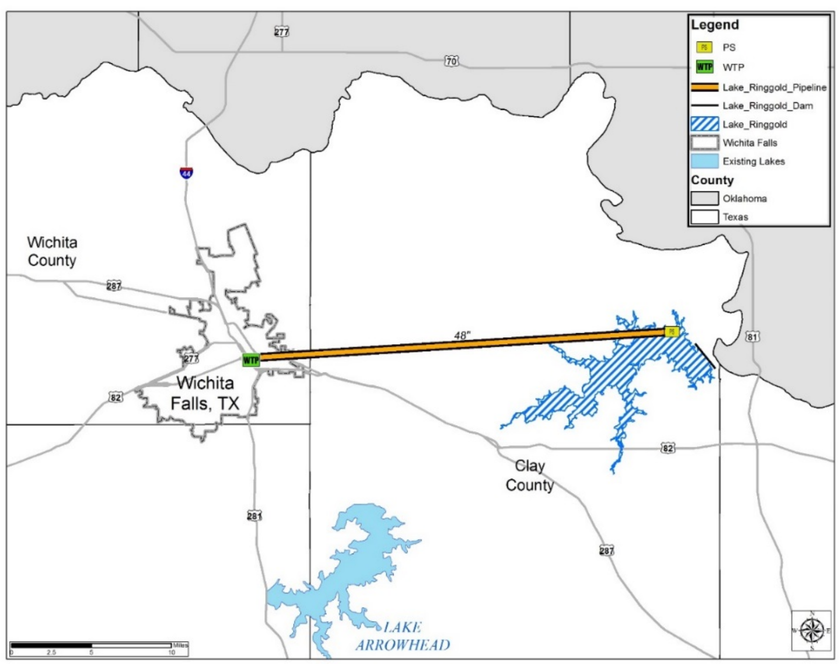
This diversion has not been historically used by any water right user although this right is jointly held by the Wichita County Water Improvement District No.2 (WCWID No.2) and Wichita Falls. An agreement would need to be reached with WCWID No.2 to allow for change of diversion and use. This does potentially preclude WCWID No.2 from using this supply in the future. This strategy does not have an impact to current agricultural water use since this water supply has never been used.

Other Relevant Factors

The relevant factors include the potential water quality, treatment options, storage options, and the potential impact of irrigation operations on reliable supply. Also since this supply is not fully reliable it would need to be combined with other sources.

Lake Ringgold

Lake Ringgold is a proposed 16,000-acre reservoir site located in Clay County, Texas. The proposed dam would be located on the Little Wichita River, approximately 0.5 miles upstream of its confluence with the Red River, and would impound 275,000 acre-feet of water at the normal pool elevation of 844 feet-msl.



This strategy includes construction of the Lake Ringgold dam, intake pump station and a 30-mile pipeline to transport water to the City. The recommend strategy supply is based on the safe yield of the reservoir if the extreme drought continues through 2016 (3-year hydrology extension from 2013).

This reservoir site has been considered as a potential water supply source for Wichita Falls since 1958. There have been many studies on the feasibility of this project, with the most recent study completed in 2012. Information from the 2012 study, along with recent hydrologic analyses, was used as the basis for this evaluation.

Water Quantity, Reliability and Cost

The City of Wichita Falls has identified a potential reservoir site approximately 30 miles northeast of Wichita Falls, near the town of Ringgold. The site would be on the Little Wichita River. Hydrologic modeling indicates that if the drought were to continue for an additional 3 years from the end of 2013 with the same severity as the past three years the firm yield would be approximately 18,600 acre feet per year (16.6 MGD). This is more conservative than the TCEQ WAM Run 3 since it accounts for the recent drought. The firm yield of Lake Ringgold from the TCEQ WAM Run 3 with consensus flows is 34,700 acre feet per year. The reliability of this water supply would be good, but with the Ringgold site being downstream and in the same drainage basin as the two existing lakes, Lake Ringgold could be adversely affected during periods of extended drought that affect the existing sources.

Of the 24,000 acres of land needed for the reservoir site, the City currently owns approximately 6,662 acres. Along with purchasing the remaining lands for the site, additional facilities including a 43 MGD lake intake structure and pump station facilities, and 30 miles of 48" transmission line to convey raw water to existing treatment facilities in Wichita Falls. As shown in the detailed cost estimate provided for the construction of the Lake Ringgold Reservoir, the total capital cost is $331 million with an annual cost of $4.92 per thousand gallons during debt service and $1.52 per thousand gallons after debt service. Unit costs would be less if the drought were to clear and the reliable supply was greater. It is estimated that it will take approximately 20 years from the start of permitting until Lake Ringgold is complete. The majority of this time, 10-12 years, is estimated for the water right and Section 404 permitting process.

Environmental Factors

The construction of Lake Ringgold would require the City to obtain a water right permit from the State to impound and divert water from the Little Wichita River. It also would require a Section 404 permit from the Corps of Engineers to construct the dam. It is estimated that permitting for this project could take 10-12 years.

This reservoir would be in the same drainage basin as Lake Arrowhead and Lake Kickapoo so it is anticipated that the water quality would be very similar to the existing reservoirs. There are currently three permitted wastewater discharges within or upstream of the proposed reservoir. These dischargers may be impacted by higher stream standards, requiring a higher level of treatment and nutrient removal. This impact will need to be considered in the planning and permitting effort for the reservoir. There is sufficient time to address modification of existing wastewater plants to achieve the future stream standards and protect Lake Ringgold as a water supply reservoir.

Lake Ringgold will impact approximately 120 acres of existing ponds and stock tanks and approximately 165 miles of streams. At the conservation elevation of 844 feet, approximately 910 acres of wetlands will be impacted. An assessment of threatened and endangered species in the feasibility study found low to no potential to negatively impact any federally listed threatened or endangered species. Only two of the nine state listed species (Texas horned lizard and Texas kangaroo rat) were identified as having a moderate potential to be impacted by Lake Ringgold. The greatest uncertainty associated with Lake Ringgold is cultural resources with the project site located in an area with known American Indian activities. Approximately two-thirds of the reservoir's site was identified as high potential for cultural resources. In addition, pump stations and the pipeline into the City would be located to avoid or minimize environmental and cultural impacts.

Impacts on Water Resources and Other Water management Strategies

Lake Ringgold is near the confluence of the Little Wichita River and the Red River Basin. The impoundment should have minimal impact on other water resources or other water management strategies. Also, the City of Henrietta's intake structure and small lake would be impacted by Lake Ringgold. A portion of the supply would need to be provided to Henrietta, but the yield in this analysis assumes that supplies to existing water right holders are met.

Impacts on agriculture and Natural resources

The Lake Ringgold alternative would have a moderate to high impact on both agriculture and rural lands in that approximately 9,700 acres of cultivated crops and grassland could be required for the site. Additional lands would likely need to be acquired for mitigation of the project. Potential mitigation sites have not been identified. For planning purpose, it is assumed that an additional 17,280 acres may be needed. The actual amount may be less.

Other Relevant Factors

Existing residences and businesses within the footprint of the reservoir would need to be acquired. Existing landowners would be compensated as part of the project. An additional challenge may be finding suitable mitigation along the Little Wichita River or near the project site.

Precipitation Enhancement

Precipitation enhancement is a water management strategy currently used in Texas to increase precipitation released from clouds over a specified area typically curing the dry summer months. The most common form of rainfall enhancement is cloud seeding. Wichita Falls has an active precipitation enhancement program that runs from March to September of each year.

Water Quantity, Reliability and Cost

The water produced by precipitation enhancement augments existing surface and groundwater supplies. During recent drought years, the City of Wichita Falls has seen increased supplies of about 1,000 acre-feet. This is considered to be reliable supply since Wichita Falls has experienced the increased volume during drought of record conditions. The cost of this program is estimated at $280,000[1].

Environmental Factors

Precipitation enhancement should have a positive impact on the environment due to the increased rainfall from storms. Possible benefits include improved wildlife habitat and landscapes. The chemicals used in weather modification should be sufficiently diluted to minimize any threat of contamination.

Impacts on Water Resources and Other Water management Strategies

This strategy may reduce the demand for water from other water management strategies as the main purpose of the program is to increase reservoir levels at Lakes Kemp, Kickapoo and Arrowhead. Downwind impacts of increased precipitation to areas outside target areas is also an additional benefit.

Impacts on agriculture and Natural resources

This strategy may also have a positive impact on agriculture and ranching by increasing productivity due to increase rainfall.

Other Relevant Factors

The precipitation enhancement program is dependent on funding from the City of Wichita Falls.

Summary of Recommended Strategies for Wichita Falls

The City of Wichita Falls has developed strategies to meet both short term needs due to on-going drought conditions and a long term strategy to meet long term growth related demands. The recommended strategies shown in Table 5-12 could provide 21,178 acre-feet by the year 2020 with an additional 18,600 acre-feet of supply in 2040 when Lake Ringgold is completed. Table 5-13 shows the capital and annual cost associated with the recommended water management strategies.

Table 5-12 Recommended Water Management Strategies for Wichita Falls

-Values in Acre-Feet per Year-

	2020	2030	2040	2050	2060	2070
Wichita Falls Safe Supply Need	10,153	10,569	10,936	11,328	11,859	12,385
Wichita Falls Wholesale Customer Safe Supply Need	5,624	5,880	6,123	6,351	6,547	6,739
Total Safe Supply Need	**15,777**	**16,449**	**17,059**	**17,679**	**18,406**	**19,124**
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	4,484	4,484	4,484	4,484	4,484	4,484
Indirect Reuse	11,210	11,210	11,210	11,210	11,210	11,210
Local Seymour Aquifer	2,242	2,242	2,242	2,242	2,242	2,242
Wichita River Supply	2,242	2,242	2,242	2,242	2,242	2,242
Lake Ringgold			18,600	18,600	18,600	18,600
Precipitation Enhancement	1,000	1,000	1,000	1,000	1,000	1,000
Total	**21,178**	**21,178**	**39,778**	**39,778**	**39,778**	**39,778**

Table 5-13 Cost of Recommended Water Management Strategies for Wichita Falls

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$36,656,000	$3,654,000	$3,654,000	$587,000	$587,000	$587,000	$587,000
Indirect Reuse	$36,400,000	$7,100,000	$7,100,000	$4,000,000	$4,000,000	$4,000,000	$4,000,000
Local Seymour Aquifer	$19,674,000	$3,590,000	$3,590,000	$1,940,000	$1,940,000	$1,940,000	$1,940,000
Wichita River Supply	$11,230,000	$1,830,000	$1,830,000	$900,000	$900,000	$900,000	$900,000
Lake Ringgold	$330,500,000			$29,790,000	$29,790,000	$9,190,000	$9,190,000
Total	**$434,460,000**	**$16,174,000**	**$16,174,000**	**$37,217,000**	**$37,217,000**	**$16,617,000**	**$16,617,000**

Additional Alternative strategies were evaluated in the Long-Range Water Supply Plan and the detailed discussion is not included in this plan. The following strategies were identifies as potential alternative strategies for Wichita Falls:

Alternative Strategies:

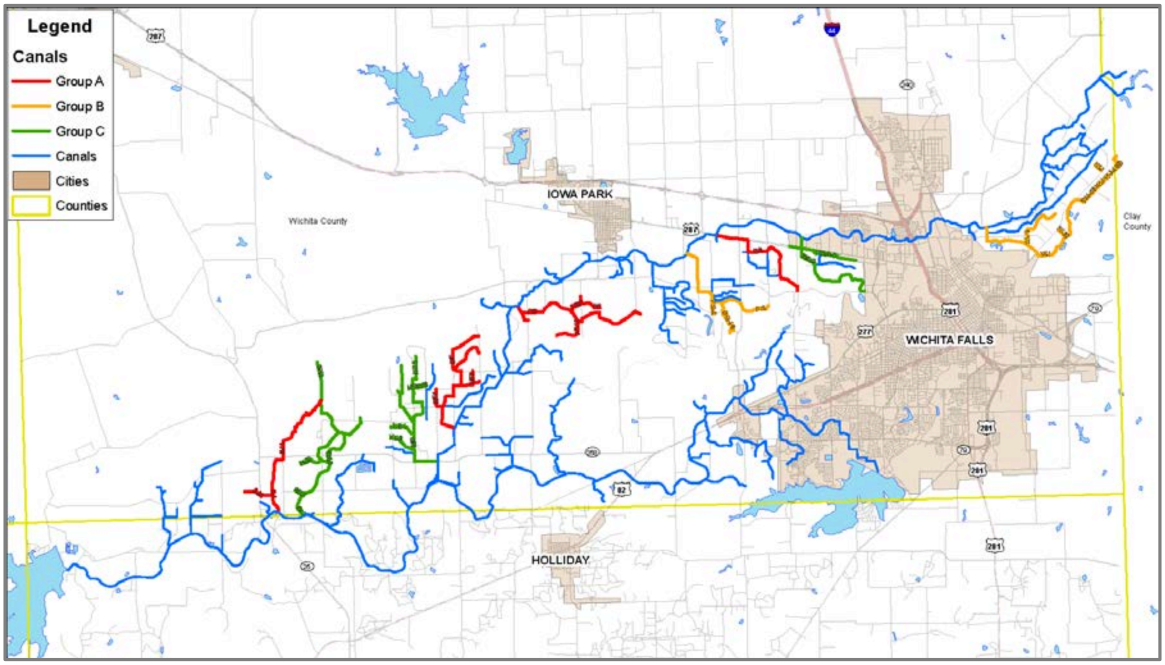
- Lake Bridgeport
- Conjunctive Use (Local Seymour and Wichita River)
- Seymour Aquifer – Wilbarger County
- Lake Texoma
- Ogallala Aquifer - Donley County

These strategies are not recommended as alternative strategies for regional planning purposes.

5.4.2 Wichita County Water Improvement District No. 2

The Wichita County Water Improvement District No. 2 operates a canal system that distributes water to farmers from Diversion Lake in Wichita County, Archer County, and extends slightly into Clay County

A study was completed in 2009 as part of the first phase of the 2011 regional water planning effort. The study, *Wichita County Water Improvement District No. 2 Water Conservation Implementation Plan,* presented results of an evaluation of the canals in the District. The flow and losses in some canals was measured directly. The direct measurements provided water loss per canal segment or length of canal that could then be related to other canals based on canal characteristics: soil type, canal width, and size and type of canal vegetation. The water loss evaluation indicated that nine canal segments, divided into three priority groups, should be considered for conversion to pipelines.



The costs for conversion of the canals to pipe have been updated to a September 2013 cost basis and the costs along with the water savings are presented in Table 5-14.

Table 5-14 Cost and Water Savings for Conversion of Canals to Pipelines

Lateral	Ranking	Water Saved (ac-ft/yr)	Capital Cost ($)	Annual Cost ($)	Unit Cost ($/ac-ft)
Priority Group A					
PB	1	830	401,900	29,900	35.98
SJ	2	1,462	477,600	35,500	24.28
RR	3	1,364	520,600	38,700	28.36
NF	4	3,362	1,646,600	122,400	36.40
Subtotal		***7,018***	***3,046,700***	***226,500***	***32.28***
Priority Group B					
WJ	5	970	731,300	54,300	56.04
PO	6	1,433	1,455,000	108,100	75.46
Subtotal		***2,403***	***2,186,300***	***162,400***	***67.59***
Priority Group C					
RRG	7	1,672	1,080,400	80,300	48.02
SK	8	790	585,000	43,500	55.03
NB	9	1,152	1,639,500	121,800	105.77
Subtotal		***3,614***	***3,304,900***	***245,600***	***67.96***
Total		**13,034**	**8,538,000**	**634,500**	**48.68**

In general, the study indicated that nine of the canal segments with the greatest water loss could be replaced with pipe for a total cost of $8,538,000, saving 13,034 acre-feet/year for the full planning period (2020-2070) at a unit cost of $48.68 per acre-ft. This equates to a savings that varies from about 13% to about 14% of the projected irrigation demand.

The water savings would be apportioned to the counties with needs, which includes Wichita and Archer counties. Clay County receives a small amount of water from the WCWID No. 2, but is not shown to have a water supply need.

Water Quantity, Reliability and Cost

The water savings associated with irrigation conservation vary.

Environmental Factors

Potential environmental impacts associated with irrigation conservation should be neutral to positive. Reductions in water use will preserve water for other uses, including potential environmental purposes.

Impacts on Water Resources and Other Water management Strategies

Impacts to natural resources should be neutral to positive. Conserved water by irrigation systems would protect limited surface water supplies for future use. If the water remains in the original source and is not used for other purposes, irrigation conservation could help maintain existing water quality of these resources. Excessive depletion of surface water sources can degrade water quality over time due to increased temperatures, leading to more rapid evaporation and concentration of salts.

Impacts on Agriculture and Natural Resources

Impacts to agricultural and natural resources should be neutral to positive. Conserved water could enable agricultural producers greater access to water for irrigation and would improve the natural resources in the vicinity of the water source.

Other Relevant Factors

There are no known impacts to other water resources and management strategies.

Table 5-15 Recommended Water Management Strategies for WCWID No. 2

-Values in Acre-Feet per Year-

Recommended Strategies	2020	2030	2040	2050	2060	2070
Canal Conversion to Pipeline	13,034	13,034	13,034	13,034	13,034	13,034

Table 5-16 Cost of Recommended Water Management Strategies for WCWID No. 2

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Canal Conversion to Pipeline	$8,538,000	$634,500	$634,500	634,500	$634,500	634,500	$634,500

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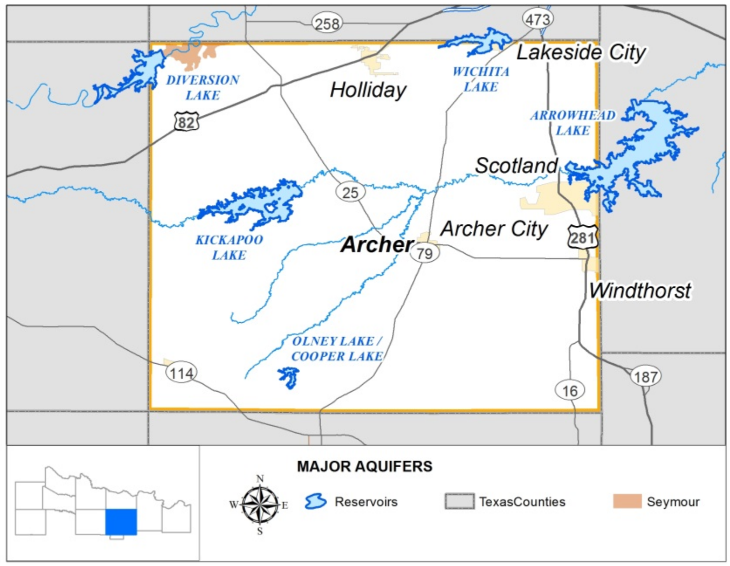
5.5 County Summaries

There are ten full counties and one partial county in Region B, of which two (Cottle and King Counties) show no projected water needs. This subchapter discusses the water issues of each county and outlines the proposed water management strategies to meet the identified needs. For some counties, there are projected shortages that cannot be met through an economically viable project. It is important to remember that economic viability of a project is based on the current understanding of the value of water and that maximum cost that can be paid for water in certain industries such as irrigated agriculture. These assumptions of economic viability may change over time and will be reevaluated in the next plan. These “unmet needs” are also identified, if present, by county. Descriptions of water management strategies that are developed by a wholesale water provider are discussed in Section 5.4 and included in the county summary tables for completeness, as appropriate. Detailed costs are presented in Appendix C and a summary evaluation matrix is included in Appendix D.

5.5.1 Archer County



Archer County is located in the southeast portion of the Region B planning area. The population of Archer County in 2010 was 9,054. Most of the municipal water supply in Archer County is supplied by Wichita Falls as either treated water or raw water directly from Lakes Arrowhead or Kickapoo. Irrigation supplies are provided from Lake Kemp through a series of canals owned and operated by the WCWID No. 2. Some local groundwater supplies are used by County-Other, Livestock and Manufacturing. The total safe-supply need in Archer County is over 2,100 acre-feet by the year 2070. Individual water user groups and their strategies are listed below. For the municipal water user groups the recommended strategies include water conservation and fulfillment of the existing contracts from Wichita Falls through Wichita Falls' development of strategies. The evaluation of the recommended strategies for Wichita Falls are discussed in Section 5.4.1.

Archer City

Archer City has a raw water contract with Wichita Falls to supply 336 acre-feet per year. The recommended strategies for Archer City include water conservation, fulfillment of the existing contract from Wichita Falls and an increase in their contract amount.

Recommended Strategies:

- Water Conservation (Section 5.3)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide the full contracted supply from Wichita Falls.
- Voluntary Transfer from Wichita Falls

Summary of Recommended Strategies for Archer City

The recommended strategies for Archer City of water conservation and the existing contract from Wichita Falls are sufficient to meet the water needs, but some additional supply will be voluntarily transferred to meet the safe supply shortage. Table 5-17 shows the need and recommended strategies to meet that need. Since Archer City has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no capital or annual costs with the existing contract, however, there will be annual costs associated with voluntary water transfers of raw water at a rate of $3.50 per 1,000 gallons. Table 5-18 shows the annual cost for the recommended strategies.

Table 5-17 Archer City Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	128	124	122	122	126	131
Safe Supply Shortage	184	178	175	174	178	183
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	0	6	15	26	32
Fulfillment of Existing Contract with Wichita Falls	164	169	175	174	178	183
Voluntary Transfer from Wichita Falls	20	9	0	0	0	0
Total	184	178	181	189	204	215

Table 5-18 Archer City Capital and Annual Cost

Recommended Strategies	**Capital Cost**	**Annual Cost**					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$123	$4,373	$10,225	$17,700	$22,011
Voluntary Transfer	$0	$228,100	$102,600	$0	$0	0$	$0
Total	$0	$228,100	$102,723	$4,373	$10,225	$17,700	$22,011

Holliday

Holliday has a treated water contract with Wichita Falls to supply "sufficient quantities to meet Holliday's needs". The recommended strategies for Holliday include water conservation and fulfillment of the existing contract from Wichita Falls.

Recommended Strategies:

- Water Conservation (Section 5.3.2.1)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide for the full contracted supply from Wichita Falls.

Summary of Recommended Strategies for Holliday

The recommended strategies for Holliday of water conservation and the existing contract from Wichita Falls are sufficient to meet the safe supply shortages. Table 5-19 shows the need and recommended strategies to meet that need. Since Holliday has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no capital or annual costs associated with fulfillment of the contractual obligations. Table 5-20 shows the annual cost for the recommended strategies.

Table 5-19 Holliday Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	110	127	135	139	145	151
Safe Supply Shortage	167	190	198	202	208	214
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	0	7	19	32	39
Fulfillment of Existing Contract with Wichita Falls	167	190	198	202	208	214
Total	167	190	205	221	240	253

Table 5-20 Holliday Capital and Annual Cost

Recommended Strategies	**Capital Cost**	**Annual Cost**					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$0	$3,934	$11,270	$19,359	$23,538

Lakeside City

Lakeside City has a treated water contract with Wichita Falls to supply an average annual supply of 179 acre-feet per year. The recommended strategies for Lakeside City include water conservation and fulfillment of the existing contract from Wichita Falls.

Recommended Strategies:

- Water Conservation (Section 5.3.2.1)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide for the full contracted supply from Wichita Falls.

Summary of Recommended Strategies for Lakeside City

The recommended strategies for Lakeside City of water conservation and the existing contract from Wichita Falls are sufficient to meet the safe supply shortages. Table 5-21 shows the need and recommended strategies to meet that need. Since Lakeside City has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no capital cost or annual costs associated with fulfillment of the contractual obligations. Any water purchased would be under the existing contract. Table 5-22 shows capital cost and the annual cost for the recommended strategies.

Table 5-21 Lakeside City Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	44	46	47	48	50	53
Safe Supply Shortage	71	73	74	74	76	79
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	0	2	6	11	15
Fulfillment of Existing Contract with Wichita Falls	71	73	74	74	76	79
Total	71	73	76	80	87	94

Table 5-22 Lakeside City Capital and Annual Cost

Recommended Strategies	**Capital Cost**	**Annual Cost**					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$0	$1,097	$3,745	$6,805	$9,085

Scotland

Scotland has a treated water contract with Wichita Falls to supply an average annual supply of 202 acre-feet per year. The recommended strategies for Scotland include water conservation and voluntary transfers from Wichita Falls.

Recommended Strategies:

- Water Conservation (Section 5.3.2.1)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide the full contracted supply from Wichita Falls.
- Voluntary Transfer from Wichita Falls

Voluntary Transfer from Wichita Falls

This strategy would provide for the full contracted supply and provide additional water through an increase in the contract amount. The current contract with Wichita Falls is for 202 acre-feet per year, which is not sufficient to cover the safe supply needs of approximately 240 acre-feet. This strategy assumes the full existing contract amount is met and the contract is increased to 325 acre-feet per year.

Water Quantity, Reliability and Cost

With the development of new water management strategies, Wichita Falls has sufficient supplies to fully meet the contractual demands for Scotland and provide an additional 123 acre-feet per year to meet the City's safe supply need of 240 acre-feet per year. The reliability is considered moderate to high with Wichita Falls recommended strategies. No additional infrastructure is required in order to use this supply thus there are no capital costs for this strategy. Costs for the additional contracted amount is based on a regional estimate for purchased water. No costs are assigned to the supplies under the existing contract.

Environmental Factors

The environmental impact of voluntary transfers from Wichita Falls are minimal. The impacts from Wichita Falls recommended strategies are discussed in section 5.3.1.

Impacts on Water Resources and other Water Management Strategies

The impact on water resources and other water management strategies of voluntary transfers from Wichita Falls are minimal. The impacts from Wichita Falls recommended strategies are discussed in section 5.3.1.

Impacts on Agriculture and Natural Resources

The impact on agriculture and natural resources of voluntary transfers from Wichita Falls are minimal. The impacts from Wichita Falls recommended strategies are discussed in section 5.3.1.

Other Relevant Factors

There are no additional factors identified.

Summary of Recommended Strategies for Scotland

The recommended strategies for Scotland of water conservation and voluntary transfers from Wichita Falls are sufficient to meet the safe supply shortages. Table 5-23 shows the need and recommended strategies to meet that need. Table 5-24 shows capital cost and the annual cost for the recommended strategies.

Table 5-23 Scotland Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	112	161	174	177	179	183
Safe Supply Shortage	156	213	228	231	233	237
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	3	8	16	22	28
Fulfillment of Existing Contract with Wichita Falls	98	102	105	108	111	115
Voluntary Transfer from Wichita Falls	58	111	123	123	122	122
Total	156	219	247	247	255	265

Table 5-24 Scotland Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$0	$1,663	$4,841	$9,510	$13,442	$16,969
Voluntary Transfer	$0	$94.491	$180,836	$200,385	$200,385	$198,756	$198,756
Total	$0	$94,491	$182,499	$205,226	$209,895	$212,198	$215,725

Wichita Valley WSC

Wichita Valley WSC has a raw and treated water contract with Wichita Falls to supply an average annual supply of 1,132 acre-feet per year. They also have a pass through contract with Iowa Park for an additional supply of 675 acre-feet per year. The recommended strategies for Wichita Valley WSC are discussed in the Wichita County summary since the majority of the use is in Wichita County.

Windthorst WSC

Windthorst WSC has a raw water contract with Wichita Falls to supply an average annual supply of 420 acre-feet per year. The recommended strategies for Windthorst WSC in both Archer and Clay Counties include water conservation and fulfillment of the existing contract from Wichita Falls.

Recommended Strategies:

- Water Conservation (Section 5.3.2.1)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide for the full contracted supply from Wichita Falls.
- Voluntary Transfer from Wichita Falls

Summary of Recommended Strategies for Windthorst WSC

The recommended strategies for Windthorst WSC of water conservation and voluntary transfers from Wichita Falls are sufficient to meet the safe supply shortages. Table 5-25 shows the need and recommended strategies to meet that need. Since Windthorst WSC has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no capital or annual costs associated with fulfillment of the contractual obligations. Table 5-26 shows capital cost and the annual cost for the recommended strategies.

Table 5-25 Windthorst WSC Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	172	190	195	200	206	212
Safe Supply Shortage	249	269	274	279	285	291
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	4	10	17	25	34
Fulfillment of Existing Contract with Wichita Falls	205	212	218	225	232	238
Voluntary Transfer from Wichita Falls	44	54	53	49	47	47
Total	249	270	281	291	304	319

Table 5-26 Windthorst WSC Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$2,254	$5,793	$10,228	$15,097	$20,404
Voluntary Transfer	$0	$5,018	$6,158	$6,044	$5,588	$5,360	$5,360
Total	$0	$5,018	$8,412	$11,837	$15,816	$20,457	$25,764

Irrigation – Archer County

Irrigation is projected to have a shortage of 736 acre-feet per year by 2070. Much of this shortage is associated with reduced supplies from the Lake Kemp/Diversion system. Strategies developed by the WCWID No.2 to reduce losses in the irrigation canals will provide additional water to irrigation users of this system. In addition, the Chloride Control Project (CCP), developed by the federal government and RRA, will also reduce demands for irrigation. The recommended strategies for irrigation in Archer County are agricultural conservation, which is discussed in Section 5.4.2 as part of the conservation that could be achieved by the WCWID No.2, and the CCP, which is discussed in Section 5.11.

Summary of Recommended Strategies for Irrigation-Archer County

The recommended strategy for irrigation in Archer County is water conservation and CCP. Table 5-27 shows the need and recommended strategy to meet that need. The capital cost and the annual cost for the canal replacement project are shown for WCWID No.2.

Table 5-27 Irrigation – Archer County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	488	528	567	604	670	736
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	489	529	568	605	671	737
Chloride Control – RRA	144	129	114	99	86	73

<u>Mining – Archer County</u>

Mining has a projected shortage of 255 acre-feet per year in 2020. There are few options for additional supplies for mining. The recommended water supply strategy for mining in Archer County is conservation which is expected to save approximately 30% of the projected demand as discussed in Section 5.3.2.3

Summary of Recommended Strategies for Mining-Archer County

The recommended strategy for mining in Archer County is water conservation. Table 5-28 shows the need and recommended strategy to meet that need. Even with conservation, there is a projected unmet water need for mining. Costs for mining conservation were not developed.

Table 5-28 Mining – Archer County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	255	333	195	131	67	67
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	101	121	86	70	53	53
Unmet Water Need (ac-ft/yr)	**154**	**212**	**109**	**61**	**14**	**14**

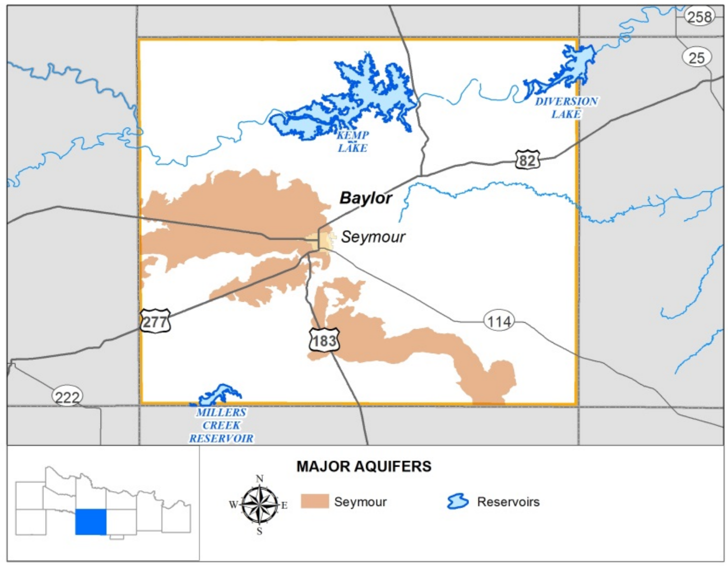
Archer County Summary

The maximum projected water need for Archer County is 1,800 acre-feet per year with most of this need (736 acre-feet per year) associated with an irrigation supply shortage. The remainder of the need is associated with insufficient supplies for existing contracts with Wichita Falls. As Wichita Falls develops its strategies to meet its contractual demands, these water needs will be met. The safe need for Archer County through the planning period is 2,109 acre-feet per year. This safe supply need will be met through Wichita Falls' supplies. Mining is shown to have an unmet need due to limited supplies.

Table 5-29 Archer County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/ 1,000 gal	Implement Decade
Archer City	Water Conservation	32	2.11	2040
	By Contract	183	NA	2020
	Voluntary Transfer	20	3.50	2020
City of Holliday	Water Conservation	39	1.85	2040
	By Contract	214	NA	2020
Lakeside City	Water Conservation	15	1.85	2040
	By Contract	79	NA	2020
Scotland	Water Conservation	28	1.85	2030
	By Contract	115	NA	2020
	Voluntary Transfer	122	5.00	2020
Windthorst WSC	Water Conservation	34	1.85	2030
	By Contract	238	NA	2020
	Voluntary Transfer	54	0.35	2020
Irrigation	Water Conservation	810	0.07	2020
Mining	Water Conservation	101	7.69	2020
TOTAL		**2,011**		
Unmet Max Mining Need of 212 acre-feet per year in 2030.				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.2 Baylor County



Baylor County is located in the south central portion of the Region B planning area. The population of Baylor County in 2010 was 3,726. Most of the water supply in Baylor County is supplied from the Seymour Aquifer, Other supplies include local aquifer, Millers Creek Reservoir, run-of-river supplies and stock ponds. The total supply need in Baylor County is approximately 518 acre-feet through the planning period. Individual water user groups and their strategies are listed below.

<u>Irrigation – Baylor County</u>

The recommended strategy for irrigation in Baylor County is agricultural conservation which is discussed in Section 5.3.2.2. Baylor County does not have a canal distribution system such as that used by WCWID No. 2, so conservation will be implemented on farm by individual producers. A specific conservation target is not established, but the volume that could result from achieving 10% conservation was assessed. With or without conservation, there is an unmet need for irrigation in 2020.

Summary of Recommended Strategies for Irrigation-Baylor County

The recommended strategy for irrigation in Baylor County is water conservation. Table 5-30 shows the need and benefit of achieving 10% additional conservation. No cost information is shown as all conservation is voluntary and will be implemented by individual producers.

Table 5-30 Irrigation – Baylor County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	388	312	213	119	119	119
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	331	321	311	302	302	302
Unmet Need (ac-ft/yr)	**57**	**0**	**0**	**0**	**0**	**0**

Livestock – Baylor County

Livestock is shown to have a water need of 130 acre-feet per year. The current sources of water include stock ponds and local groundwater from the Seymour or Other aquifers. There is no available groundwater to develop additional supplies for livestock and the reliability of water from additional stock ponds is low during drought. Conservation options for livestock are limited. The most likely response in drought would be to reduce livestock herds through sales or transfer to other properties outside of Baylor County. There is no recommended strategy for Baylor County livestock needs. The unmet water needs are shown in Table 5-31.

Table 5-31 Livestock – Baylor County Unmet Water Need

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	130	130	130	130	130	130

Baylor County Summary

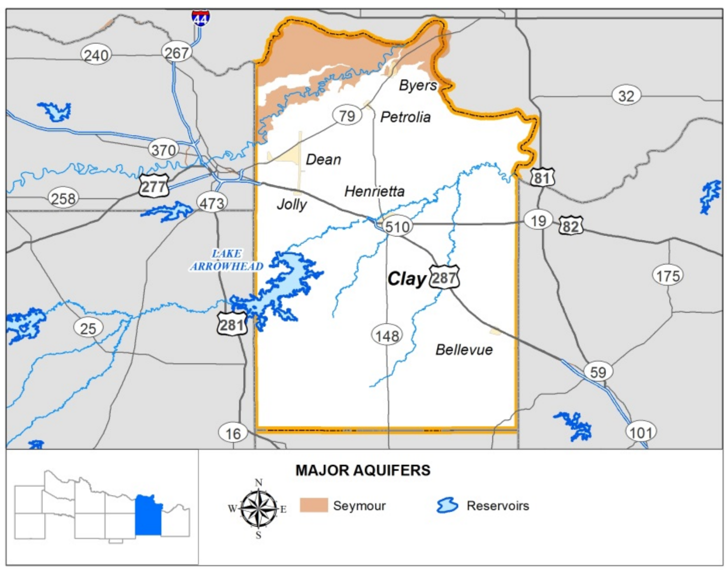
The maximum projected water need for Baylor County is 518 acre-feet per year with most of this need (388 acre-feet per year) associated with an irrigation supply shortage. Livestock has a need of 130 acre-feet per year, which cannot be met through available supplies in the county. A summary of the recommended strategies for Baylor County is shown on Table 5-32.

Table 5-32 Baylor County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/ 1,000 gal	Implement Decade
County-Other	Water Conservations	14	$2.35	2050
Irrigation	Water Conservation	331	$0.03	2020
TOTAL		345		
Unmet Irrigation Need of 57 acre-feet per year in 2020.				
Unmet Livestock Need of 130 acre-feet per year through planning period				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.3 Clay County

Clay County is located in the eastern portion of the Region B planning area. The population of Clay County in 2010 was 10,752. The water supply in Clay County is supplied from a variety of sources including the Seymour Aquifer, Other supplies include local aquifer, run-of-river supplies stock ponds, and contracts with Wichita Falls. The total safe-supply need in Clay County is approximately 160 acre-feet by the year 2070. Individual water user groups and their strategies are listed below.



Clay County - Other

Clay County-Other has sufficient supplies to meet its water needs, but is shown to have a small safe supply need. Municipal conservation, which is discussed in Section 5.3.2.1, will meet some of the safe supply shortage. To meet the remaining safe supply need, small rural communities could purchase water from Henrietta. Henrietta is shown to have supplies in excess of their needs.

Summary of Recommended Strategies for Clay County-Other

The recommended strategy for Clay County-Other is water conservation and voluntary transfer at $3.50 per 1,000 gallons. It is assumed that no additional infrastructure is needed. Table 5-33 shows the need and recommended strategy to meet that need. Table 5-34 shows the capital cost and the annual cost for the recommended strategies.

Table 5-33 Clay County Other Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	0	0	0	0
Safe Supply Shortage	50	53	39	35	40	47
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	0	0	18	43	60
Voluntary Transfer	50	53	39	17	0	0
Total	50	53	39	35	43	60

Table 5-34 Clay County-Other Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$0	$0	$13,821	$33,005	$46,384
Voluntary Transfer	$0	$57,021	$60,442	$44,476	$19,387	0	0
Total	$0	$57,021	$60,442	$44,476	$33,208	$33,005	$46,384

<u>Dean Dale SUD</u>

Dean Dale SUD is split between Clay and Wichita Counties with the majority of the population and demand in Clay County. Dean Dale SUD has a treated water contract with Wichita Falls to supply 462 acre-feet. The recommended strategies for Dean Dale SUD include water conservation and fulfillment of the existing contract from Wichita Falls.

<u>Recommended Strategies:</u>

- Water Conservation (Section 5.3.2.1)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide for the full contracted supply from Wichita Falls.

Summary of Recommended Strategies for Dean Dale SUD

The recommended strategy for Dean Dale SUD is water conservation and fulfillment of existing contract with Wichita Falls. Table 5-35 shows the need and recommended strategy to meet that need. Since Dean Dale SUD has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no capital or annual costs. Table 5-36 shows the annual cost for the recommended strategy.

Table 5-35 Dean Dale SUD Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	21	22	20	24	34	42
Safe Supply Shortage	72	72	68	71	82	90
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	0	0	0	0	7
Fulfillment of Existing Contract with Wichita Falls	72	72	68	71	82	90
Total	72	72	68	71	82	97

Table 5-36 Dean Dale SUD Capital and Annual Cost

Recommended Strategies	**Capital Cost**	**Annual Cost**					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Conservation	$0	$0	$0	$0	$0	$0	$5,616

Windthorst WSC

Windthorst WSC's service area is located primarily in Archer County and the discussion of their recommended strategies can be found in Section 5.5.1.

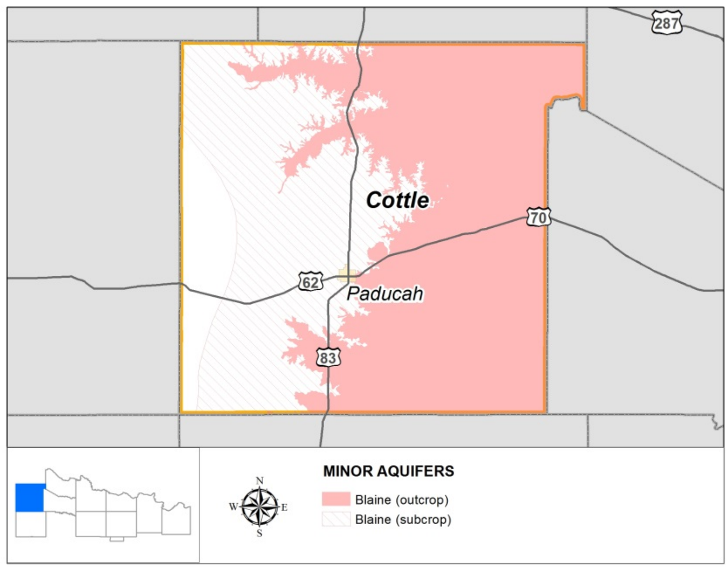
Clay County Summary

The maximum projected water need for Clay County is 42 acre-feet per year associated with a supply shortage for Dean Dale SUD. Safe need for Clay County is 140 acre-feet per year. A summary of the recommended strategies for Clay County is shown on Table 5-37.

Table 5-37 Clay County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/ 1,000 gal	Implement Decade
Dean Dale SUD	Water Conservation	7	2.46	2070
	By Wichita Falls Contract	90	NA	2020
County Other	Water conservation	18	2.35	2050
	Voluntary Transfer	53	3.50	2020
TOTAL		168		
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.4 Cottle County

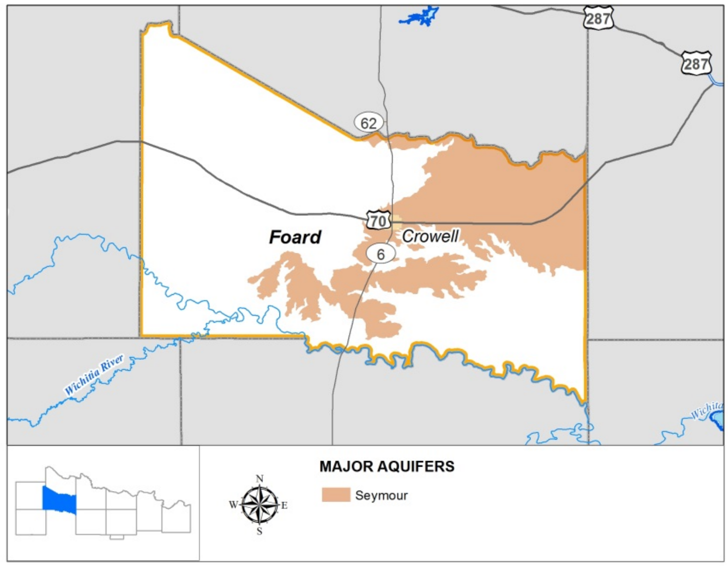


Cottle County is located in the far western portion of the Region B planning area. The population of Cottle County in 2010 was 1,505. The water supply in Cottle County is primarily groundwater from the Blaine Aquifer and other local aquifers. Some supplies for irrigation and livestock are from run-of-river supplies or stock ponds. There are no identified needs in Cottle County during the planning period.

<u>Cottle County Summary</u>

There are no projected water needs in Cottle County through the planning period.

5.5.5 Foard County



Foard County is located in the central portion of the Region B planning area. The population of Foard County in 2010 was 1,336. The water supply in Foard County is obtained from a variety of sources including Greenbelt Reservoir, the Seymour aquifer, the Blaine aquifer, other local aquifers, and stock ponds. There are no firm supply water needs in Foard County. The City of Crowell and County-Other have a total safe-supply need of approximately 30 acre-feet by the year 2070. This is associated with supply allocations from the Greenbelt MIWA. The MIWA has sufficient supplies to meet these needs.

<u>Foard County - Other</u>

Foard County-Other purchases water from the City of Crowell and Red River Authority, and uses self-supplied groundwater. Both Crowell and RRA receive water from Greenbelt MIWA. There is a small safe supply need associated with these water sales. The recommended strategy for Foard County-Other is obtaining additional supplies, if needed, from Greenbelt MIWA sources to meet the safe supply demand.

<u>Recommended Strategies:</u>

- Water Conservation (Section 5.3)
- Voluntary Transfer- This strategy would provide additional supply from Greenbelt MIWA through Crowell and RRA. Greenbelt MIWA is located in Region A and has sufficient current supplies to meet this safe supply need.

Summary of Recommended Strategies for Foard County-Other

The recommended strategy for Foard County-Other is water conservation and voluntary transfer from Greenbelt MIWA at a rate of $3.50 per 1,000 gallons. Table 5-38 shows the need and recommended strategy to meet that need. Table 5-39 shows the annual cost for the recommended strategy.

Table 5-38 Foard County-Other Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	0	0	0	0
Safe Supply Shortage	5	3	1	1	1	1
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	0	1	4	7	8
Voluntary Transfer	5	3	0	0	0	0
Total	5	3	1	4	7	8

Table 5-39 Foard County-Other Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$0	$883	$3,027	$5,086	$6,478
Voluntary Transfer	$0	$5,702	$3,421	$0	$0	$0	0
Total	$0	$5,702	$3,421	$2,023	$4,167	$6,226	$7,618

Crowell

The City of Crowell purchases water from the Greenbelt MIWA. The MIWA will provide for all of Crowell's demands. The shortage shown for Crowell is the additional supply needed to meet the safe supply demand. Greenbelt MIWA has sufficient supplies to meet these safe demands. The recommended strategy for Crowell is municipal conservation and obtaining additional supplies, if needed, from Greenbelt MIWA to meet the safe supply demand.

Recommended Strategies:

- Water Conservation (Section 5.3)
- Voluntary Transfer – This strategy would provide additional Supply from Greenbelt MIWA.

Summary of Recommended Strategies for Crowell

The recommended strategy for Crowell is water conservation and additional supplies from Greenbelt MIWA. Table 5-40 shows the need and recommended strategy to meet that need. The additional supplies from Greenbelt MIWA do not require any additional infrastructure and therefore have no capital costs. Annual cost represent the regional purchase price for treated water at an estimated rate of $3.50 per 1,000 gallons. Table 5-41 shows capital cost and the annual cost for the recommended strategy.

Table 5-40 Crowell Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	0	0	0	0
Safe Supply Shortage	28	27	26	26	26	26
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	0	2	7	13	16
Voluntary Transfer	28	27	24	19	13	10
Total	28	27	26	26	26	26

Table 5-41 Crowell Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$0	$1,458	$5,586	$10,244	$12,040
Voluntary Transfer	$0	$31,931	$30,791	$27,370	$21,668	$14,825	$11,404
Total		$31,931	$30,791	$28,828	$27,254	$25,069	$23,444

Foard County Summary

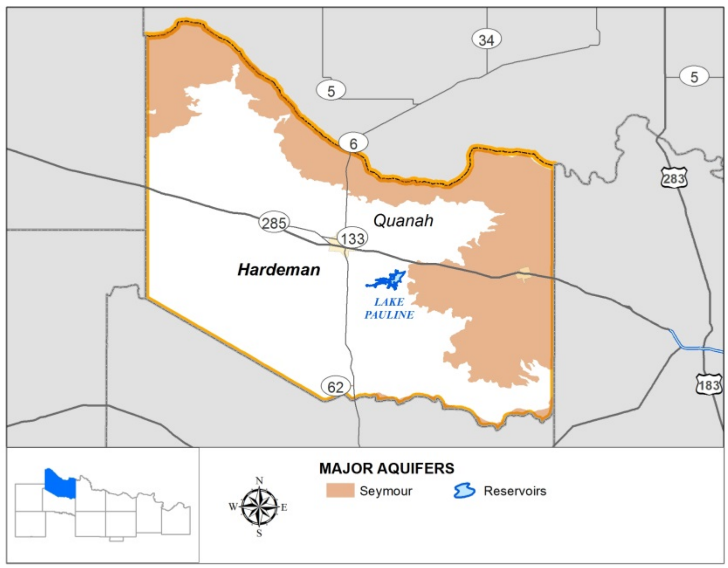
Foard County has sufficient supplies to meet its needs. There is a small safe supply need associated with customers of Greenbelt MIWA. The Authority has sufficient supplies to meet the safe water needs. There is a safe need only of 33 acre-feet per year for Foard County with most of that need (28 acre-feet per year) associated with the City of Crowell. A summary of the recommended strategies for Foard County is shown on Table 5-42.

Table 5-42 Foard County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/ 1,000 gal	Implement Decade
County Other	Water Conservation	1	$2.70	2040
	Voluntary Transfer	5	$3.50	2020
Crowell	Water Conservation	2	$2.24	2040
	Voluntary Transfer	28	$3.50	2020
TOTAL		36		
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.6 Hardeman County

Hardeman County is located in the northeastern portion of the Region B planning area. The population of Hardeman County in 2010 was 4,139. The water supply in Hardeman County is supplied from a variety of sources including Greenbelt Reservoir, the Seymour aquifer, the Blaine aquifer, other local aquifers, run-of-river, and stock ponds. The only water user with a projected shortage is irrigation. There are several small safe supply needs identified for municipal and manufacturing users. These needs are associated with supply allocations from the Greenbelt MIWA. The MIWA has sufficient supplies to meet these needs. The total water need in Hardeman County is approximately 1,960 acre-feet by the year 2070. Individual water user groups and their strategies are listed below.



<u>Hardeman County - Other</u>

Hardeman County-Other purchases water from the RRA, and uses self-supplied groundwater. There are sufficient supplies to meet the demands in Hardeman County, but there is a small safe supply need. To meet these safe supply needs, the recommended strategy for Hardeman County-Other is municipal conservation and obtaining additional supplies from RRA through the Greenbelt MIWA.

Recommended Strategies:

- Water Conservation (Section 5.3)
- Voluntary transfer – This strategy would provide additional supply from RRA. This strategy would provide for the safe supply need from Greenbelt MIWA to the RRA. Greenbelt MIWA is located in Region A and has sufficient current supplies to meet this safe supply need.

Summary of Recommended Strategies for Hardeman County-Other

The recommended strategy for Hardeman County-Other is water conservation and voluntary transfer. Table 5-43 shows the need and recommended strategy to meet that need. The additional supplies from Greenbelt MIWA do not require any additional infrastructure and therefore have no capital costs. Annual cost represent the regional purchase price for treated water estimated at approximately $3.50 per 1,000 gallons. Table 5-44 shows the annual cost for the recommended strategy.

Table 5-43 Hardeman County-Other Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	0	0	0	0
Safe Supply Shortage	16	15	12	15	16	17
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	0	0	4	8	13
Voluntary Transfer	16	15	12	11	8	4
Total	16	15	12	15	16	17

Table 5-44 Hardeman County-Other Capital and Annual Cost

Recommended Strategies	**Capital Cost**	**Annual Cost**					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$0	$0	$2,786	$6,487	$9,846
Voluntary Transfer	$0	$18,247	$17,106	$13,685	$12,545	$9.123	$4,562
Total		$18,247	$17,106	$13,685	$15,331	$15,610	$14,408

Quanah

The City of Quanah purchases water from Greenbelt MIWA. The City also provides water to manufacturing use in Hardeman County. Neither the City nor Manufacturing have a firm supply need, but there is a small safe supply need. This need can be met through Greenbelt MIWA. The recommended strategy for Quanah is municipal conservation and purchase additional water from Greenbelt MWIA.

Recommended Strategies:

- Water Conservation (Section 5.3)
- Voluntary transfer- This strategy would provide supplies from Greenbelt MIWA. Greenbelt MIWA is located in Region A and has sufficient current supplies to meet this safe supply need.

Summary of Recommended Strategies for Quanah

The recommended strategy for Quanah is water conservation and additional supplies from Greenbelt MIWA. Table 5-45 shows the need and recommended strategy to meet that need. The additional supplies from Greenbelt MIWA do not require any additional infrastructure and therefore have no capital costs. Annual cost represent the regional purchase price for treated water estimated at $3.50 per 1,000 gallons. Table 5-46 shows the annual cost for the recommended strategy.

Table 5-45 Quanah Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	0	0	0	0
Safe Supply Shortage	79	78	78	79	79	80
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	0	5	23	41	48
Voluntary Transfer	79	78	73	56	38	32
Total	79	78	78	79	79	80

Table 5-46 Quanah Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$0	$0	$3,277	$13,843	$24,389	$28,840
Voluntary Transfer	$0	$90,092	$88,952	$83,250	$63,863	$43,336	$36,493
Total	$0	$90,092	$88,952	$86,527	$77,706	$67,725	$65,333

<u>Irrigation – Hardeman County</u>

The recommended strategy for irrigation in Hardeman County is agricultural conservation which is discussed in Section 5.3.2.2. Hardeman County does not have a canal distribution system such as that used by WCWID No. 2, so conservation will be implemented on farms by individual producers. A specific conservation target is not established.

Summary of Recommended Strategies for Irrigation-Hardeman County

The recommended strategy for irrigation in Hardeman County is water conservation. Table 5-47 shows the need and recommended strategy. However, conservation cannot fully meet the projected needs for irrigation. As a result, there is an unmet need over the planning period.

Table 5-47 Irrigation – Hardeman County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Supply Shortage	2,491	2,253	2,022	1,798	1,798	1,798
	Supply in Acre-Feet per Year					
Recommended Strategies	2020	2030	2040	2050	2060	2070
Water Conservation	794	770	747	725	725	725
Unmet Water Need (ac-ft/yr)	1,697	1,483	1,275	1,073	1,073	1,073

<u>Manufacturing – Hardeman County</u>

Manufacturing purchases its water from Quanah. This user group has sufficient supplies to meet its firm water needs, but shows a small shortage for safe supply. It is assumed that Quanah will provide this additional water, if needed, through additional supplies from Greenbelt MIWA.

Summary of Recommended Strategies for Manufacturing – Hardeman County

The recommended strategy for manufacturing in Hardeman County is additional supplies from Quanah. Table 5-48 shows the need and recommended strategy to meet that need. It is assumed that no new infrastructure is needed for this supply. Annual cost represent the regional purchase price for treated water estimated at approximately $3.50 per 1,000 gallons. Table 5-49 the annual cost for the recommended strategy.

Table 5-48 Manufacturing – Hardeman County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	0	0	0	0
Safe Supply Shortage	55	59	63	66	66	66
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Voluntary Transfer	55	59	63	66	66	66

Table 5-49 Manufacturing – Hardeman County Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Voluntary Transfer	$0	$62,723	$67,284	$71,846	$75,267	$75,267	$75,267

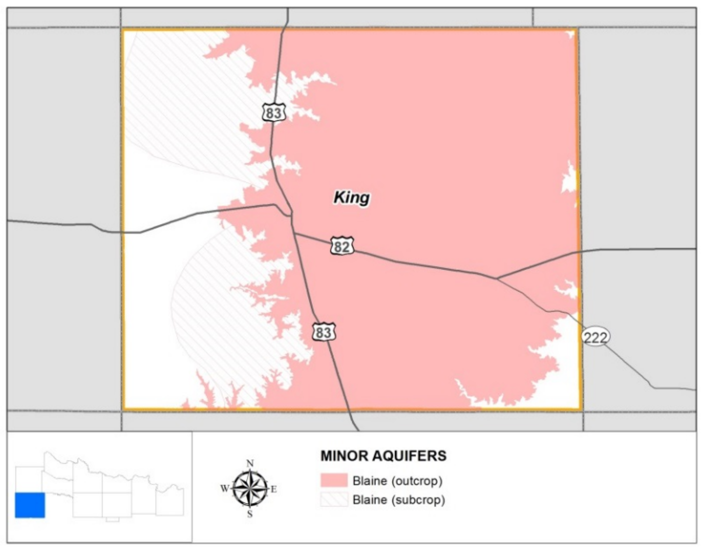
Hardeman County Summary

The maximum projected water need for Hardeman County is 2,491 acre-feet per year with all being associated with an irrigation supply shortage. Also, there is a safe supply need of 163 acre-feet per year for County Other, Quanah, and Manufacturing. A summary of the recommended strategies for Hardeman County is shown on Table 5-50.

Table 5-50 Hardeman County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/ 1,000 gal	Implement Decade
Irrigation	Water Conservation	794	$0.03	2020
County Other	Water Conservation	13	$2.32	2050
	Voluntary Transfer	16	$3.50	2020
Quanah	Water Conservation	48	$1.84	2070
	Voluntary Transfer	79	$3.50	2020
Manufacturing	Voluntary Transfer	66	$3.50	2020
TOTAL		1,016		
Unmet Irrigation Need of 1,697 acre-feet per year through planning period				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.7 King County

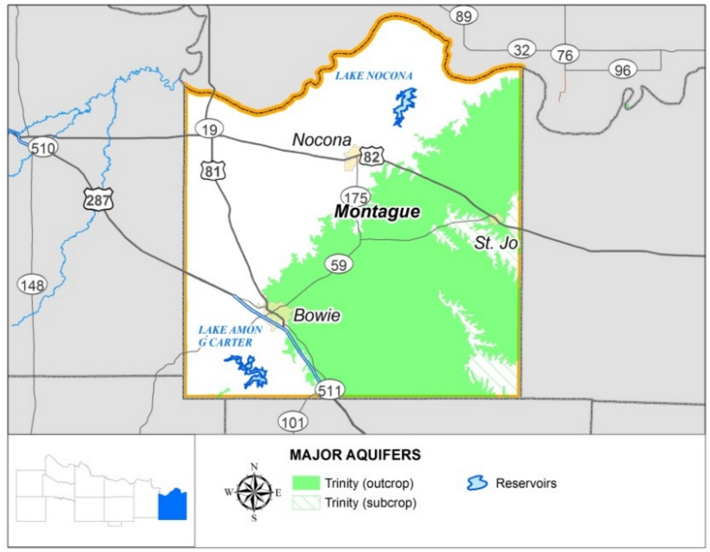


King County is located in the southwestern portion of the Region B planning area. The population of King County in 2010 was 286. The water supply in King County is supplied from the Blaine aquifer, other local aquifers, and stock ponds. There are no identified needs in King County during the planning period.

King County Summary

There are no projected water needs in King County through the planning period.

5.5.8 Montague County



Montague County is located in the north central portion of the Region B planning area. The population of Montague County in 2010 was 19,719. The water supply in Montague County is supplied from a variety of sources including Lake Amon Carter, Lake Nocona, the Trinity Aquifer, other local aquifers, run-of-river, stock ponds, and direct reuse for mining. The total safe-supply need in Montague County is approximately 370 acre-feet by the year 2070. Individual water user groups and their strategies are listed below.

<u>Bowie</u>

The recommended strategy for Bowie is municipal conservation which is discussed in Section 5.3. Table 5-51 shows the need and recommended strategy to meet that need. Even with conservation there is a small safe supply need after 2050. It is likely that this need can be met with increased conservation during drought. Table 5-52 shows the capital cost and the annual cost for the recommended strategy.

Table 5-51 Bowie Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	0	0	0	0
Safe Supply Shortage	0	0	13	86	161	171
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	27	43	40	48	64	81

Table 5-52 Bowie Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Conservation	$0	$16,420	$25,603	$24,220	$28,554	$38,160	$48,678

Montague County - Other

Montague County-Other uses water purchased from the cities of Bowie and Nocona, and self-supplied groundwater. This water user has sufficient supplies to meet its needs but is shown to have a safe supply need. To meet this need, the recommended strategies for Montague County-Other is municipal conservation, which is discussed in Section 5.3, and purchase additional water from either Bowie and/or Nocona. Since these entities already provide water to County-Other, it is assumed that no additional infrastructure is needed. Purchase water cost are estimated at $3.50 per 1,000 gallons. Table 5-53 shows the need and recommended strategy to meet that need. Table 5-54 shows capital cost and the annual cost for the recommended strategy.

Table 5-53 Montague County-Other Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	0	0	0	0
Safe Supply Shortage	191	191	175	177	188	199
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	0	3	47	105	144
Voluntary Transfer	191	191	172	130	83	55
Total	191	191	175	177	188	199

Table 5-54 Montague County-Other Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$0	$0	$2,345	$35,997	$80,655	$111,122
Voluntary Transfer	$0	$217,831	$217,831	$196,162	$148,262	$94,660	$62,726

Mining - Montague County

Mining obtains water from groundwater and reuse from the City of Bowie. This user is projected to have a shortage in 2020. The recommended strategy for mining in Montague County is water conservation which is discussed in Section 5.3. A water conservation goal of 25% is established based on produced water reuse/recycle and use of alternative sources not suitable for other uses.

Summary of Recommended Strategies for Mining – Montague County

The recommended strategy for Montague County Mining is water conservation. Table 5-55 shows the need and recommended strategy to meet that need. No costs were developed for mining conservation.

Table 5-55 Mining - Montague County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	1,315	250	281	0	0	0
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	910	644	402	173	194	194
Unmet Mining Needs	**405**	**0**	**0**	**0**	**0**	**0**

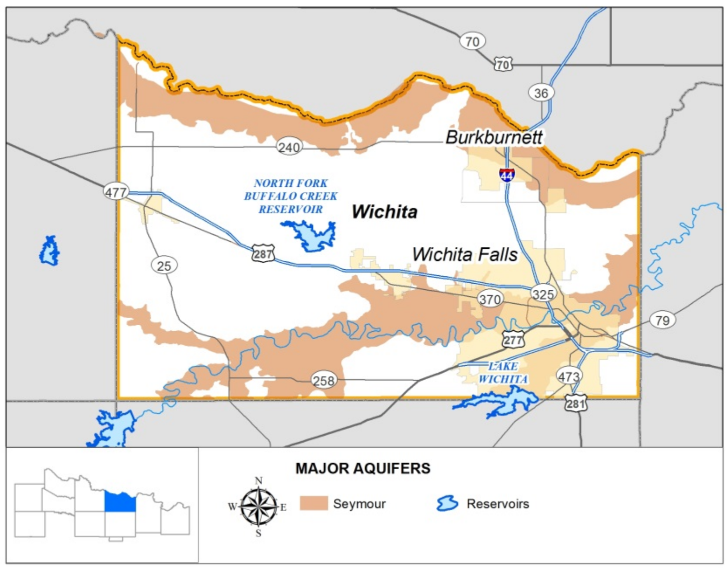
Montague County Summary

The maximum projected water need for Montague County is 805 acre-feet per year and all being associated with a mining supply shortage. The safe need for Montague County is 996 acre-feet per year. A summary of the recommended strategies for Montague County is shown on Table 5-56.

Table 5-56 Montague County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/ 1,000 gal	Implement Decade
Mining	Water Conservation	910	$7.67	2020
County Other	Water Conservation	144	$2.37	2070
	Voluntary Transfer	191	$3.50	2020
Bowie	Water Conservation	81	$1.84	2070
TOTAL		1,326		
Unmet Mining Need of 405 acre-feet per year in 2020.				
Unmet Safe Bowie Need of 90 acre-feet per year by2070.				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.9 Wichita County



Wichita County is located in the north central portion of the Region B planning area. The population of Wichita County in 2010 was 131,500. Most of the municipal water supply in Wichita County is supplied by Wichita Falls. Irrigation supplies are provided from Lake Kemp through a series of canals owned and operated by the WCWID No.2. Some Seymour aquifer and local groundwater supplies are used by municipal users, livestock and manufacturing. The total safe-supply need in Wichita County is over 44,900 acre-feet by the year 2070. Individual water user groups and their strategies are listed below. For the municipal water user groups the recommended strategies include water conservation and fulfillment of existing contracts from Wichita Falls.

Burkburnett

The City of Burkburnett obtains water from local wells and the City of Wichita Falls. Burkburnett has a treated water contract with Wichita Falls to supply 1,872 acre-feet per year. Burkburnett does not have a water supply need, but does show a small safe supply shortage beginning in 2030. This shortage can be met through water conservation and fulfillment of the existing contract from Wichita Falls.

Recommended Strategies:

- Water Conservation (Section 5.3)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide for the full contracted supply from Wichita Falls.

Summary of Recommended Strategies for Burkburnett

The recommended strategies for Burkburnett of water conservation and the existing contract from Wichita Falls are sufficient to meet the safe supply shortages. Table 5-57 shows the need and recommended strategies to meet that need. Since Burkburnett has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, no costs are associated with fulfillment of the contractual obligations. Table 5-58 shows the capital cost and the annual cost for the recommended strategies.

Table 5-57 Burkburnett Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	0	0	0	0
Safe Supply Shortage	0	2	36	77	133	190
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	148	305	269	251	251	254
Fulfillment of Existing Contract with Wichita Falls	0	2	36	77	133	190
Total	148	307	305	328	384	444

Table 5-58 Burkburnett Capital and Annual Cost

Recommended Strategies	**Capital Cost**	**Annual Cost**					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$113,955	$234,570	$207,279	$193,588	$192,999	$195,765

Wichita County-Other

Wichita County-Other obtains water from the Seymour aquifer and sales from Wichita Falls. This water user has a projected shortage of 114 acre-feet per year and a safe supply shortage of 219 acre-feet per year. This shortage can be met through water conservation, fulfillment of the existing contract from Wichita Falls and voluntary transfer from Wichita Falls.

Recommended Strategies:

- Water Conservation (Section 5.3)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide for the full contracted supply from Wichita Falls.
- Voluntary Transfer from Wichita Falls

Summary of Recommended Strategies for Wichita County-Other

Table 5-59 shows the need and recommended strategies to meet that need. Since Wichita County-Other has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no capital or annual costs associated with fulfillment of the contractual obligations. Voluntary Transfer costs are estimated at $5.00 per 1,000 gallons. No additional infrastructure is required. Table 5-60 shows capital cost and the annual cost for the recommended strategies.

Table 5-59 Wichita County-Other Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	51	66	80	91	102	114
Safe Supply Shortage	156	172	187	197	208	219
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	0	2	15	27	36
Fulfillment of Existing Contract with Wichita Falls	136	141	145	150	154	159
Voluntary Transfer from Wichita Falls	20	31	42	47	54	60
Total	156	172	189	212	235	255

Table 5-60 Wichita County-Other Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water	$0	$0	$0	$1,597	$11,232	$20,828	$27,844
Voluntary Transfer From Wichita Falls	$0	$32,583	$50,504	$68,424	$76,570	$87,974	$97,749
Total	$0	$32,583	$50,504	$70,021	$87,802	$108,802	$125,593

Dean Dale SUD

Dean Dale SUD provides water to customers in Clay and Wichita Counties. The SUD has a treated water contract with Wichita Falls to supply 462 acre-feet per year. The recommended strategies for Dean Dale SUD are discussed in the Clay County summary since the majority of the use is in Clay County.

Electra

Electra has a pass through contract with Iowa Park to receive 841 acre-feet per year of treated water from Wichita Falls. It also has a groundwater well field in the Seymour aquifer, which is used during drought. The City has a projected shortage of 464 acre-feet per year by 2070 and a safe supply shortage of 670 acre-feet per year. The recommended strategies for Electra include water conservation, fulfillment of the existing contract from Wichita Falls, and an increase in the Wichita Falls contract to provide a safe supply.

Recommended Strategies:

- Water Conservation (Section 5.3)
- Fulfillment of Existing Contract with Wichita Falls - This strategy would provide for the full contracted supply and meet the projected needs.
- Increase contract amount with Wichita Falls to meet the safe supply.

Summary of Recommended Strategies for Electra

The recommended strategies for Electra of water conservation and the existing contract from Wichita Falls through Iowa Park are sufficient to meet the safe supply shortages. Table 5-61 shows the need and recommended strategies to meet that need. Since Electra has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no costs associated with fulfillment of the contractual obligations. Increased supplies are estimated at $5.00 per 1,000 gallons of treated water. Table 5-62 shows capital cost and the annual cost for the recommended strategies.

Table 5-61 Electra Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	315	348	375	405	436	464
Safe Supply Shortage	504	541	571	604	638	670
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	8	25	53	82	105
Fulfillment of Existing Contract with Wichita Falls	410	424	437	450	464	477
Voluntary Transfer from Wichita Falls	94	117	134	154	174	193
Total	504	549	596	657	720	775

Table 5-62 Electra Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$5,049	$15,132	$31,765	$49,046	$63,251
Voluntary Transfer From Wichita Falls	$0	$153,140	$190,611	$218,306	$250,889	$283,472	$314,426
Total	$0	$153,140	$195,660	$233,438	$282,654	$332,518	$377,677

Iowa Park

Iowa Park has a treated water contract with Wichita Falls to supply 1,400 acre-feet per year directly to Iowa Park, 841 acre-feet per year to Electra, and 675 acre-feet to Wichita Valley WSC. The recommended strategies for Iowa Park include water conservation and fulfillment of the existing contract from Wichita Falls.

Recommended Strategies:

- Water Conservation (Section 5.3)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide for the full contracted supply from Wichita Falls.

Summary of Recommended Strategies for Iowa Park

The recommended strategies for Iowa of water conservation and the existing contract from Wichita Falls are sufficient to meet the safe supply shortages. Table 5-63 shows the need and recommended strategies to meet that need. Since Iowa Park has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount, there are no costs associated with fulfillment of the contractual obligations. Table 5-64 shows no capital cost and the annual cost for the recommended strategies.

Table 5-63 Iowa Park Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	424	449	472	498	525	553
Safe Supply Shortage	602	628	652	677	707	736
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	0	5	36	76	91
Fulfillment of Existing Contract with Wichita Falls	602	628	652	677	707	736
Total	602	628	657	713	783	827

Table 5-64 Iowa Park Capital and Annual Cost

Recommended Strategies	**Capital Cost**	**Annual Cost**					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$0	$3,124	$21,350	$45,722	$54,303

Wichita Falls

Wichita Falls is both a wholesale supply to customers in the region and provider to the City of Wichita Falls. A detailed discussion of the strategies for Wichita Falls are included in Section 5.4.1

Wichita Valley WSC

Wichita Valley WSC has a raw and treated water contract with Wichita Falls to supply an average annual supply of 1,132 acre-feet per year. They also have a pass through contract with Iowa Park for an additional supply of 675 acre-feet per year. Wichita Valley is only projecting a safe need and the recommended strategies for Wichita Valley WSC include water conservation and fulfillment of the existing contract from Wichita Falls.

Recommended Strategies:

- Water Conservation (Section 5.3)
- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide for the full contracted supply from Wichita Falls. The evaluation of the recommended strategies for Wichita Falls are discussed in Section 5.4.1

Summary of Recommended Strategies for Wichita Valley WSC

The recommended strategies for Wichita Valley WSC of water conservation and the existing contract from Wichita Falls are sufficient to meet the safe supply shortages. Table 5-65 shows the need and recommended strategies to meet that need. Since Wichita Valley WSC has an existing contract with Wichita Falls and the existing infrastructure is sufficient to deliver the full contracted amount there are no costs associated with fulfillment of the contractual obligations. Table 5-66 shows capital cost and the annual cost for the recommended strategies.

Table 5-65 Wichita Valley WSC Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	0	0	0	0
Safe Supply Shortage	0	0	0	0	9	34
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	0	0	0	12	24
Fulfillment of Existing Contract with Wichita Falls	0	0	0	0	9	34
Total	0	0	0	0	21	58

Table 5-66 Wichita Valley WSC Capital and Annual Cost

Recommended Strategies	**Capital Cost**	**Annual Cost**					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	$0	$0	$0	$0	$0	$7,920	$16,653

Irrigation – Wichita County

Irrigation is projected to have a shortage of 28,188 acre-feet per year by 2070. Much of this shortage is associated with reduced supplies from the Lake Kemp/Diversion system. Strategies developed by the WCWID No.2 to reduce losses in the irrigation canals will provide additional water to irrigation users of this system. The recommended strategy for irrigation in Wichita County is agricultural conservation which is discussed in Section 5.4.2 as part of the conservation that could be achieved by the WCWID No.2.

Summary of Recommended Strategies for Irrigation-Wichita County

The recommended strategy for irrigation in Wichita County is water conservation. Table 5-67 shows the need and recommended strategy to meet that need. The capital cost and the annual cost for the canal replacement project are shown for WCWID No. 2. Costs for the CCP are discussed in Section 5.5.12.

Table 5-67 Irrigation – Wichita County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	18,069	19,777	21,485	23,196	25,694	28,188
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	17,193	17,072	16,951	16,833	16,767	16,701
Chloride Control – RRA	5,249	4,752	4,254	3,756	3,256	2,758
Total	22,442	21,824	21,205	20,589	20,023	19,459
Unmet Water Needs	**0**	**0**	**280**	**2,607**	**5,671**	**8,729**

Manufacturing – Wichita County

The recommended strategies for manufacturing in Wichita County include water conservation and fulfillment of the existing contracts from Wichita Falls customers. While there are site specific and unique opportunities for water conservation in the manufacturing sector, a specific water conservation goal is not established. The region encourages all water users to conserve water.

Recommended Strategies:

- Fulfillment of Existing Contract from Wichita Falls - This strategy would provide for the full contracted supply from Wichita Falls. The evaluation of the recommended strategies for Wichita Falls are discussed in Section 5.4.1

Summary of Recommended Strategies for Manufacturing -Wichita County

The recommended strategy for manufacturing in Wichita County is fulfillment of existing contracts from Wichita Falls customers. No costs are assessed to fulfill existing contract amounts. Table 5-68 shows the need and recommended strategy to meet that need.

Table 5-68 Manufacturing – Wichita County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	1,254	1,361	1,486	1,595	1,640	1,686
Safe Supply Shortage	1,802	1,935	2,092	2,227	2,273	2,317
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
By Contract	1,802	1,935	2,092	2,227	2,273	2,317
Total	1,802	1,935	2,092	2,227	2,273	2,317

Steam Electric – Wichita County

The steam electric power water needs are associated with the water needs for Wichita Falls. Once Wichita Falls develops strategies, these needs will be met. The recommended strategies for steam electric power generation in Wichita County is fulfillment of the existing contracts from Wichita Falls. While a specific water conservation target for steam electric is not established, it is recognized that this use category may be able to identify unique water conservation opportunities. The region encourages all water users to conserve water.

Recommended Strategies:

- Fulfill Existing Contract with Wichita Falls - This strategy would provide for the full need from Wichita Falls. The evaluation of the recommended strategies for Wichita Falls are discussed in Section 5.4.1

Summary of Recommended Strategies for Steam Electric -Wichita County

The recommended strategy for steam electric power in Wichita County is fulfillment of the existing contract with Wichita Falls. Table 5-69 shows the need and recommended strategy to meet that need. There are no costs to fulfill existing contracts.

Table 5-69 Steam Electric – Wichita County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	175	181	187	193	199	204
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Fulfillment of Existing Contract	175	181	187	193	199	204

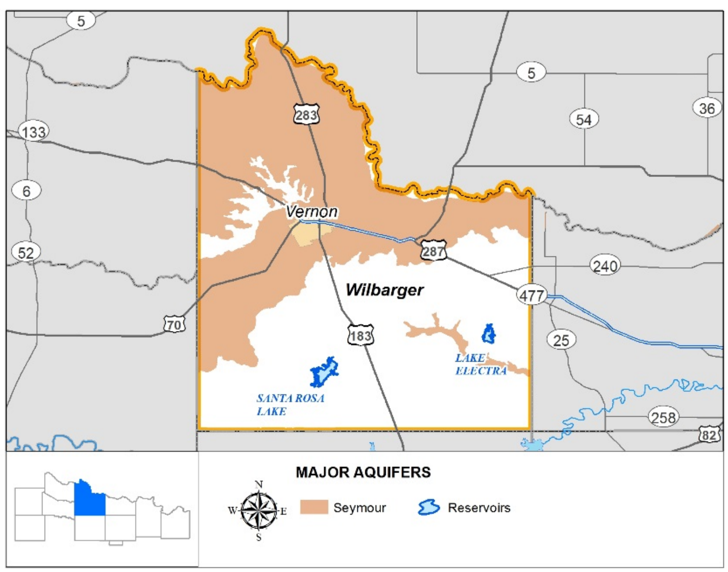
Wichita County Summary

The maximum projected water need for Wichita County is 39,955 acre-feet per year with most of this need (28,188 acre-feet per year) associated with an irrigation supply shortage. The safe need for Wichita County is 44,705 acre-feet per year. Most of the needs in the county will be met through strategies developed by Wichita Falls and WCWID No. 2. A summary of the recommended strategies is presented in Table 5-70.

Table 5-70 Wichita County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/ 1,000 gal	Implement Decade
County Other	Water Conservation	36	$2.37	2070
	By Contract	159	NA	2020
	Voluntary Transfer	60	$5.00	2030
Burkburnett	Water Conservation	254	$2.37	2070
	By Contract	190	NA	2070
Electra	Water Conservation	105	$1.85	2070
	By Contract	477	NA	2020
Iowa Park	Water Conservation	91	$1.84	2070
	By Contract	602	NA	2020
Wichita Valley	Water Conservation	24	$2.12	2070
	By Contract	34	NA	2070
Wichita Falls	Water Conservation	2,242	$0.97	2030
	Indirect Reuse	11,210	$2.00	2020
	Local Seymour Aquifer	2,242	$4.70	2020
	Wichita River Supply	2,242	$2.37	2020
	Lake Ringgold	18,600	$4.56	2040
	Precipitation Enhancement	1,000		2020
Irrigation	Water Conservation	22,442	$0.03	2020
Manufacturing	By Contract	2,317	NA	2020
Steam Electric	By Contract	204	NA	2020
TOTAL		58,282		
Unmet Irrigation Need over planning period, with a maximum of 8,729 acre-per year by 2070.				
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.10 Wilbarger County



Wilbarger County is located in the north central portion of the Region B planning area. The population of Wilbarger County in 2010 was 13,535. The water supply in Wilbarger County is supplied from a variety of sources including the Seymour Aquifer, Lake Kemp for Steam Electric Power, other local aquifers, run-of-river, stock ponds, and Santa Rosa Lake. Each of these sources are fully allocated to existing users, which leaves few options for the development of new water. Considering the limitations of water availability in the county, the total safe-supply need in Wilbarger County is approximately 6,440 acre-feet by the year 2070. Individual water user groups and their strategies are listed below.

Wilbarger County - Other

Wilbarger County-Other has sufficient supplies to meet its water demands, but is shown to have a safe supply shortage. It is assumed that Vernon would provide the water to meet this shortage for Wilbarger County-Other. Municipal conservation was considered and is discussed in Section 5.3.

Voluntary Transfer from Vernon

This strategy would provide for the safe supply for County-Other through strategies developed by Vernon. Those strategies are discussed under the City of Vernon.

Summary of Recommended Strategies for Wilbarger County-Other

The recommended strategy for Wilbarger County-Other is water conservation and purchase water from Vernon. Table 5-71 shows the need and recommended strategy to meet that need. Table 5-72 shows capital cost and the annual cost for the recommended strategies. It is assumed that there are no capital or annual costs associated with the voluntary transfer.

Table 5-71 Wilbarger County-Other Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	0	0	0	0
Safe Supply Shortage	1	6	16	38	46	53
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation	0	0	0	13	31	45
Voluntary Transfer from Vernon	1	6	16	38	46	53
Total	1	6	16	51	77	98

Table 5-72 Wilbarger County-Other Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$0	$0	$0	$10,259	$23,872	$34,775

Vernon

The City of Vernon provides water to its residents, rural customers (RRA and others), and manufacturing in Wilbarger County. Vernon obtains its water supplies from several well fields in the Seymour aquifer. There is a main transmission line from these well fields to the City that was recently found to be losing water. The City shows a water shortage beginning in 2040 and a safe supply shortage in 2020. The safe supply shortages for Vernon and its customers total over 1,100 acre-feet per year by 2070. The options available for Vernon include municipal conservation, wastewater reuse and additional groundwater. Municipal conservation is discussed in Section 5.3, including discussion on water loss reductions associated with the repair/replacement of the transmission pipeline from the City's well field.

Wastewater Reuse

It is assumed that Vernon's wastewater effluent would be treated to a very high level through reverse osmosis for the purpose of water supply to manufacturing users in Wilbarger County. The water would be transported through a separate distribution system and would not be blended with the City's municipal water supplies.

Water Quantity, Reliability and Cost

This strategy would provide up to 400 acre-feet per year of high quality treated reuse water. The quantity of water would be sufficient to provide for the safe supply for manufacturing needs in Wilbarger County. The capital costs are estimated at $8.5 million.

Environmental Factors

Currently, the City discharges its wastewater to Pease River. Reusing a portion of these flows would reduce the discharges, but most of the reuse supplies are associated with increased water demands. Therefore, the reduction in discharges would be minimal.

Impacts on Water Resources and other Water Management Strategies

The impact on water resources and other water management strategies are low. This strategy reduces the potential demand for additional groundwater for Vernon.

Impacts on Agriculture and Natural Resources

There are no expected impacts to agriculture and natural resources.

Other Relevant Factors

The ability to use reuse water for manufacturing will depend upon the quality of water required by the manufacturers and ability to permit this water for this purpose.

New Groundwater Wells

This strategy assumes that Vernon develops a new well field in the Seymour aquifer in Wilbarger County. Since the groundwater supplies in the county are fully allocated to existing users, it is assumed that Vernon would purchase groundwater rights from irrigators, which would reduce the supply to irrigation. The new well field would be located within 10 miles of the City and include 22 new wells, with pumping capacities of 35 gpm each. Due to potential elevated nitrates, the strategy includes a 0.5 MGD ion exchange treatment facility. Water loss from ion exchange is typically less than 5 percent. Waste from the ion exchange unit would be blended with the wastewater discharge from the City's treatment plant.

Water Quantity, Reliability and Cost

This strategy would provide 600 acre-feet per year of reliable supply to Vernon to meet the City's safe water needs. The additional groundwater would secure additional sources to increase the reliability of its existing well fields. The capital cost for the strategy is $8.3 million.

Environmental Factors

The new well field would have minimal environmental impacts. The location of wells and the transmission system can be adjusted if needed to avoid environmentally sensitive areas.

The discharge from the ion exchange facility may increase nitrate concentrations in the receiving stream.

Impacts on Water Resources and other Water Management Strategies

The new well field would place additional demand on the Seymour aquifer; however, this strategy assumes that water rights are purchased from existing users. The MAG values for the Seymour aquifer in Wilbarger County are not exceeded.

Impacts on Agriculture and Natural Resources

This strategy does reduce water supplies available to irrigated agriculture and increases the projected shortages for this water user group.

Other Relevant Factors

This strategy assumes that the water rights would be purchased on a willing seller, willing buyer basis. There are no expected third party impacts.

Summary of Recommended Strategies for Vernon

The recommended strategy for Vernon is water conservation, direct reuse for manufacturing customers and additional wells. Table 5-73 shows the need and recommended strategy to meet that need. Table 5-74 shows capital cost and the annual cost for the recommended strategies.

Table 5-73 Vernon Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs (Vernon and Manufacturing)	0	0	84	289	331	366
Safe Supply Shortage (Vernon and Manufacturing)	455	610	801	1,047	1,097	1,139
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Conservation (Vernon)	313	313	313	364	437	513
Direct Reuse - Manufacturing	0	0	300	400	400	400
Additional Wells - Seymour Aquifer	600	600	600	600	600	600
Total	913	913	1,213	1,364	1,437	1,513

Table 5-74 Vernon Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$7,807,000	$711,000	$711,000	$58,000	$78,518	$105,744	$127,550
Direct Reuse - Manufacturing	$8,500,000			$1,091,000	$1,091,000	$380,000	$380,000
Additional Wells -	$9,810,000	$1,076,000	$1,076,000	$255,000	$255,000	$255,000	$255,000
Total	**$24,647,000**	**$1,651,000**	**$1,651,000**	**$1,391,000**	**$1,411,518**	**$727,744**	**$749,550**

Irrigation – Wilbarger County

Irrigation is shown to have a shortage in 2020 and 2030. With the proposed transfer of groundwater from irrigation to Vernon, this water user group has a shortage over the planning period (with the exception in 2050 due to reduced demands). The options for new supply for irrigation are limited. Agricultural conservation is a potential strategy for irrigation in Wilbarger County, but would need to be implemented on-farm. For purposes of this plan, a 10 percent reduction in demand could be achieved. The recommended strategy for irrigation in Wilbarger County is conservation and is shown to meet the irrigation needs as shown on Table 5-75.

Table 5-75 Irrigation – Wilbarger County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs (Surplus)	1,082	344	(375)	(944)	(372)	(172)
Transfer of Supply to Vernon	600	600	600	600	600	600
Total Water Needs	*1,682*	*944*	*225*	*0*	*228*	*428*
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Conservation	3,160	3,066	2,974	2,884	2,884	2,884

Manufacturing – Wilbarger County

The recommended strategy for manufacturing in Wilbarger County is purchase water from Vernon. This strategy is discussed under the City of Vernon.

Summary of Recommended Strategies for Manufacturing - Wilbarger County

Table 5-76 shows the need and recommended strategy to meet that need. The costs for the recommended strategy is shown with the City of Vernon. While most of the water from Vernon is expected to come from reuse, some will be provided from groundwater.

Table 5-76 Manufacturing – Wilbarger County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	0	0	32	115	131	143
Safe Supply Shortage	227	243	304	417	433	445
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Purchase from Vernon	227	243	304	417	433	445

Steam Electric – Wilbarger County

Steam electric power generation in Wilbarger County is associated with the Oklaunion Power Plant, which relies on Lake Kemp for its supplies. The current drought has reduced the reliable supply from Lake Kemp and created a need. Options for additional water are limited in Wilbarger County. Previous investigations into local brackish groundwater found that the quantity was limited and the TDS levels were very high. The most likely option would be to retrofit the facility for alternative cooling technology. Other existing supplies in Wilbarger County are already fully allocated.

Summary of Recommended Strategies for Steam Electric - Wilbarger County

The recommended strategy for steam electric power generation in Wilbarger County is water conservation. Table 5-77 shows the need and recommended strategy to meet that need. Table 5-78 shows the capital cost and the annual cost for the recommended strategy.

Table 5-77 Steam Electric – Wilbarger County Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Water Needs	1,114	1,959	2,803	3,648	4,492	5,337
	Supply in Acre-Feet per Year					
Recommended Strategies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Total	1,114	1,959	2,803	3,648	4,492	5,337

Table 5-78 Steam Electric – Wilbarger County Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost (millions)					
		2020	2030	2040	2050	2060	2070
Alternative Cooling Technology	$89,740,000	$4.87	$4.87	$1.12	$5.99	$5.99	$2.24

Wilbarger County Summary

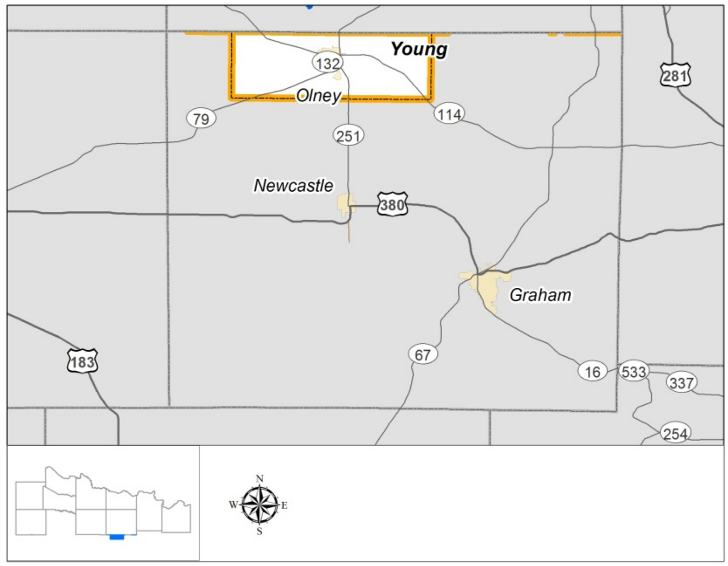
The maximum projected need for Wilbarger County is 6,756 acre-feet per year, with most of that need (5,337 acre-feet per year) being associated with steam electric power.

Wilbarger County has limited water supplies available for water management strategies. As a result, the only option for steam electric power is alternative cooling technology. Water conservation, direct reuse and developing additional wells for Vernon are the recommended strategies for Wilbarger County. These strategies are summarized in Table 5-79.

Table 5-79 Wilbarger County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/1,000 gal	Implement Decade
County-Other	Conservation	45	$2.37	2050
	Voluntary Transfer (Vernon)	53	NA	2020
Vernon	Conservation	202	$0.53	2050
	Direct Reuse	400	$8.37	2040
	New Groundwater	600	$4.81	2020
Irrigation	Conservation	3,160	$0.03	2020
Manufacturing	Voluntary Transfer (Vernon)	445	NA	2020
Steam Electric	Alternative Cooling	5,337	$1.29	2020
TOTAL		7,082		
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.11 Young County



Young County is located in the south central portion of the Region B planning area. A portion of the county, which includes the City of Olney, is included in Region B while the remainder of the county is located in the Brazos G Planning Area. The total population of Young County in 2010 was 18,550, with 3,746 located in the Region B portion. The water supply in Young County is supplied from Lake Olney/Cooper, Wichita Falls, and other local aquifers. There is only a safe need identified in Young County during the planning period.

<u>**Young County - Other**</u>

The recommended strategies for Young County-Other are municipal conservation which is discussed in Section 5.3 and voluntary transfer of water from Olney at a rate of $3.50 per 1,000 gallons.

Summary of Recommended Strategies for Young County-Other

Table 5-80 shows the need and recommended strategy to meet that need and Table 5-81 shows capital cost and the annual cost for the recommended strategies.

Table 5-80 Young County-Other Need and Recommended Strategies

	Values in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Water Needs	0	0	0	0	0	5
Safe Supply Shortage	0	0	0	7	16	26
	Supply in Acre-Feet per Year					
Recommended Strategies	2020	2030	2040	2050	2060	2070
Water Conservation	0	0	0	0	3	5
Voluntary Transfer	0	0	0	7	13	21
Total	0	0	0	7	16	26

Table 5-81 Young County-Other Capital and Annual Cost

Recommended Strategies	Capital Cost	Annual Cost					
		2020	2030	2040	2050	2060	2070
Water Conservation	$0	$0	$0	$0	$0	$2,497	$4,221
Voluntary Transfer	$0	$0	$0	$0	$7,983	$14,825	$23,949
Total	$0	$0	$0	$0	$7,983	$17,322	$28,170

Olney

The City of Olney does not have an identified shortage during the planning period, however, the City is planning an indirect reuse project to pump treated wastewater to Lake Olney/Cooper. This project would include approximately 4.5 miles of 8" reuse line along with a new pump station at the wastewater plant with the capacity to convey approximately 885 acre feet per year of treated wastewater into Lake Cooper. The Texas Water Development Board provided a loan in the amount of $2.4 million to fund this project which should be in operation within the next two years. Since it is already funding and under construction, no costs have been developed for eth indirect reuse project.

Young County Summary

The maximum projected water need for Young County is 5 acre-feet per year and a safe need of 26 acre-feet per year and all being associated with a County Other shortage. The City of Olney is developing an indirect reuse project which would shore up its supplies in Lakes Olney-Cooper. With this additional water, Olney would have sufficient supplies to meet the small county-other need identified in the Region B portion of Young County. A summary of the recommended strategies is shown in Table 5-82.

Table 5-82 Young County Recommended Strategies Summary

Water User	Strategy Description	Supply (ac-ft/yr)	Cost/ 1,000 gal	Implement Decade
County Other	Water Conservation	5	$2.60	2060
	Voluntary Transfer	21	$3.50	2050
Olney	Indirect Reuse	885	NA	2020
TOTAL		911		
ALTERNATE STRATEGIES – NONE IDENTIFIED				

5.5.12 Regional Strategies

Red River Chloride Control Project

The concentration of dissolved salts, particularly chloride, in some surface waters in Region B limits the use of these waters for municipal, industrial, and agricultural purposes. The Red River Authority of Texas is the local sponsor and has been working in cooperation with the U.S. Army Corps of Engineers (USACE) for a number of years on a project to reduce the chloride concentration of waters in the Red River Basin. The successful completion of this project would result in an increase in the volume of water available for municipal and industrial purposes in Region B and water would be available for a broader range of agricultural activities. Therefore, the Chloride Control Project (CCP) is included in the Regional Water Plan as one of the feasible strategies for meeting the water supply needed in Region B. Following is a summary of the CCP that presents the background of the project, the components, and current status of the project, and an analysis of the CCP as a regional water resource strategy.

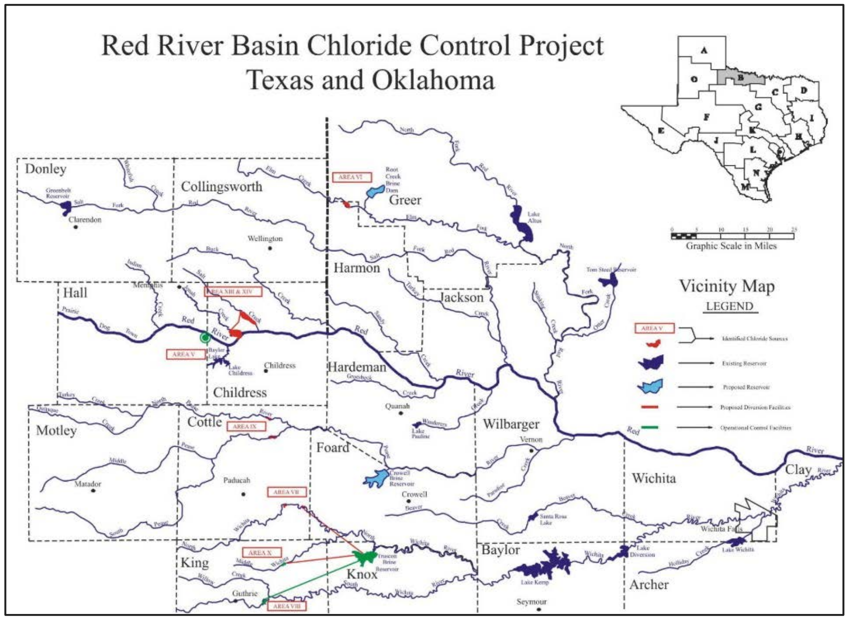
Background

In 1957 the U.S. Public Health Service initiated a study to locate the natural sources that contribute high concentrations of chloride to surface waters in the Red River Basin. It was determined that ten natural salt source areas in the basin contributed approximately 3,300 tons of chloride each day to the Red River.

In 1959 the USACE performed a study to identify control measures for these salt sources. Subsequently, structural measures were recommended for eight source areas.

Description of the Chloride Control Project

The primary strategy for reducing the flow of highly saline waters to the Red River is to impound these flows behind low flow dams and pump the saline waters to off-channel brine reservoirs where the water evaporates or is disposed of by deep-well injection. During high-flow periods, when the chloride concentration is lower, waters flow over the low dams and proceed downstream.



There are four saline inflow areas that impact water quality in Region B:

- Areas VII, VIII, and X affect the quality of water in the Wichita River including Lake Kemp and Lake Diversion.
- Area IX affects the quality of waters in the Pease River, including the proposed Pease River Reservoir.

Construction of the chloride control facilities at Area VIII on the South Fork of the Wichita River in King County and Knox County was authorized in 1974. These facilities include a low flow dam near Guthrie, Texas, with a deflatable weir to collect the saline inflows; the Truscott Brine Reservoir near Truscott, Texas; and, a pump station and pipeline to transport the saline water from the impoundment at Guthrie to the Truscott Brine Reservoir. These facilities have been in operation since May 1987. Construction of the facilities at Area X was initiated in 1991, but they have not been completed due to a decision to modify the design of these facilities, a change to the brine disposal area, and a need to address environmental issues identified by the U.S. Fish and Wildlife Service (USFWS) and the

Texas Parks and Wildlife Department (TPWD). A Final Environmental Statement (FES) was prepared for the project and published in 1977. A supplement to the FES (SFES) and an Economic evaluation of the project were completed for the Wichita Basin in 2003. These studies found that the Wichita Basin CCP is economically and environmentally feasible and the Record of Decision was signed in March 2004. Construction of the facilities for Areas X and VII are waiting for budget approval.

The effectiveness and environmental impacts of the project will be evaluated as the CCP facilities are completed and operating within the Wichita River Basin. The results of this effort will be used to determine if and, if so, how CCP facilities will be provided for Area IX on the Pease River. The potential Pease River Reservoir would not be viable for a municipal water supply without completion of the CCP for the Pease River Basin.

Because of the improved water quality resulting from implementation of the CCP, it has been identified as a feasible supply alternative for Region B. Following is an evaluation of the quantity and quality of water that would be provided; the reliability of the supply; the cost to distribute, treat, or convey the water; potential impacts on the environment and agriculture in the area; the regulatory and political acceptability of, and public support for, the project; and the extent to which this strategy could affect other strategies. This evaluation addresses the completion of the CCP in the Wichita Basin. When the scheduling for the Pease River Basin phase of the project is more certain, the regional plan should be amended to include an evaluation of the effects of the Pease River phase of the project on water resources in Region B.

Water Quantity, Reliability and Cost

While no additional water is directly made available through this strategy, there would be water savings realized through the reduction in water losses associated with advanced water treatment for municipal use and more efficient applications of irrigation water. The estimate of these water savings is approximately 6,500 acre-feet per year in 2020, reducing over time as supplies from Lake Kemp decline. The Corps of Engineers estimated the remaining construction cost to complete the project is $59,371,000[2]. It should also be noted that the cost impacts of the CCP on residents of Region B and the State of Texas are different than the cost impacts of membrane treatment or other supply strategies. The capital costs of the CCP facilities will be funded with federal monies.

Environmental Factors

The project will improve the overall water quality in the Wichita River Basin, which is considered a benefit to the environment. As previously discussed, environmental impact studies have been for this project. The environmental issues that have been identified are summarized below:

- Selenium (Se) is a naturally occurring element in soils in the western United States and in the waters of the CCP project area. Se in trace amounts is an essential dietary component. However, it has been concluded that, in higher concentrations in water and sediment, Se adversely impacts aquatic birds in some areas of the country. Concern has been expressed that the concentration of Se in the brine disposal reservoirs will increase due to evaporation and pose a threat to local and migratory birds, fish, and wildlife. Data collected at the Truscott Brine Reservoir have found no increases in Selenium concentrations following 11 years of operation and Selenium is not expected to result in excessive risk at the Brine Lake.

- Small decreases in flows are projected to occur in the Wichita River and the Red River between the Wichita River confluence and Lake Texoma. These flow decreases will result from the diversion of low flows to the brine disposal reservoirs and increased use of the river flow for irrigation when the quality improves. Changes in water quality and quantity could impact the composition of vegetation along these river reaches and result in vegetative encroachment on the stream channel. There is a concern that decreased flows and changes in vegetative composition could adversely affect the habitat for aquatic life, birds, and wildlife. These changes are expected to be low to moderate and potential impacts are addressed in the monitoring and mitigation plan for the project.

- There is a concern that wetlands in the Red River flood plain will be adversely impacted as a result of both changes in the hydrologic regime and the conversion of land adjacent to the river to cropland and pasture. These potential impacts are also addressed in the monitoring and mitigation plan for the CCP.

- Concern has been expressed that the reduction in the TDS concentration in Lake Texoma, associated changes in physical characteristics of the lake (turbidity), a decrease in primary production rates due to a decrease in the depth of the eutrophic zone, and alterations in nutrient cycling will reduce the sport fish harvest in the lake, and may affect the aesthetic quality of the lake. Studies have shown that the changes in TDS concentration in Lake Texoma associated with the Wichita River CCP are expected to have negligible adverse impacts to fisheries or aesthetics to the lake.

Each of these issues was addressed in the SFEIS, and the report concludes there will not be significant impacts in most cases. Where potential impacts have been identified, mitigation and monitoring measures are proposed.

Several state and federally listed threatened and endangered species are present in, or migrate through, the project area. To address concerns related to the bald eagle, whooping crane, and least tern, in 1994 the USFWS and USACE agreed upon a Biological Opinion that defines Reasonable and Prudent Measures to protect these species. These measures are described in Supplement I to the SFES.

Impacts on Water Resources and Other Water Management Strategies

The CCP should have a positive impact on water resources and other water management strategies. This strategy is considered a demand reduction strategy, which would result in lower demands on other water management strategies.

Impacts on Agriculture and Natural resources

This project will have a positive impact on agriculture and natural resources by improving the water quality in the Wichita River Basin. The improvements in the quality of water will allow the water to be used to irrigate a wider variety of crops and reduce the potential for salt build-up in soils.

Other Relevant Factors

The brine will be stored in impoundment facilities similar to the Truscott Brine Lake. The water supply source that will be enhanced by the Wichita Basin CCP is the Lake Kemp/Diversion system. As previously described in Chapter 3 of the Region B Water Plan, the firm yield of this system is estimated at 42,875 acre-feet per year in 2020, and 22,500 acre-feet per year in 2070. The yield decrease, which is attributable to sedimentation, is expected to be mitigated through an increase in the water conservation elevation and use of a seasonal pool during the irrigation months. Benefits of the CCP would be applicable to all waters stored in the Lake Kemp/Diversion system.

The political acceptability of the project varies depending on the sector of the community. Municipalities, industries, and the agricultural community are supportive of the project. The degree of support for the project is evidenced by the congressional approval and funding of the project in bills enacted in 1962, 1966, 1970, 1974, 1976, and 1986. In 1988, a special panel created by the Water Resource Development Act of 1986 issued a report favorable to the project.

The natural resource agencies, Lake Texoma sport fishermen, and related lake businesses have expressed opposition to the project. However, substantial progress has been made in addressing the natural resource and fishing concerns.

LIST OF REFERENCES

1Seeding Operations and Atmospheric Research, Wichita Falls Weather Modification Program, prepared for the City of Wichita Falls, Texas. January 6, 2015.

2United State Corps of Engineers, Red River Chloride Control Project, Texas and Oklahoma; Fact Sheet, February 6, 2012.

ATTACHMENT 5-1

WMS CONSIDERED AND EVALUATED

2016 FINAL PLAN

REGION B

DECEMBER 2015

Every WUG Entity with an Identified Need				WMSs REQUIRED TO BE CONSIDERED BY STATUTE											ADDITIONAL						
Water User Group Name	County	Maximum Need 2020-2070 (acf/yr)	Maximum Safe Supply Need 2020-2070 (acf/yr)	Conservation	Drought Management	Reuse	Reallocation of Storage	Voluntary Transfers	Conjunctive Use	Expansion of Existing	New Supplies	Regional Water Supply	Improvement of Water Quality	Emergency Transfer of Water	System Optimization, Subordination, and Enhancement	Brush Control	Precipitation Enhancement	Desalination	Aquifer Storage and Recovery	Cancellation of Water Rights	Interbasin Transfers
Archer City	Archer	131	184	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Archer	0	0	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Holliday	Archer	151	214	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lakeside City	Archer	53	79	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Scotland	Archer	183	237	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wichita Valley WSC	Archer	0	3	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Windthorst WSC	Archer	175	240	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Archer	737	737	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Archer	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Archer	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Archer	333	333	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Archer	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Baylor	0	0	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Seymour	Baylor	0	0	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Baylor	388	388	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Baylor	130	130	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Baylor	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Baylor	0	0	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Baylor	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Clay	0	53	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Dean Dale SUD	Clay	27	58	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Henrietta	Clay	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Petrolia	Clay	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Windthorst WSC	Clay	37	51	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Clay	0	0	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Clay	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Clay	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Clay	0	0	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Clay	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Cottle	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Paducah	Cottle	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Cottle	0	0	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Cottle	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Cottle	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Cottle	0	0	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Cottle	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Foard	0	5	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Crowell	Foard	0	28	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Irrigation	Foard	0	0	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Livestock	Foard	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Manufacturing	Foard	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mining	Foard	0	0	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Steam Electric	Foard	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Chillicothe	Hardeman	0	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
County-Other	Hardeman	0	17	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Quanah	Hardeman	0	80	■	☐	☐	☐	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Every WUG Entity with an Identified Need				WMSs REQUIRED TO BE CONSIDERED BY STATUTE											ADDITIONAL						
Water User Group Name	County	Maximum Need 2020-2070 (acf/yr)	Maximum Safe Supply Need 2020-2070 (acf/yr)	Conservation	Drought Management	Reuse	Reallocation of Storage	Voluntary Transfers	Conjunctive Use	Expansion of Existing	New Supplies	Regional Water Supply	Improvement of Water Quality	Emergency Transfer of Water	System Optimization, Subordination, and Enhancement	Brush Control	Precipitation Enhancement	Desalination	Aquifer Storage and Recovery	Cancellation of Water Rights	Interbasin Transfers
Irrigation	Hardeman	2,491	2,491	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Livestock	Hardeman	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Manufacturing	Hardeman	0	66	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□
Mining	Hardeman	0	0	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Steam Electric	Hardeman	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
County-Other	King	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Irrigation	King	0	0	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Livestock	King	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Manufacturing	King	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Mining	King	0	0	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Steam Electric	King	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Bowie	Montague	0	171	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
County-Other	Montague	0	199	■	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□
Nocona	Montague	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Saint Jo	Montague	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Irrigation	Montague	0	0	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Livestock	Montague	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Manufacturing	Montague	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Mining	Montague	1,315	1,315	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Steam Electric	Montague	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Burkburnett	Wichita	0	190	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
County-Other	Wichita	114	219	■	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□
Dean Dale SUD	Wichita	15	32	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Electra	Wichita	464	670	■	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□
Iowa Park	Wichita	552	736	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Wichita County WID 2	Wichita	28,925	28,925	■	□	□	□	□	□	□	□	□	□	□	■	□	□	□	□	□	□
Wichita Falls	Wichita	8,748	12,385	■	□	■	□	■	■	□	■	□	□	□	■	□	■	□	□	□	□
Wichita Valley WSC	Wichita	0	34	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Irrigation	Wichita	28,188	28,188	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Livestock	Wichita	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Manufacturing	Wichita	1,685	2,317	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Mining	Wichita	0	0	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Steam Electric	Wichita	204	204	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
County-Other	Wilbarger	0	53	■	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□
Vernon	Wilbarger	194	604	■	□	■	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□
Irrigation	Wilbarger	1,082	1,082	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Livestock	Wilbarger	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Manufacturing	Wilbarger	143	445	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□
Mining	Wilbarger	0	0	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Steam Electric	Wilbarger	5,337	5,337	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
County-Other	Young	5	26	■	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□
Olney	Young	0	0	■	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Irrigation	Young	0	0	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Livestock	Young	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Manufacturing	Young	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Mining	Young	0	0	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Steam Electric	Young	0	0	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□

ATTACHMENT 5-2

SUMMARY OF RECOMMENDED STRATEGIES

2016 FINAL PLAN

REGION B

DECEMBER 2015

ATTACHMENT 5-2
SUMMARY OF RECOMMENDED STRATEGIES

Entity	County Used	Expected Online Date	Capital Cost	First Decade Unit Cost ($/ac-ft/yr)	Total Yield 2020	2030	2040	2050	2060	2070	Last Decade Unit Cost ($/ac-ft/yr)
Alternative Cooling											
Steam Electric Power	Wilbarger	2020	$89,740,000	$4,372	1,114	1,959	2,803	3,648	4,492	5,337	$420
Chloride Control											
Red River Authority	Multiple	2020	$59,371,000	$987	6,538	5,917	5,295	4,674	4,052	3,432	$227
Groundwater											
Wichita Falls	Wichita	2020	$19,674,000	$1,601	2,242	2,242	2,242	2,242	2,242	2,242	$865
Vernon	Wilbarger	2020	$9,810,000	$1,793	600	600	600	600	600	600	$425
Irrigation Conservation											
Wichita County WID 2		2020	$8,538,000	$49	13,034	13,034	13,034	13,034	13,034	13,034	$49
	Wichita	2020			12,666	12,623	12,580	12,540	12,474	12,408	
	Archer	2020			368	411	454	494	560	626	
	Clay	2020			0	0	0	0	0	0	
Irrigation	Archer	2020	$0	$8.2	121	118	114	111	111	111	$8.2
Irrigation	Baylor	2020	$0	$8.2	331	321	311	302	302	302	$8.2
Irrigation	Clay	2020	$0	$8.2	144	140	136	132	132	132	$8.2
Irrigation	Cottle	2020	$0	$8.2	400	388	377	366	366	366	$8.2
Irrigation	Foard	2020	$0	$8.2	394	382	371	360	360	360	$8.2
Irrigation	Hardeman	2020	$0	$8.2	794	770	747	725	725	725	$8.2
Irrigation	King	2020	$0	$8.2	3	3	3	3	3	3	$8.2
Irrigation	Montague	2020	$0	$8.2	87	87	87	87	87	87	$8.2
Irrigation	Wichita	2020	$0	$8.2	4,527	4,449	4,371	4,293	4,293	4,293	$8.2
Irrigation	Wilbarger	2020	$0	$8.2	3,160	3,066	2,974	2,884	2,884	2,884	$8.2
Mining Conservation											
Mining	Archer	2020	$1,004,000	$2,500	101	121	86	70	53	53	$2,500
Mining	Baylor	2020	$33,000	$2,500	4	4	3	3	3	3	$2,500
Mining	Clay	2020	$1,635,000	$2,500	153	197	146	118	89	89	$2,500
Mining	Cottle	2020	$83,000	$2,500	10	10	10	9	8	8	$2,500
Mining	Foard	2020	$25,000	$2,500	3	3	3	3	3	3	$2,500
Mining	Hardeman	2020	$42,000	$2,500	4	4	5	5	5	5	$2,500
Mining	King	2020	$789,000	$2,500	95	83	72	63	55	55	$2,500
Mining	Montague	2020	$7,553,000	$2,500	910	644	402	173	194	194	$2,500
Mining	Wichita	2020	$133,000	$2,500	16	15	14	12	11	11	$2,500
Mining	Wilbarger	2020	$42,000	$2,500	5	5	5	5	5	5	$2,500
Mining	Young	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Municipal Conservation											
Archer City	Archer	2040	$0	$729	0	0	6	15	26	32	$688
Holliday	Archer	2040	$0	$562	0	0	7	19	32	39	$604
Lakeside City	Archer	2040	$0	$549	0	0	2	6	11	15	$606
Scotland	Archer	2030	$0	$554	0	3	8	16	22	28	$606
Windthorst WSC	Archer, Clay	2030	$0	$564	0	4	10	17	25	34	$600
County Other	Baylor	2050	$0	$736	0	0	0	6	10	14	$768
County Other	Clay	2050	$0	$768	0	0	0	18	43	60	$773
Dean Dale SUD	Clay	2070	$0	$802	0	0	0	0	0	7	$802
County Other	Foard	2040	$0	$883	0	0	1	4	7	8	$810
Crowell	Foard	2040	$0	$729	0	0	2	7	13	16	$753
County Other	Hardeman	2050	$0	$697	0	0	0	4	8	13	$757
Quanah	Hardeman	2040	$0	$655	0	0	5	23	41	48	$601
Bowie	Montague	2020	$0	$608	27	43	40	48	64	81	$601
County Other	Montague	2040	$0	$782	0	0	3	47	105	144	$772
Burkburnett	Wichita	2020	$0	$770	148	305	269	251	251	254	$771
County Other	Wichita	2040	$0	$799	0	0	2	15	27	36	$773
Electra	Wichita	2030	$0	$631	0	8	25	53	82	105	$602
Iowa Park	Wichita	2040	$0	$625	0	0	5	36	76	91	$597
Wichita Falls	Wichita	2020	$36,656,000	$815	4,484	4,484	4,484	4,484	4,484	4,484	$131
Wichita Valley WSC	Wichita	2060	$0	$660	0	0	0	0	12	24	$694
County Other	Wilbarger	2050	$0	$789	0	0	0	13	31	45	$773
Vernon	Wilbarger	2050	$7,807,000	$201	313	313	313	364	437	515	$172
County Other	Young	2060	$0	$832	0	0	0	0	3	5	$844
Olney	Young	2050	$0	$600	0	0	0	16	38	59	$600

ATTACHMENT 5-2
SUMMARY OF RECOMMENDED STRATEGIES

Entity	County Used	Expected Online Date	Capital Cost	First Decade Unit Cost ($/ac-ft/yr)	Total Yield						Last Decade Unit Cost ($/ac-ft/yr)
					2020	2030	2040	2050	2060	2070	
Precipitation Enhancement											
Wichita Falls		2020			1,000	1,000	1,000	1,000	1,000	1,000	
Reservoir											
Wichita Falls	Wichita	2040	$330,500,000	$1,602	0	0	18,600	18,600	18,600	18,600	$494
Reuse											
Wichita Falls	Wichita	2020	$36,400,000	$632	11,210	11,210	11,210	11,210	11,210	11,210	$360
Vernon	Wilbarger	2040	$8,500,000	$2,728	0	0	300	400	400	400	$950
Surface Water											
Wichita Falls	Wichita	2020	$11,230,000	$816	2,242	2,242	2,242	2,242	2,242	2,242	$397
Voluntary Transfer											
Archer City	Archer	2020	$0	$114	20	9	0	0	0	0	$114
Scotland	Archer	2020	$0	$1,629	58	111	123	123	122	122	$1,629
Windthorst WSC	Archer	2020	$0	$114	44	54	53	49	47	47	$548
County Other	Clay	2020	$0	$1,140	50	53	39	17	0	0	$1,140
County Other	Foard	2020	$0	$1,140	5	3	0	0	0	0	$1,140
Crowell	Foard	2020	$0	$1,140	28	27	24	19	13	10	$2,344
County Other	Hardeman	2020	$0	$1,140	16	15	12	11	8	4	$1,141
Quanah	Hardeman	2020	$0	$1,140	79	78	73	56	38	32	$1,140
Manufacturing	Hardeman	2020	$0	$1,140	55	59	63	66	66	66	$1,140
County Other	Montague	2020	$0	$1,423	191	191	175	177	188	199	$315
County Other	Wichita	2020	$0	$1,629	20	31	42	47	54	60	$1,629
Electra	Wichita	2020	$0	$1,629	94	117	134	154	174	193	$1,629
County Other	Wilbarger	2020	$0	$0	1	6	16	38	46	53	$0
County Other	Young	2050	$0	$1,140	0	0	0	7	13	21	$1,140

CHAPTER 6

IMPACTS OF REGIONAL WATER PLAN

2016 FINAL PLAN

REGION B

DECEMBER 2015

CHAPTER 6

IMPACTS OF REGIONAL WATER PLAN
2016 FINAL PLAN
REGION B

6.1 Requirements

The development of viable strategies to meet the demand for water is the primary focus of regional water planning. However, another important goal of water planning is the long-term protection of resources that contribute to water availability, and to the quality of life in the State. The purpose of this chapter is to describe how the 2016 Plan is consistent with the long-term protection of the State's water resources, agricultural resources, and natural resources. The requirement to evaluate the impact of the regional water plan and its consistency with protection of resources is found in 31 TAC Chapter 357.40 & 41, which require the following:

- A description of the socioeconomic impacts of not meeting identified water needs in the region. . (§357.40(a))
- A description of potential impacts of the regional water plan regarding agricultural resources; other water resources including groundwater and surface water interrelationships; threats to agricultural and natural resources; third-party social and economic impacts resulting from voluntary redistributions of water including moving water from rural and agricultural areas; major impacts of recommended water management strategies on key parameters of water quality; and, effects on navigation. . (§357.40(b))
- A summary of identified water needs that remain unmet by the plan. . (§357.40(c))
- A description of how the 2016 Plan is consistent with the long-term protection of the state's water resources, agricultural resources, and natural resources. . (§357.41)
- A summary describing how the 2016 Plan is consistent with the guidelines for water planning as outlined in §357.20. (§357.60(a))

Following are descriptions of the remaining sections of this Chapter.

- Section 6.2 addresses the socioeconomic impacts of not meeting identified water needs in Region B.
- Section 6.3 addresses impacts of the plan on agricultural resources.
- Section 6.4 addresses impacts of the plan on other water resources.
- Section 6.5 addresses threats to agricultural and natural resources.
- Section 6.6 addresses third-party social and economic impacts resulting from voluntary redistributions of water including moving water from rural and agricultural areas.
- Section 6.7 addresses major impacts of recommended water management strategies on key parameters of water quality.
- Section 6.8 addresses impacts on navigation and impacts on existing water contracts and option agreements.
- Section 6.9 provides a summary of identified water needs that remain unmet by the plan.
- Section 6.10 provides a description of how the 2016 Plan is consistent with the long-term protection of the state's water resources, agricultural resources, and natural resources.
- Section 6.11 provides a description of the plan's consistency with the guidelines for water planning.

6.2. Socioeconomic Impacts of not Meeting Identified Water Needs

The TWDB provided technical assistance to regional planning groups in the development of the potential socio-economic impacts of failing to meet projected water needs. The TWDB's analysis calculated the impacts of a severe drought occurring in a single year at each decadal period in Region B. It was assumed that all of the projected shortage was attributed to drought. Under these assumptions, the TWDB's findings can be summarized as follows:

- Without any additional supplies, the projected water needs would reduce the region's projected 2020 employment by 4,800 jobs. This declines to 3,870 lost jobs by 2070. Most of this reduction occurs in the mining and manufacturing sectors.

- Without any additional supplies, the projected water needs would reduce the region's projected annual income in 2020 by approximately $644 million. This represents about 6.5 percent of the region's current income. The loss in income reduces to approximately 370 million in 2070.

The complete socio-economic study report by the TWDB is included in Appendix E.

6.3 Impacts of the Regional Water Plan on Agricultural Resources

Agriculture which encompasses both farming and ranching is an important economic driver within Region B. With over one million acres in cropland, irrigation is a critical input for sustaining agriculture in the region even when rainfall is normal or above normal, accounting for about 61 percent of all water used. The evaluation of water sources indicates that existing water sources are not sufficient to meet irrigation demands in five counties (Archer, Baylor, Hardeman, Wichita, and Wilbarger) and water quality may further limit irrigation supplies in two counties (Archer and Wichita), even though irrigation demand is expected to decline during the planning period. Water conservation will balance supplies with demands in all but Hardeman and Wichita counties. For these counties an unmet need of 9,802 acre-feet per year remains. The socioeconomic impacts resulting from not meeting these water needs are addressed in Chapter 4.

6.4 Impacts of the Regional Water Plan on Other Water Resources

The water resources in Region B include of three river basins providing surface water, and portions of three aquifers providing groundwater. The three river basins present in Region B are the Red River Basin, a small portion of the Trinity River Basin and a small portion of the Brazos River Basin. The respective boundaries of these basins are depicted in Figure 2, in Chapter 1.

Surface water accounts for approximately 58% of the total water supply in the region. Sources within the region include six major reservoirs that are used for water supply and several smaller reservoirs that were previously used for water supply or supply very small amounts of water Currently, the majority of the available surface water supply used in Region B comes from the Red River Basin with one reservoir in the Trinity River Basin.

The region's groundwater resources include two major aquifers (Seymour and Trinity) and one minor aquifer (Blaine). The extents of these aquifers within the region are depicted on Figures 1-3 and 1-4, in Chapter 1. Groundwater is primarily supplied in Region B by the Seymour and the Blaine. The Seymour is found in the central and western portions of the region. It is currently used in Hardeman, Wilbarger, Wichita, Clay, Baylor, and Foard Counties. The Blaine is considered a minor aquifer and useable groundwater is limited to the westernmost portion of the region. These aquifers provide a large percentage of available supply in these counties. In addition, the upper portion of the Trinity Aquifer occurs in Montague County in the eastern part of the region. Limited quantities of groundwater are used from the Trinity for municipal and irrigation uses.

There are also other formations within the region that are used for groundwater supply in limited areas. The TWDB identifies these sources as "Undifferentiated Other Aquifer". These formations generally are not well defined in the literature, but still provide substantial quantities of water in Archer, Clay, Cottle, King, Montague, Wichita, and Wilbarger Counties.

To be consistent with the long-term protection of water resources, the 2016 Plan must recommend strategies that minimize threats to the region's sources of water over the planning period. The water management strategies identified in Chapter 5 were evaluated for threats to water resources. The recommended strategies represent a comprehensive plan for meeting the needs of the region while effectively minimizing threats to water resources. Threats to water resources are minimized in the 2016 Plan in the following ways:

6.4.1 Water Conservation.

Strategies for water conservation have been recommended that will help reduce the demand for water, thereby reducing the impact on the region's groundwater and surface water sources. Advanced water conservation practices are expected to save approximately 30,382 acre-feet of water annually by 2020, reducing impacts on both groundwater and surface water resources. By 2070, the advanced conservation strategies will save a total of 34,217 acre-feet per year. These savings are in addition to the basic water savings assumed in the demands. The plan assumes basic conservation savings in municipal demands due to the implementation of plumbing codes and basic conservation savings in agriculture due to improvements in irrigation efficiency and crop varieties. The total projected water savings from both basic and advanced conservation for Region B by 2070 is 48,384 acre-feet per year. Water conservation benefits the State's water resources by reducing the volumes of withdrawals from water sources that are needed to support human activity.

6.4.2 Water Reuse.

Currently, the majority of reuse in Region B is limited to municipal irrigation and/or use at the wastewater treatment facilities; however, the City of Bowie sells nearly all of its wastewater effluent for mining purposes. The City of Wichita Falls recently ceased an emergency direct potable reuse project that used up to 5 million gallons per day (MGD) of treated wastewater effluent, and is converting this project to an indirect reuse strategy that will deliver 10 MGD of treated wastewater to Lake Arrowhead. This indirect potable reuse will help maximize the availability of Wichita Falls' surface water sources. Water reuse in general provides a means to more efficiently use the supplies available within the region, conserving the water resources in Region B. Other entities considering new or additional wastewater reuse include the cities of Olney and Vernon.

6.4.3 Voluntary Transfers.

This strategy involves the voluntary transfer of water resources from one entity that has a surplus to another entity that has a need. In most cases these transfers are handled directly through implementation of infrastructure that will facilitate a physical transfer of water instead of the transfer or lease of water rights that would constitute a paper transfer without connecting infrastructure. In Region B these voluntary transfers have become a necessary means of addressing water supply to overcome both water supply quantity limitations and water quality limitations. A major benefit of voluntary transfers is reduction of the potential to overuse, overdraft, or otherwise reduce the longevity of existing water resources. In addition, use of voluntary transfers has allowed for reduction of demand from some existing water sources.

6.4.4 Development of New and/or Expanded Use of Surface Water Supplies

Lake Ringgold.

This strategy will increase surface water supplies available for cities, industry, and agriculture in Region B by 18,600 acre-feet per year (firm yield). Lake Ringgold will impact approximately 120 acres of existing ponds and stock tanks and approximately 165 miles of streams. At the conservation elevation of 844 feet, approximately 910 acres of wetlands will be impacted. Lake Ringgold is near the confluence of the Little Wichita River and the Red River Basin. The impoundment should have minimal impact on other water resources or other water management strategies. The WAM, a part of the regional planning process, assesses how the increased use of surface water resources will impact the Region's water resources. The evaluation of Lake Ringgold utilized the current WAM with extended hydrology to ensure that this project did not over allocate State water and respected the water supplies of other water resources.

Wichita River Diversion

Water management strategies that involve existing surface water resources are designed optimize the utilization of these resources. One of these options is the Wichita River Diversion at Wichita Falls, which would require an amendment of the Lake Kemp permit to allow for municipal use and diversion at a point downstream from the current diversion point. This project respects the quantity of water already permitted and considers more recent droughts in estimating the available supply.

6.4.5 New and/or Expanded Use of Groundwater.

This strategy has generally been recommended for entities with sufficient groundwater supply available to meet needs, but currently without adequate infrastructure (i.e., well capacity). Groundwater availability reported in the plan is based on the long-term sustainability of the aquifers. No strategies are recommended to use water above currently identified sustainable levels. Therefore, it is not expected that additional use of groundwater will have adverse effects on other water sources.

6.4.6 Brush Control

Brush control is a strategy that is aimed at reducing the amount of water consumed by deep-rooted woody vegetation that has minimal economic or environmental value. This vegetation consumes water from a large area robbing moisture from native grasses and parching the subsoil. The large leaf canopy also intercepts moisture that would otherwise land on the soil. As a result, the brush reduces the potential for runoff and for percolation of moisture into the subsoil that may contribute to aquifer recharge. Brush control removes this vegetation and potentially improves the hydrologic condition of the soil and increases potential for groundwater recharge, especially in water table aquifers like those found in Region B.

6.4.7 Conjunctive Use

Conjunctive use is a strategy the will effectively increase the overall water supply through balancing groundwater demand at critical times with surface water supplies. During times when surface water is plentiful, the groundwater system can recharge or recover. While this strategy may have short term impacts on groundwater during drought conditions, the potential for extended recovery periods offsets the short term impact.

6.4.8 Advanced Treatment

Advanced treatment typically involves removing salts from various marginal or somewhat brackish sources of water. When this process is implemented, the waste stream will contain concentrated salts. It is proposed that these wastes would be discharged in conjunction with existing wastewater discharges. There may be impacts on downstream water resources if the total daily salt load resulting from this strategy is increased over current levels. An alternative would be disposal in an injection well

6.4.9 Precipitation Enhancement

The purpose of precipitation enhancement is to increase the potential for rainfall through cloud seeding operations. The goal is to increase the overall water supply. The success of this strategy would have little impact on other water sources.

6.4.9 Chloride Control Project

The chloride control project is designed to capture water from the chloride seeps that would otherwise flow into the existing surface water sources. While the project structures would capture highly concentrated chloride, water resources would be improved downstream of the capture points. Therefore, this strategy would have little impact on other water resources.

6.5 Threats to Agricultural and Natural Resources

Region B contains many natural resources including threatened or endangered species; local, state, and other public land; and energy/mineral reserves. In addition, excessive concentrations of total dissolved solids, sulfate, and chloride are a general problem in most streams of the Red River Basin under low flow conditions. Following is a brief discussion of how the 2016 Plan may present threats to agricultural and natural resources.

6.5.1 Agricultural Resources

Region B includes over one million acres of cropland and over two million acres of rangeland. Agriculture is an important part of the economy, lifestyle, and history of Region B. Some entire communities were originally built around agricultural products, and lack of water could dramatically change the nature of these communities. When there is insufficient water to grow range grasses and fill stock tanks, there is a high probability that producers will cull or sell entire herds. If herds are not thinned then overgrazing and introduction of noxious grasses, forbes, and woody vegetation will occur.

6.5.2 Natural Resources

As mentioned in Section 6.4.4, construction of Lake Ringgold has the potential to impact natural resources through inundation of 165 miles of streams and 910 acres of wetlands. Many environmental studies will need to be completed in order move forward with this project. Other natural resource impacts may be identified, but as part of the study portion for this project, impacts on natural resources will be evaluated and mitigation designed as needed to offset the impacts.

6.6 Impacts of Moving Water from Agricultural and Rural Areas

The implementation of water management strategies recommended in Chapter 5 of this regional plan is not expected to significantly impact water supplies that are currently in use for agricultural purposes. The voluntary transfer of groundwater from agricultural use to municipal use is predicated on a willing buyer, willing seller basis. The only recommended strategy that assumes transfer of groundwater from agriculture is the City of Vernon's new well field.

Most of the other recommended water management strategies for municipal water users rely on conservation, reuse and the development of Lake Ringgold. Conservation and reuse are protective of existing water supplies, which can delay or eliminate the need for new water. The development of Lake Ringgold would impact some landowners within the footprint of the reservoir. It is assumed that these landowners would be fairly compensated for their property. When possible, Wichita Falls intends to purchase the lands on a willing buyer, willing seller basis.

The methodology for assessing the available supply of water for strategies in this regional water plan protects the existing supplies of current users. The plan honors the MAG values adopted for groundwater such that groundwater is protected for current and future use. New surface water supplies were determined using the WAM that protects existing water right holders, including rural and agricultural users.

6.7 Major Impacts of Recommended WMSs on Key Parameters of Water Quality

This section presents an assessment of the water quality parameters that could be affected by the implementation of water management strategies for Region B. This assessment includes an evaluation of specific water quality parameters that are routinely monitored through the Texas Clean Rivers Program and regulated by the U.S. Clean Water Act. Based on this assessment, the key water quality parameters for each type of strategies are identified. From this determination, the specific water management strategies selected for Region B were evaluated with respect to potential impacts to the key water quality parameters.

6.7.1 Water Conservation

Water conservation is a recommended strategy for irrigation, municipal water and steam electric power use in Region B. Recommended irrigation conservation measures include conversion of canals to pipelines and on-farm conservation. For steam electric power, alternative cooling technologies are recommended. These strategies are not expected to affect water quality adversely. The results should be beneficial because the demand on surface and groundwater resources will be decreased. Municipal conservation should have similar beneficial effects, but at a smaller scale.

6.7.2 Reuse

In general, there are three possible water quality effects associated with the reuse of treated wastewaters:

- There can be a reduction in instream flow if treated wastewaters are not returned to the stream, which could affect TDS, nutrients, and DO concentrations of the receiving stream.
- Conversely, in some cases, reducing the volume of treated wastewater discharged to a stream could have a positive effect and improve levels of TDS, nutrients, DO, and possibly metals in the receiving stream.
- Reusing water multiple times and then discharging it can significantly increase the TDS concentration in the effluent and in the immediate vicinity of the discharge in the receiving stream. Total loading to the stream (i.e. the amount of dissolved material in the waste stream) should not change significantly.

These impacts will vary depending on the quality and quantity of treated wastewater that has historically been discharged to the stream and the existing quality and quantity of the receiving stream.

6.7.3 Voluntary Transfers

Voluntary transfers generally involve the sale of water from one provider to another.
Voluntary transfers of groundwater sources will have minimal impacts on water quality parameters assuming there is no relative change in the amount of groundwater pumped. Impacts on key water quality parameters for large increases in groundwater pumpage to meet contractual sales are discussed in Section 6.1.4 (New and/or Expanded Use of Groundwater Resources).

Pending the location and use of the water under voluntary transfers, changes in locations of return flows (if applicable) could impact flows in receiving streams. Such impacts would be site specific and could be positive or negative, pending the changes.

Generally, these impacts are relative to the quantities of water that are diverted or redistributed. Small quantities are likely to have minimal to no impacts, while large quantities may have measured impacts.

6.7.4 New and/or Expanded Use of Groundwater Resources

Increased use of groundwater can decrease instream flows if the base flow is supported by spring flow. Increased use of groundwater has the potential to increase TDS concentrations in area streams if the groundwater sources have higher concentrations of TDS or hardness than local surface water and are discharged as treated effluent. However, this is regulated by the State under its wastewater discharge requirements. Generally, wastewater discharged to a state water course cannot exceed the stream standards of eth receiving stream.

6.7.5 Development of New Surface Water Supplies

Two proposed new surface water projects are included in the Region B Plan. One is the use of Wichita River water which is already permitted but has never been used. The second is the construction of Lake Ringgold. The use of the Wichita River will require the use of advanced treatment (RO) and the discharge back to the Wichita River may have minimal impact on water quality. The construction of Lake Ringgold may include the modification of existing upstream wastewater plants to ensure protection of the water quality in the reservoir.

6.7.6 Brush Control

Brush control is a recommended strategy for the Lake Kemp and Lakes Arrowhead and Kickapoo watersheds. Impacts to the water quality of area streams will depend upon the methods employed to control the brush. It is assumed that chemical spraying will not be used near water sources. Mechanical removal, prescribed burns and use of the salt cedar beetle are the preferred methods near water sources. With these assumptions, chemical contamination of water source is very low. Increases in stream flow due to reduced evapotranspiration associated with the removed brush should improve water quality in these watershed.

6.7.7 Conjunctive Use

Conjunctive use is a recommended strategy for Wichita Falls. This strategy would conjunctively use surface water from Wichita Falls sources and groundwater from the Seymour aquifer. It would allow Wichita Falls the ability to operate their reservoirs in a manner that minimizes impacts to key water quality parameters in the lake while still being able to provide sufficient supplies to its customers from groundwater.

6.7.8 Advanced Treatment

Advanced treatment is recommended for Wichita Falls for the local groundwater and supplies from the Wichita River. The waste stream from the advanced treatment would likely be discharged under its existing permit for discharge to the Wichita River. Under the existing permit, the water quality of the receiving stream is protected. The small amount of proposed discharge is not expected to have impacts to key water quality parameters.

6.7.9 Precipitation Enhancement

Precipitation enhancement is considered as part of the irrigation conservation strategies. These operations are already in progress, so there are no expected changes in water quality associated with this strategy.

6.7.10 Chloride Control Project

The Chloride Control Project is a recommended strategy for WCWID No.2. The sole purpose of the project is to improve the overall water quality in the Wichita River Basin. This project would have a positive impact on the water quality within the region.

6.8 Impacts on Navigation, Existing Water Contracts, and Option Agreements

In accordance with Section 10 of the Rivers and Harbors Act of 1899, navigable waters are those waters that are subject to the ebb and flow of the tide and/or are presently being used, or have been used in the past for use to transport interstate or foreign commerce. In Region B, the major river is the Red River. The Red River is not considered navigable within Region B. Therefore, the Region B Water Plan does not have an impact on navigation.

The Region B Water Plan protects existing water contracts and option agreements by reserving the contracted amount for included in those agreements where those amounts were known. In some cases there were insufficient supplies to meet existing contracts. In those cases, water was reduced proportionately for each contract holder. For entities with shortages, water management strategies were recommended to meet deficits in contractual obligations.

6.9 Summary of Identified Water Needs that Remain Unmet

The water needs that remain unmet in Region B are summarized in Table 6-1.

Table 6-1 Summary of Unmet Needs

County	Water Use	Decade of Unmet Need	Maximum Vol.(ac-ft/yr)
Archer	Mining	2020-2070	212
Archer*	Irrigation	2020-2070	114
Baylor	Irrigation	2020	57
Baylor	Livestock	2020-2070	130
Hardeman	Irrigation	2020-2070	1,697
Montague	Mining	2020	405
Wichita	Irrigation	2040-2070	8,729

* Portions of Archer County Irrigation in the Brazos and Trinity Basins

6.10 Consistency with Protection of State Water Resources, Agricultural Resources, and Natural Resources

The objective of this section is to address how the selected water management strategies are consistent with protection of water resources, agricultural resources, and natural resources within and beyond the boundaries of the Regional Planning Area.

In developing the Region B Water Plan, the RWPG balanced meeting water shortages with good stewardship of water, agricultural, and natural resources within the region. During the strategy selection process, long-term protection of the State's resources were considered through assessment of environmental impacts, impacts to agricultural and rural areas and impacts to natural resources. The identification and development of strategies considered the maintenance or improvement of the water quality of sources in Region B, which is consistent with the state water quality management plan. Existing in-basin or region supplies were utilized as feasible before recommendations for new water supply projects. The proposed conservation and reuse measures for municipalities, irrigators, mining and steam electric power operators will continue to protect and conserve the State's resources for future water use. Discussion of how the plan addresses threats and impacts to the State's resources within Region B is presented in Sections 6.3 through 6.5. The following sections discuss the consistency with these protections by resource.

6.10.1 Water Resources

The primary water management strategies that may have an impact beyond the boundaries of Region B are those that impact the surface water resources of a stream that flows well beyond the region. For this planning region that is the Red River. Strategies that may produce impacts beyond the limits of the region include:

- **Water reuse.** Potentially reduces downstream flows and may increase water quality concerns downstream.
- **Lake Ringgold.** May also reduce flows in the Little Wichita River downstream of the dam (which is less than 1,000 feet) and possibly the Red River. This will be mitigated through environmental flow releases.
- **Wichita River Diversion.** May reduce flows in the Wichita River downstream of the diversion; however, the quantity of water proposed for diversion is a small fraction of the total annual flows in the Red River below the confluence with the Wichita River. Also, these diversions are already authorized by the state.
- **Advanced treatment.** May produce a waste that flows downstream and potentially creates water quality concerns.

Potential impacts to surface water – groundwater interactions are minimized due to the lack of defined groundwater aquifers in areas of Region B where there are surface water projects. The Seymour aquifer, which is a shallow alluvium formation, is known to have connectivity to adjacent surface waters. This interaction is dependent upon specific conditions at the project location. The following projects have the potential to impact the connectivity between surface water and groundwater:

- **Seymour Aquifer Development (Wichita Falls).** This strategy would likely only be used during drought, which could potentially reduce groundwater discharge to the

Wichita River. These potential impacts would be temporary as both stream flows and aquifer storage will be recharged during rain events.

- **Wichita River Diversion.** Potential reductions in flows in the Little Wichita River downstream of the dam may reduce groundwater recharge. However, during drought it appears that the local aquifer is recharging the surface water and would help support this project. These potential impacts would be temporary as both stream flows and aquifer storage will be recharged during rain events.

6.10.2 Agricultural Resources

The selected water management strategies are not expected to create concerns for agricultural resources at the statewide level.

6.10.3 Natural Resources

The selected water management strategies are not expected to create concerns for natural resources at the statewide level. However, threatened and endangered species, parks and public lands, and energy/mineral resources are addressed individually below.

Threatened/Endangered Species.

A list of species of special concern, including threatened or endangered species, located within Region B is contained in Table1-13. Included are ten species of birds, four mammals, two reptiles, one amphibian, two fish, and one mollusk. In general, most WMSs planned for Region B will not affect threatened or endangered species. Development of a new reservoir in the region could affect threatened or endangered species and their habitats. However, the development of any reservoir requires extensive environmental impact studies that address potential effects on threatened or endangered species. Any such impacts indicated by these studies would need to be mitigated in accordance with federal and state environmental regulations in order for the reservoir project to be allowed.

Parks and Public Lands.

The Copper Breaks State Park is located in Hardeman County and the Lake Arrowhead State Park is located in Clay County. In addition, there are numerous local (e.g., city or county parks), recreational facilities, and other local public lands located throughout the region. None of the water management strategies currently proposed for Region B is expected to adversely impact state or local parks or public land.

Energy/Mineral Reserves.

The Texas Railroad Commission reports that Region B has approximately 16,867 regular producing oil wells and 750 regular producing gas wells. Table 1-11 provides a tabulation by county of the current oil and gas wells, as of February, 2014. These wells are largely in the Barnett Shale. In addition, Georgia-Pacific Corporation operates a gypsum mine in Hardeman County. It is anticipated that the water management strategies will not adversely impact either the oil and gas exploration and production activity within the region or the gypsum mine.

6.11 Consistency with State Water Planning Guidelines

To be considered consistent with long-term protection of the State's water, agricultural, and natural resources, the Region B Water Plan must also be determined to be in compliance with provisions of 31 TAC Chapter 357. The information, data, evaluation, and recommendations included in Chapters 1 through 5 and, Chapters 7 through 11 of the 2016 Plan collectively demonstrate compliance with these regulations. To more clearly demonstrate compliance, Region B has developed a matrix addressing the specific recommendations contained in the referenced regulations. Appendix F contains a completed matrix or checklist highlighting each pertinent paragraph of the regulations. The content of the 2016 Plan have been evaluated against this matrix.

CHAPTER 7

DROUGHT RESPONSE INFORMATION, ACTIVITIES, AND RECOMMENDATIONS

2016 WATER PLAN

REGION B

DECEMBER 2015

CHAPTER 7

DROUGHT RESPONSE INFORMATION, ACTIVITIES, AND RECOMMENDATIONS
2016 FINAL PLAN
REGION B

7.1 Introduction

Drought response and management have long been important aspects of regional water planning. The extensive drought experienced in Texas during the 2010-2015 time-frame, however, served to re-focus attention on the need for comprehensive consideration of drought management measures. Requirements for improved drought planning in the State through the regional water planning process are found in Title 31 of the Texas Administrative Code (TAC), Part 10, Chapter 357, Subchapter D. Specifically §357.42 of Subchapter D includes requirements related to drought response information, activities, and recommendations. This chapter of the regional plan addresses the requirements found in §357.42.

This chapter also addresses the recommendation of the Drought Preparedness Council (DPC) by generally following the outline template provided by the TWDB for Chapter 7. The DPC also recommended that this chapter address "drought preparedness impacts of unanticipated population growth or industrial growth." As described in Chapter 2, the Region B projections for population growth and corresponding municipal demand reflect a slow growth rate. The RWPG has not identified any factors that would contribute to unanticipated growth that would impact drought planning and preparedness. Industrial growth is not specifically identified as a non-municipal water demand, but may be captured by manufacturing or mining water use. Similarly, the RWPG has not identified factors that would contribute to unanticipated growth in water demand in these sectors of water use. Mining demand was expected to continue increasing in some areas of the region over the next decade, but this demand was partially addressed by water conservation strategies as described in Chapter 5. In addition, recent economic factors have resulted in a decrease in oil and gas drilling and production activity in the region; however, it is anticipated that this may be a temporary condition.

Region B was significantly impacted by drought during 2010-2015, and although the drought subsided during the late spring and summer of 2015 as major water supply reservoirs were filled, the region can rapidly return to a drought status with seasonal or longer periods of drought occurring frequently.

7.2 Droughts of Record

A central principal of regional water planning is that the availability of water sources is determined for drought-of-record conditions. State-wide, the drought of the 1950’s is often considered the drought of record, but on regional or sub-regional bases, other periods of time may actually be demonstrated to have been more severe. Chapter 7 includes a detailed examination of preparations for and responses to drought conditions in the region, as required by §357.42. Such examination begins with identification of significant recent droughts within the region.

Numerous definitions of drought have been developed to describe drought conditions based on various factors and potential consequences. In the simplest of terms, drought can be defined as “a prolonged period of below-normal rainfall.” However, the State Drought Preparedness Plan provides more specific and detailed definitions:

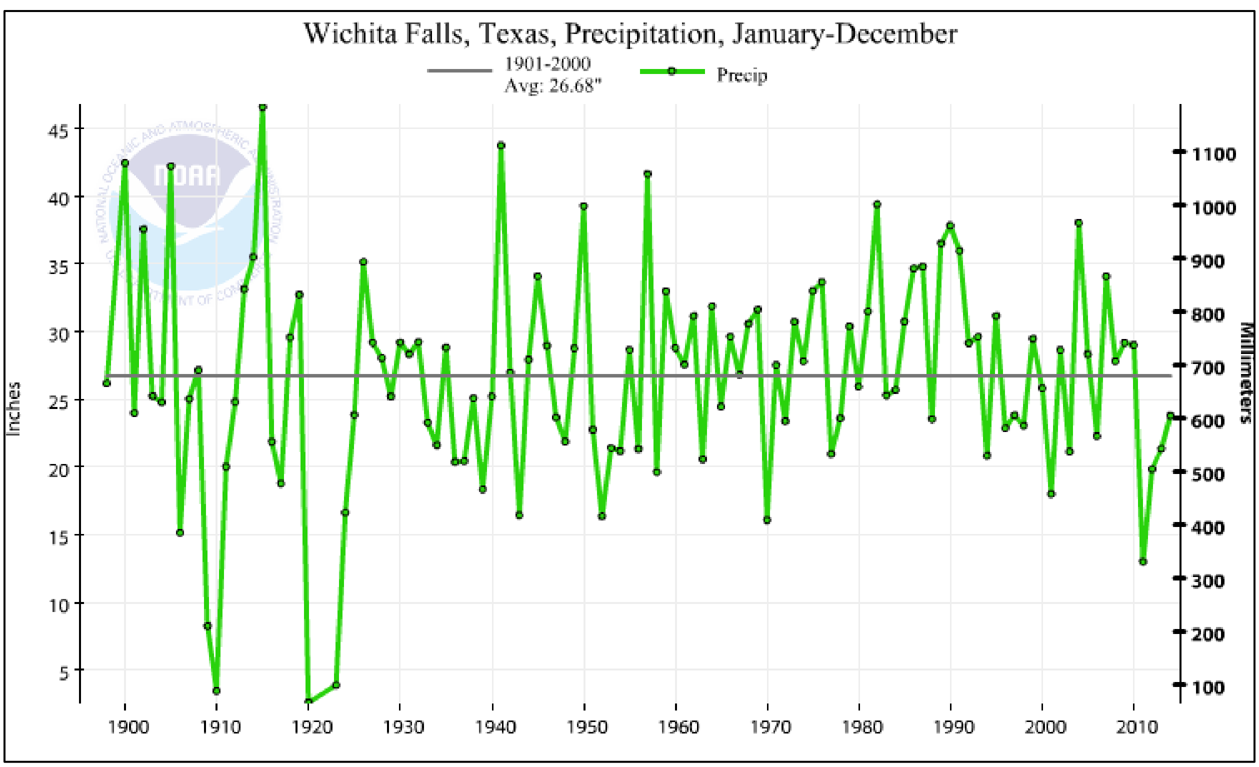
- Meteorological Drought. A period of substantially diminished precipitation duration and/or intensity that persists long enough to produce a significant hydrologic imbalance.
- Agricultural Drought. Inadequate precipitation and/or soil moisture to sustain crop or forage production systems. The water deficit results in serious damage and economic loss to plant and animal agriculture. Agricultural drought usually begins after meteorological drought but before hydrological drought and can also affect livestock and other agricultural operations.
- Hydrological Drought. Refers to deficiencies in surface and subsurface water supplies. It is measured as streamflow, and as lake, reservoir, and groundwater levels. There is usually a lack of rain or snow and less measurable water in streams, lakes, and reservoirs, making hydrological measurements not the earliest indicators of drought.

- Socioeconomic Drought. Occurs when physical water shortages start to affect the health, well-being, and quality of life of the people, or when the drought starts to affect the supply and demand of an economic product.

These definitions are not mutually exclusive, and provide valuable insight into the complexity of droughts and their impacts. They also help to identify factors to be considered in the development of appropriate and effective drought preparation and contingency measures.

Regional water planning primarily addresses meteorological, agricultural, and hydrological drought and response to these conditions in an attempt to avoid socioeconomic drought. Figure 7-1 shows the long term precipitation for Wichita Falls. This location was chosen instead of the National Oceanic and Atmospheric Agency (NOAA) Climatic Division 3 data for North Central Texas, because Climatic Division 3 represents an area extending down to the Austin – Waco area, and does not accurately reflect the average precipitation for Region B.

Figure 7-1 Precipitation Record for Wichita Falls



Source: http://www.ncdc.noaa.gov/cag/time-series/us

It can be noted that there were significant periods of low and high rainfall from 1905 to 1930, but this was prior to development of many of the current water supply sources. The minimal rainfall that occurred in 2011 is also less than any annual rainfall total since the 1920s.

7.2.1 Current Droughts of Record .

As described in Chapter 3, the surface water supplies for the regional water plans were determined using the TCEQ-approved Water Availability Models (WAM).[1] For example, the firm yield of a reservoir is the greatest amount of water a reservoir can supply on an annual basis without shortage during a repeat of historical hydrologic conditions, particularly the drought of record. The WAMs incorporate historical hydrologic conditions that occurred between 1940 and 1996; however, data for hydrologic conditions through December 2013 was used to. The droughts of record that were used to evaluate currently available water supplies (Chapter 3) are provided in Table 7-1.

The drought of record can be different for different geographic locations. Based on the current data it appears there have been two primary droughts of record in Region B:

- The drought of the 1950s in the southeastern portion of the region.
- The current drought with initiation dates varying from 1993 to 2010 depending upon the location within the remainder of the region.

Table 7-1 Current Droughts of Record for Water Supply Reservoirs

Reservoir Name	Date Last Full	Date of Minimum Content	Drought of Record
Amon Carter(3)	June 1951	March 1957	1951-1957
Arrowhead	June 1993	December 2013(2)	1993 - Current
Kemp	September 2010	December 2013(2)	2010-Current
Kickapoo	October 2005	December 2013(2)	2005-Current
Olney/Cooper	June 1993	December 2012(2)	1993-Current
Nocona	March 2001	December 2013(2)	2001-Current

(1) The Date Last Full is based on the safe yield analyses. (Note: Safe yield analyses assume the reservoir is full at the beginning of the simulation.)
(2) Date of the end of the simulation.
(3) Hydrology for Amon Carter is based on the Trinity WAM period of record and was not extended.

The drought of record reported for Amon Carter may actually become the current drought period when the hydrology for the Trinity WAM is extended to include the current precipitation and runoff data.

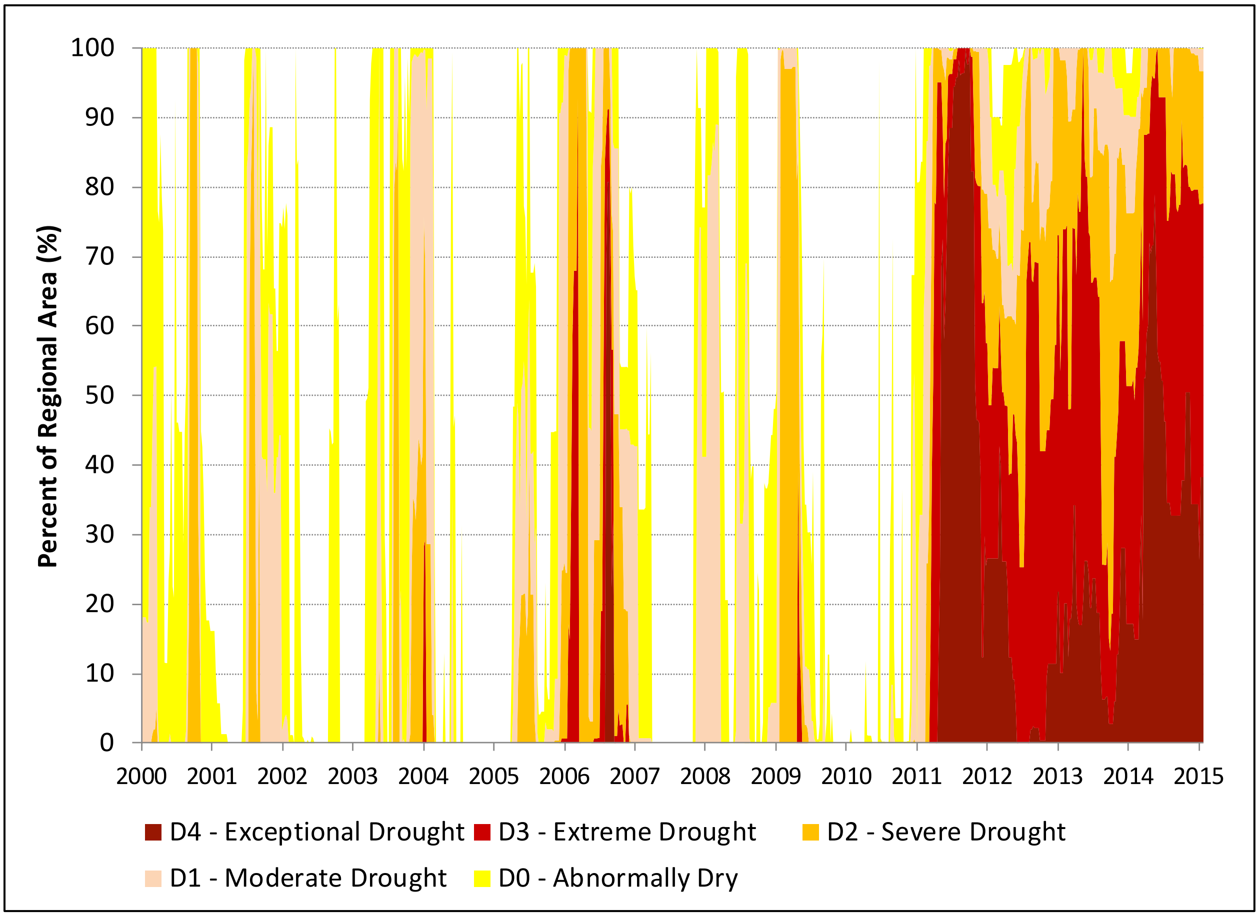
7.2.2 Recent Droughts in the Region .

There are many ways to measure drought, including the U.S. Drought Monitor index, the Palmer Hydrological Drought Index, and reservoir water levels. These three indicators were reviewed to identify significant droughts in Region B since the mid-1990's.

The Drought Monitor is a composite index that is calculated weekly based on measurements of climatic, hydrologic, and soil conditions, as well as reported impacts and observations from more than 350 contributors around the country.[2] The Drought Monitor was initiated in 2000, and data can be obtained for each county in the United States. Figure 7-2 shows a composite Drought Monitor index calculated for the counties in Region B over the period of record. This composite index shows the percentage of the land area in the affected counties that experienced different levels of drought. The Drought Monitor index indicates that about 50 percent of region has continued with Extreme Drought or Exceptional Drought conditions from early 2011 through the start of 2015. Over 95 percent of the region experienced Exceptional Drought conditions from late July through early October 2011 with about 25 percent of the region being in extreme or exceptional drought continuously from July 2011 through May 2015.

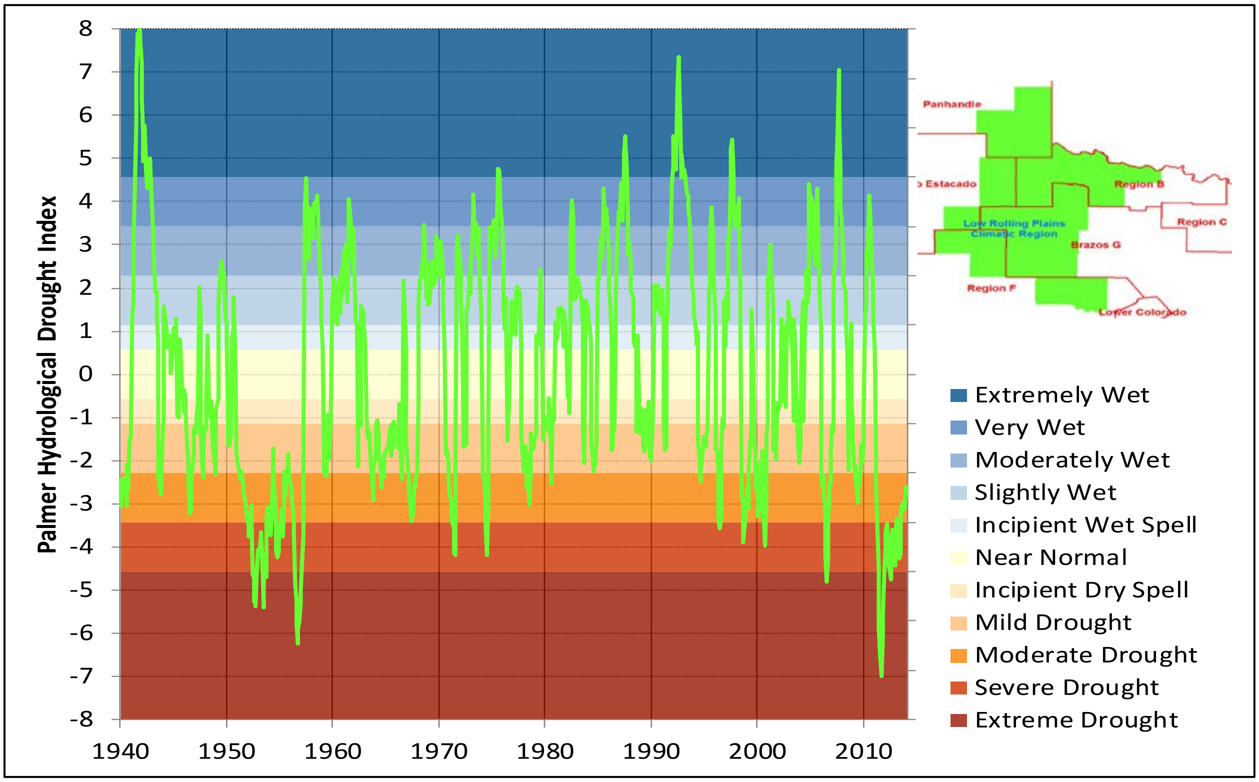
Compared to climatic effects of drought, the hydrological effects, such as lower reservoir and groundwater levels, may take longer to develop and longer still for recovery. The Palmer Hydrological Drought Index (PHDI) was developed as an indicator of the long-term cumulative moisture supply. The PHDI is available on a monthly basis for each year since 1900 for ten climatic regions in each state.[3] The Low Rolling Plains climatic region includes the western half of Region B and the North Central climatic region includes the eastern half of Region B. Figure 7-3 shows the PHDI for the Low Rolling Plains and Figure 7-4 shows the PHDI for the North Central climatic region.

Figure 7-2 Composite Drought Monitor Index for Counties in Region B



Source: Data provided by the National Drought Mitigation Center, January 2015.

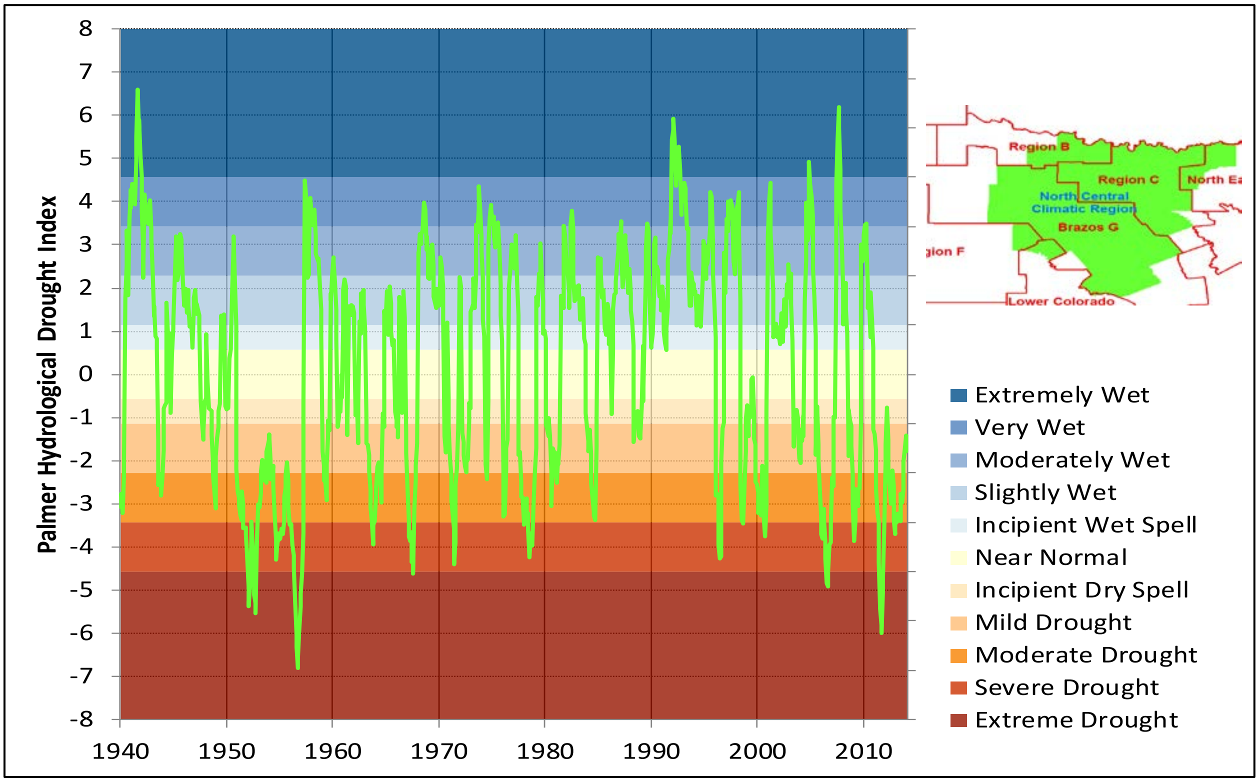
Figure 7-3 Palmer Hydrological Drought Index for the Low Rolling Plains Climatic Region



The PHDI reflects extended droughts during the 1950s and 2010-2015 with many shorter term droughts occurring during the period of record. According to the PHDI, the peak (lowest downward spike) of the 2010-2015 drought was slightly more severe in the Low Rolling Plains region and slightly less severe in the North Central region than the peak of the drought in the 1950s, but very similar in both regions to the drought of the 1950s..

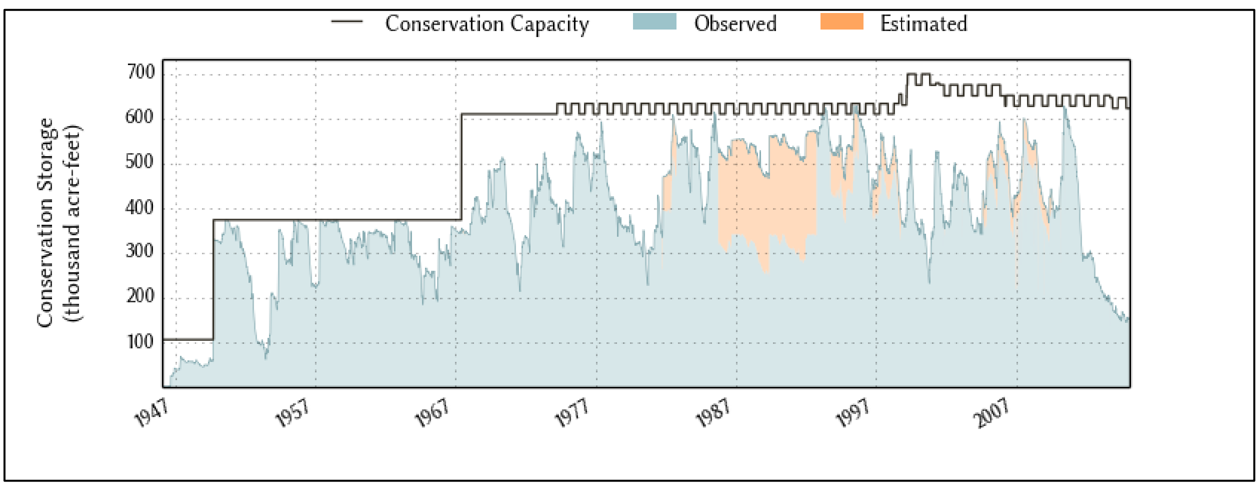
Another means of considering the drought is the impact on specific water sources. The total reservoir storage in Region B over the period of record is presented in Figure 7-5. This figure indicates that the total conservation storage available within the region has increased as the result of constructing additional reservoirs. However, the impact due to the current drought (2010-2015) has reduced the available water supply to about 150,000 acre-feet and is approaching the 100,000 acre-feet that remained in storage during the drought of the 1950s even though the total available reservoir storage capacity has almost doubled since then.

Figure 7-4 Palmer Hydrological Drought Index for the North Central Climatic Region



Source: Source: National Climatic Data Center: PHDI Divisional Data, URL: http://www1.ncdc.noaa.gov/pub/data/cirs/drd/drd964x.phdi.txt, accessed January 2015.

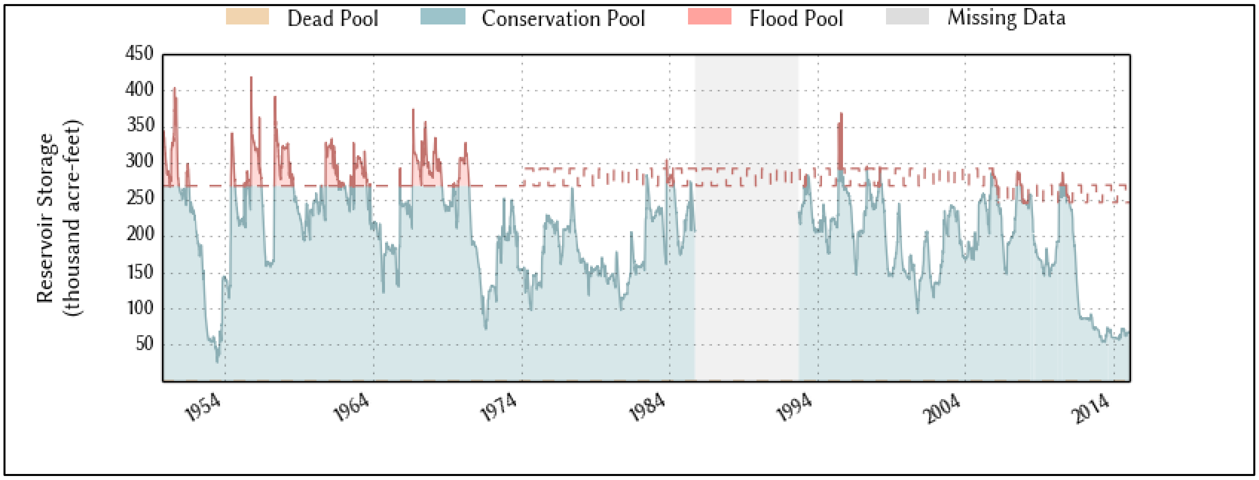
Figure 7-5 Composite Reservoir Storage in Region B



Source: Texas Water Development Board: Region B Planning Region Reservoirs, URL: http://waterdatafortexas.org/reservoirs/region/region-b, accessed January 2015.

Figure 7-6 provides the reservoir storage volume for Lake Kemp, which is one of the oldest and largest reservoirs serving Region B. Since about 1970, the reservoir has seldom been filled above the conservation pool level.

Figure 7-6 Reservoir Storage in Lake Kemp



Source: Texas Water Development Board: Region B Planning Region Reservoirs, URL: http://waterdatafortexas.org/reservoirs/individual/kemp, accessed January 2015.

All of these drought indicators suggest that the 2011-2015 period is a significant drought, if not the drought of record for Region B.

7.3 Summary of Current Drought Triggers.

The majority of the drought contingency plans in Region B use trigger conditions based on the state of water supply sources. For surface water sources the drought triggers are specific reservoir levels or volumes. For groundwater sources, the drought triggers are based on groundwater production capacity. Drought triggers for each of the surface water sources and information regarding the managing entity for each source follows. Where appropriate, the RWPG recommended retaining the triggers by stage currently in place in drought contingency plans adopted by entities responsible for managing the water source.

7.3.1 Lake Kickapoo and Lake Arrowhead

The City of Wichita Falls operates Lake Kickapoo and Lake Arrowhead. The following describes the existing drought stages triggers in these lakes under the City's DCP:

- Stage 1 – "Drought Watch" combined storage falls below 60% of conservation storage.
- Stage 2 – "Drought Warning" combined storage level falls below 50% of conservation storage
- Stage 3 – Drought Emergency" combined storage level falls below 40% of conservation storage
- Stage 4 – "Drought Disaster" combined storage level falls below 30% of conservation storage
- Stage 5 – "Drought Catastrophe" combined storage level falls below 25% of conservation storage.

7.3.2 Lake Kemp

The Wichita County Water Improvement District No. 2 operates Lake Kemp. The following describes the existing drought stages triggers for this lake under the District's DCP:

- Stage 1 – Moderate Water Shortage - Lake elevation drops below 1,133 ft msl
- Stage 2 – Critical Water Shortage - Lake elevation drops below 1,130 ft msl
- Stage 3 – Severe Water Shortage - Lake elevation drops below 1,123 ft msl
- Stage 4 – Emergency Water Shortage - Lake elevation drops below 1,114 ft msl

7.3.3 Petrolia City Lake

The City of Petrolia operates Petrolia City Lake. The following describes the existing drought stages triggers for this lake under the City's DCP:

- Stage 1 – Lake storage drops below 60% capacity
- Stage 2 – Lake storage drops below 50% capacity
- Stage 3 – Lake storage drops below 35% capacity

7.3.4 Lakes Olney and Cooper

The City of Olney operates Lakes Olney and Cooper which are adjoining reservoirs. The following describes the existing drought stages triggers for Lake Cooper under the City's DCP:

- Stage 1 – Lake elevation drops below 1,135 ft msl
- Stage 2 – Lake elevation drops below 1,133 ft msl
- Stage 3 – Lake elevation drops below 1,130 ft msl
- Stage 4 – Lake elevation drops below 1,127 ft msl

7.3.5 Megargel City Lake

The City of Megargel operates City Lake. The following describes the existing drought stages and triggers for this lake under the City's DCP:

- Stage 1 – "Drought Watch" Lake level drops 6 feet below normal pool
- Stage 2 – "Drought Emergency" Lake level drops 8 feet below normal pool
- Stage 3 – "Drought Disaster" Lake level drops 10 feet below normal pool

7.3.6 North Fork Buffalo Creek Lake

The City of Iowa Park operates North Fork Buffalo Creek Lake. The lake is no longer used for municipal water supply and there are no longer trigger conditions identified for this reservoir. The City of Iowa Park has adopted a DCP that follows the DCP triggers for Wichita Falls.

7.3.7 Lake Electra

The City of Electra operates Lake Electra. The lake is no longer used for municipal water supply and there are no longer trigger conditions identified for this reservoir. The City of Electra has adopted a DCP that follows the DCP triggers for Wichita Falls.

7.3.8 Lake Amon G. Carter

The City of Bowie operates Lake Amon G. Carter. The following describes the existing drought stages triggers in this lake under the City's DCP:

- Stage 1 – Lake elevation drops below 917 feet msl
- Stage 2 – Lake elevation drops below 913 feet msl
- Stage 3 – Lake elevation drops below 909 feet msl
- Stage 4 – Lake elevation drops below 905 feet msl.

- Stage 5 – Emergency, major water production or distribution limitations.

7.3.9 Greenbelt Reservoir

The Greenbelt Municipal and Industrial Water Authority (GMIWA) operates Greenbelt Reservoir, which is located in Region A. Several of the water suppliers in Region B obtain water from Greenbelt Reservoir and have adopted DCPs based on the GMIWA DCP. The following describes the existing drought stages triggers under the GMIWA's DCP:

- Stage 1 – Mild water shortage, lake elevation drops below 2,637.0 feet msl
- Stage 2 – Moderate water shortage, lake elevation drops below 2,634.0 feet msl
- Stage 3 – Severe water shortage, lake elevation drops below 2,631.0 feet msl
- Stage 4 – Emergency water shortage, lake elevation drops below 2,628.0 feet msl

7.3.10 Groundwater Sources

Drought contingency plans are addressed for the following groundwater conservation districts:

- Gateway Groundwater Conservation District
- Rolling Plains Groundwater Conservation District
- Upper Trinity Groundwater Conservation District

Gateway Groundwater Conservation District

The Gateway Groundwater Conservation District has adopted rules that indicate the district will provide drought severity information to all groundwater users in the district. The Palmer Drought severity index value will updated on the District's web site on a bi-monthly basis.

Rolling Plains Groundwater Conservation District

The Rolling Plains Groundwater conservation District primarily serves an agricultural area and has adopted a philosophy that water conservation is a continuous operating principle, and that all agricultural producers are to make every effort to conserve groundwater. Due to the significant impact that drought can have on agricultural producers, the district has adopted an operating policy that it will not limit groundwater use during drought periods beyond the limits provided by district rules.

Upper Trinity Groundwater Conservation District

The Upper Trinity Groundwater Conservation District has adopted the objective of performing a monthly review of drought conditions as posted by the TWDB on the Board's web site. In addition, the District will complete an annual review of drought conditions within the district and include this information in the Annual Report to the Board of Directors and will post the information on the District's web site.

7.4 Current Drought Preparations and Response

In 1997, the Texas Legislature directed the TCEQ to adopt rules establishing common drought plan requirements for water suppliers in response to drought conditions throughout the state. Since 1997, the TCEQ has required all wholesale public water suppliers (TAC §288.30, (6)), retail public water suppliers serving 3,300 connections or more (TAC §288.30, (5)), and irrigation districts (TAC §288.30, (7)) to submit drought contingency plans. The TCEQ now also requires all retail public water suppliers serving less than 3,300 connections to prepare and adopt drought contingency plans by no later than May 1, 2009 (TAC §288.30, (6)). All drought contingency plans should be updated every five years and be available for inspection upon request. The most recent updates were to be submitted to the TCEQ by May 1, 2014.

All wholesale water providers and most municipalities in Region B have taken steps to prepare for and respond to drought through the preparation of individual Drought Contingency Plans and by taking the necessary steps to implement the Drought Contingency Plans. The plans are required to specify quantifiable targets for water use reductions for each stage, and a means and method for enforcement.

7.4.1 Entities Required to Have DCPs.

Table 7-2 is a list of all entities required to have DCPs, indicates which water suppliers are required to submit the DCP to Region B, and which suppliers have voluntarily provided a copy of the DCP to the Region B.

Table 7-2 Region B Water Suppliers Required to Maintain Drought Contingency Plans

Regulated Entity	County	Required to Submit DCP to Region B	DCP Submitted to Region B
Amon G Carter Lake WSC	Montague		
Archer County MUD 1	Archer		
Baylor WSC	Baylor		Y
Bluegrove WSC	Clay		
Brazos River Authority	Multiple		Y
Charlie WSC	Clay		
City Of Archer City	Archer		Y
City Of Bellevue	Clay		
City Of Bowie	Montague	Y	Y
City Of Burkburnett	Wichita	Y	Y
City Of Byers	Clay		
City Of Chillicothe	Hardeman		
City Of Crowell	Foard		Y
City Of Electra	Wichita		Y
City Of Henrietta	Clay		Y
City Of Holliday	Archer		Y
City Of Iowa Park	Wichita		Y
City Of Lakeside City	Archer		Y
City Of Megargel	Archer		Y
City Of Nocona	Montague		Y
City Of Olney	Young		Y
City Of Paducah	Cottle		
City Of Petrolia	Clay		
City Of Quanah	Hardeman		
City Of Saint Jo	Montague		N
City Of Scotland	Archer		Y
City Of Seymour	Baylor		
City Of Vernon	Wilbarger	Y	Y
City Of Wichita Falls	Wichita	Y	Y
Dean Dale SUD	Clay		Y
Forestburg WSC	Montague		
Friberg Cooper WSC	Wichita		
Gateway GWCD	Hardeman		Y
Greenbelt Municipal & Industrial Water Authority	Montague		Y
Harrold WSC	Wilbarger		
King Cottle WSC	Cottle		
Nocona Hills WSC	Montague		
North Montague County WSD	Montague		Y
Northside WSC	Wilbarger		
Oakshores Community	Montague		
Oklaunion WSC	Wilbarger		
Prairie Valley ISD	Montague		
Red River Authority of Texas	Multiple	Y	Y
RRA Arrowhead Lake Lots Water System	Clay		Y
RRA Box Community Water System	Wilbarger		Y
RRA Farmers Valley Water System	Wilbarger		Y
RRA Foard County Water System	Foard		Y
RRA Goodlett Water System	Hardeman		Y

Regulated Entity	County	Required to Submit DCP to Region B	DCP Submitted to Region B
RRA Guthrie Dumont Water System	King		Y
RRA Hinds Wildcat Water System	Wilbarger		Y
RRA Lake Arrowhead Ranch Estates	Clay		Y
RRA Lockett Water System	Wilbarger		Y
RRA Medicine Mound Water System	Hardeman		Y
RRA New Goodlett Water System	Hardeman		Y
RRA Northeast Quanah Water System	Hardeman		Y
RRA Ringgold WSC	Montague		Y
RRA South Quanah Original Water System	Hardeman		Y
RRA Southwest Quanah Water System	Hardeman		Y
Rolling Plains GCD	Baylor		Y
Sheppard Air Force Base	Wichita		
Sunset Water System	Montague		
Thalia WSC	Foard		
The Cove at Lake Nocona	Montague		
Town Of Pleasant Valley	Wichita		Y
TPWD Copper Breaks State Park	Hardeman		
Upper Trinity GCD	Montague		Y
Wichita County WID#2	Wichita	Y	Y
Wichita Valley WSC	Wichita		Y
Windthorst WSC	Archer		

7.4.2 Water Use Reduction Targets

Stage 1 water use reduction targets range from 5 to 20 percent of total water use. Water use reduction targets in the final stage range from 30 to 60 percent of total water use. In some cases the final stage includes water rationing or reduction to a specific water production limit, which results in even greater water savings. Some WUGs do not list a reduction target for the final stage, but these plans indicate that water use limits will be based on the available supply. Table 7-3 includes a summary of the basis for drought triggers, the drought triggers for each stage and the conservation goals for each stage included in the DCPs for entities in Region B that have provided copies to the RWPG. This table also indicates the first stage where mandatory measures are required. In some cases the conservation goals are stated in the plan as a surcharge based on level of use or as specific enumerated use restrictions.

Table 7-3 Drought Trigger Conditions and Goals Documented in Drought Contingency Plans

Entity	Trigger Based On:		No. of Stages	First Stage with Mandatory Measures	Drought Stage Trigger Water Use Reduction Goal by Stage: (Reduction in Total Use Unless Otherwise Specified)					
	Supply	Demand			1	2	3	4	5	6
City of Archer City	Lakes Arrowhead & Kickapoo	Demand	5	2	Lakes @ 60% Demand @ 105% Surcharge	Lakes @ 50% Demand @ 110% Surcharge	Lakes @ 40% Demand @ 115% Surcharge	Lakes @ 30% Demand @ 120% Surcharge	Lakes @ 25% Demand @ 120% Surcharge	
City of Bowie	Lake Amon G. Carter	Demand	5	2	Lake @ 917 ft Demand @ 85% 5%	Lake @ 913 ft Demand @ 90% 15%	Lake @ 909 ft Demand @ 100% 25%	Lake @ 905 ft Demand @ 110% 35%	Source contam-ination As Needed	-
City of Burkburnett	Notice from Wichita Falls	Total Demand	6	2	5/1-9/30 Annually 5%	21 MG for 10 days 15%	24 MG for 10 days 35%	27 MG for 10 days 45%	30 MG for 10 days 50%	Rationing
City of Crowell		Demand relative to capacity.	3	2	Use=85% capacity for 2 days 5%	Use=95% capacity for 2 days 25%	Use=100% capacity for 2 days 25%	-	-	-
City of Electra	Lakes Arrowhead & Kickapoo	Demand	5	1	Lakes @ 60% Demand @ 105% 10%	Lakes @ 50% Demand @ 110% 20%	Lakes @ 40% Demand @ 115% 35%	Lakes @ 30% Demand @ 120% 40%	Lakes @ 25% Demand @ 120% 45%	
City of Henrietta	Lake Arrowhead Volume	Demand	5	2	Lake @ 60% and Demand @ 1.2 mgd Use Limits	Lake @ 50% and Demand @ 1.3 mgd Use Limits	Lake @ 40% and Demand @ 1.35 mgd Use Limits	Lake @ 30% and Demand @ 1.38 mgd Use Limits	Lake @ 25% Use Limits	
City of Iowa Park	Lakes Arrowhead & Kickapoo	Demand	5	2	Lakes @ 60% Demand @ 105% 10%	Lakes @ 50% Demand @ 110% 20%	Lakes @ 40% Demand @ 115% 35%	Lakes @ 30% Demand @ 120% 40%	Lakes @ 25% Demand @ 120% 45%	-

Entity	Trigger Based On:		No. of Stages	First Stage with Mandatory Measures	Drought Stage Trigger Water Use Reduction Goal by Stage: (Reduction in Total Use Unless Otherwise Specified)					
	Supply	Demand			1	2	3	4	5	6
City of Lakeside City	Lakes Arrowhead & Kickapoo	Demand	4	2	Lakes @ 60% Demand @ 105% N/A	Lakes @ 50% Demand @ 110% Surcharge	Lakes @ 40% Demand @ 115% Surcharge	Lakes @ 30% Demand @ 120% Surcharge	Lakes @ 25% Demand @ 120% Surcharge	
City of Megargel	City Lake Levels		3	2	6 ft below normal 5%	8 ft. below normal 15%	10 ft. below normal 35%			
City of Nocona	Lake Nocona Levels	Treatment Capacity	6	2	5/1 to 9/30 Annually 30% of peak day	Lake 824 ft Demand @ 85% of Capacity 15%	Lake 822 ft Demand @ 70% of Capacity 30%	Lake 819 ft Demand @ 50% of Capacity 50%	Lake 817 ft Demand @ 40% of Capacity 60%	As Needed
City of Olney	Lake Cooper		4	1	Lake @ 1135 ft. Use Limits	Lake @ 1133 ft. Use Limits	Lake @ 1130 ft. Use Limits	Lake @ 1127 ft. Use Limits	-	-
City of Saint Jo	Lakes Arrowhead & Kickapoo	Treatment Capacity	5	2	Lakes @ 60% Demand @ 105% 5%	Lakes @ 50% Demand @ 110% 15%	Lakes @ 40% Demand @ 115% 35%	Lakes @ 30% Demand @ 120% As Needed	Lakes @ 25% Demand @ 120% As Needed	
City of Scotland	Lakes Arrowhead & Kickapoo	Treatment Capacity	4	2	Lakes @ 60% Demand @ 105% 5%	Lakes @ 50% Demand @ 110% 15%	Lakes @ 40% Demand @ 115% 35%	Lakes @ 30% Demand @ 120% As required	Lakes @ 25% Demand @ 120% As required	-
City of Vernon	Production capacity of Winston/ Odell/ Schmoker well fields		5	3	15% reduction in well capacity 15%	20% reduction in well capacity 20%	25% reduction in well capacity 25%	30% reduction in well capacity 30%	50% reduction in well capacity 50%	-

Entity	Trigger Based On:		No. of Stages	First Stage with Mandatory Measures	Drought Stage Trigger Water Use Reduction Goal by Stage: (Reduction in Total Use Unless Otherwise Specified)					
	Supply	Demand			1	2	3	4	5	6
City of Wichita Falls	Lakes Arrowhead & Kickapoo	Treatment Capacity	5	2	Lakes @ 60% Demand @ 105% 5%	Lakes @ 50% Demand @ 110% 15%	Lakes @ 40% Demand @ 115% 35%	Lakes @ 30% Demand @ 120% 17 mgd* limit	Lakes @ 25% Demand @ 120% 14 mgd* limit	-
Dean Dale SUD	Lakes Arrowhead & Kickapoo		4	2	Lakes @ 60% Demand @ 105% 5%	Lakes @ 50% Demand @ 110% 15%	Lakes @ 40% Demand @ 115% 20%	Lakes @ 30% Demand @ 120% 30%	-	-
Lockett Water System RRA	City of Vernon		5	3	15% reduction in well capacity 15%	20% reduction in well capacity 20%	25% reduction in well capacity 25%	30% reduction in well capacity 30%	50% reduction in well capacity 50%	-
North Montague County Water Supply District	Lake Nocona	Total Demand	6	3	5/1 to 9/30 Annually 30% of Peak Day	Lake @ 824 ft. Demand @ 0.66 mgd 15%	Lake @ 822 ft. Demand @ 0.88 mgd 30%	Lake @ 819 ft. Demand @ 1.1 mgd 50%	Lake @ 817 ft. major interrupt 50% + Alt. Sources	Lake @ 815 ft. major interrupt Ration
RRA Arrowhead Lake Lots Water System	Lakes Arrowhead & Kickapoo	Treatment Capacity	5	2	Lakes @ 60% Demand @ 105% 5%	akes @ 50% Demand @ 110% 15%	Lakes @ 40% Demand @ 115% 35%	Lakes @ 30% Demand @ 120% 17 mgd*	Lakes @ 25% Demand @ 120% 14 mgd*	-
RRA Box Community Water System	City of Vernon		5	3	15% reduction in well capacity 15%	20% reduction in well capacity 20%	25% reduction in well capacity 25%	30% reduction in well capacity 30%	50% reduction in well capacity 50%	-

Entity	Trigger Based On: Supply	Trigger Based On: Demand	No. of Stages	First Stage with Mandatory Measures	Drought Stage Trigger / Water Use Reduction Goal by Stage: (Reduction in Total Use Unless Otherwise Specified) 1	2	3	4	5	6
RRA Farmers Valley Water System	GW Capacity		4	3	20% reduction in well capacity 20%	30% reduction in well capacity 30%	40% reduction in well capacity 40%	50% reduction in well capacity 50%	-	-
RRA Foard County Water System	Greenbelt Reservoir	Daily Demand	4	2	Res. @ 2637 ft. 10%	Res. @ 2634 ft. 20%	Res. @ 2631 ft. 30%	Res. @ 2628 ft. No goal	-	-
RRA Goodlett Water System	Greenbelt Reservoir	Daily Demand	4	2	Res. @ 2637 ft. 10%	Res. @ 2634 ft. 20%	Res. @ 2631 ft. 30%	Res. @ 2628 ft. No goal	-	-
RRA Guthrie Dumont Water System	GW Capacity		4	3	20% reduction in well capacity 20%	30% reduction in well capacity 30%	40% reduction in well capacity 40%	50% reduction in well capacity 50%	-	-
RRA Hinds Wildcat Water System	City of Vernon		5	3	15% reduction in well capacity 15%	20% reduction in well capacity 20%	25% reduction in well capacity 25%	30% reduction in well capacity 30%	50% reduction in well capacity 50%	-
RRA Lake Arrowhead Ranch Estates	Wichita Falls				Lakes @ 60% Demand @ 105% 5%	akes @ 50% Demand @ 110% 15%	Lakes @ 40% Demand @ 115% 35%	Lakes @ 30% Demand @ 120% 17 mgd*	Lakes @ 25% Demand @ 120% 14 mgd*	
RRA Medicine Mound Water System	Greenbelt Reservoir	Daily Demand	4	2	Res. @ 2637 ft. 10%	Res. @ 2634 ft. 20%	Res. @ 2631 ft. 30%	Res. @ 2628 ft. No goal	-	-
RRA New Goodlett Water System	Greenbelt Reservoir	Daily Demand	4	2	Res. @ 2637 ft. 10%	Res. @ 2634 ft. 20%	Res. @ 2631 ft. 30%	Res. @ 2628 ft. No goal	-	-
RRA Northeast Quanah Water System	Greenbelt Reservoir	Daily Demand	4	2	Res. @ 2637 ft. 10%	Res. @ 2634 ft. 20%	Res. @ 2631 ft. 30%	Res. @ 2628 ft. No goal	-	-

Entity	Trigger Based On:		No. of Stages	First Stage with Mandatory Measures	**Drought Stage Trigger** Water Use Reduction Goal by Stage: (Reduction in Total Use Unless Otherwise Specified)					
	Supply	**Demand**			**1**	**2**	**3**	**4**	**5**	**6**
RRA Ringgold WSC	GW Capacity		4	3	20% reduction in well capacity 20%	30% reduction in well capacity 30%	40% reduction in well capacity 40%	50% reduction in well capacity 50%	-	-
RRA South Quanah Original Water System	Greenbelt Reservoir	Daily Demand	4	2	Res. @ 2637 ft. 10%	Res. @ 2634 ft. 20%	Res. @ 2631 ft. 30%	Res. @ 2628 ft. No goal	-	-
RRA Southwest Quanah Water System	Greenbelt Reservoir	Daily Demand	4	2	Res. @ 2637 ft. 10%	Res. @ 2634 ft. 20%	Res. @ 2631 ft. 30%	Res. @ 2628 ft. No goal	-	-
Town of Pleasant Valley			5	2	Lakes @ 60% Demand @ 105% 5%	akes @ 50% Demand @ 110% 15%	Lakes @ 40% Demand @ 115% 35%	Lakes @ 30% Demand @ 120% 17 mgd*	Lakes @ 25% Demand @ 120% 14 mgd*	-

* Note that the volume shown is for the Wichita Falls System

Drought response measures vary somewhat across drought contingency plans. In general, retail water suppliers have a wider range of drought response measures available to them compared to wholesale water suppliers. One of the main drought response measures for retail water suppliers is restricting irrigation. Many plans include the following progression of irrigation limits:

- Stage 1: Voluntary limits on irrigation days (maximum of twice per week, odd/even schedule, etc.) and hours (no irrigation in the middle of the day).
- Stage 2: Mandatory limits on irrigation days and hours with irrigation limited to two days per week
- Stage 3: Irrigation limited to one day per week. Hand-held hoses may be used.
- Stage 4: Hand-held hoses or watering cans only may be used on the designated day and within the allowable hours.
- Stage 5: No outdoor water use.

The majority of Region B was in some stage of drought status from late 2010 until May of 2015. Wichita Falls and most of the other water suppliers in Region B moved to Stage 5 or the highest stage of the DCPs in May 2014. The utilities and customers operated in Stage 5 for approximately one full year with no outdoor watering from the public water supplies allowed.

7.5 Existing and Potential Emergency Interconnects

According to Texas Statute §357.42(d),(e) regional water planning groups are to collect information on existing major water infrastructure facilities that may be used in the event of an emergency shortage of water. Pertinent information includes identifying the potential user(s) of the interconnect, the potential supplier(s), the estimated potential volume of supply that could be provided, and a general description of the facility. Texas Water Code §16.053(c) requires information regarding facility locations to remain confidential.

This section provides general information regarding existing and potential emergency interconnects among water user groups within Region B.

7.5.1 Existing Emergency Interconnects

Much of Region B has dealt with drought conditions repeatedly over the last 20 years. As a result many of the local supplies derived from smaller reservoirs or from groundwater systems have been limited. In addition water quality has limited use of some supplies. Therefore, interconnects between water systems have become routine with many of the systems now relying on supplies from neighboring systems. In fact, the last 5 years of drought have required implementation of almost all feasible interconnects. The existing interconnects are shown in Table 7-5.

Table 7-5 Existing Interconnects Between Region B WUGs

Receiver Public Water System	Provider WUG
Amon G Carter Lake WSC	City of Bowie
Archer County MUD 1	City of Wichita Falls
Baylor WSC	City of Seymour
Charlie WSC	City of Byers, Dean Dale WSC, and City of Wichita Falls
City Of Burkburnett	Wells, City of Wichita Falls
City Of Byers	Dean Dale WSC and City of Wichita Falls
City Of Chillicothe	Greenbelt MIWA
City Of Crowell	Greenbelt MIWA
City Of Electra	City of Iowa Park, City of Wichita Falls
City Of Holliday	City of Wichita Falls
City Of Iowa Park	City of Wichita Falls
City Of Lakeside City	City of Wichita Falls
City Of Quanah	Greenbelt MIWA
City Of Scotland	City of Wichita Falls
City Of Seymour	Baylor WSC
Dean Dale SUD	City of Wichita Falls
Friberg Cooper WSC	City of Wichita Falls
Harrold WSC	City of Electra, City of Iowa Park, City of Wichita Falls
Horseshoe Bend Homeowners Assn	City of Wichita Falls
RRA Lockett Water System	City of Vernon
Northside WSC	City of Vernon
Oklaunion WSC	City of Vernon
RRA Box Community Water System	City of Vernon
RRA Farmers Valley Water System	Greenbelt MIWA
RRA Foard County Water System	City of Crowell, Greenbelt MIWA
RRA Goodlett Water System	Greenbelt MIWA

Receiver Public Water System	Provider WUG
RRA Medicine Mound Water System	Greenbelt MIWA
RRA New Goodlett Water System	Greenbelt MIWA
RRA Northeast Quanah Water System	Greenbelt MIWA
RRA Southwest Quanah Water System	Greenbelt MIWA
Sheppard Air Force Base	City of Wichita Falls
Thalia WSC	City of Crowell, Greenbelt MIWA
Town Of Pleasant Valley	City of Wichita Falls
TPWD Copper Breaks State Park	Greenbelt MIWA
Wichita Valley WSC	City of Archer City, City of Iowa Park, City of Wichita Falls
Windthorst WSC	City of Bowie

Source: Texas Commission on Environmental Quality: Water Utility Database, URL: http://www14.tceq.texas.gov/iwud/index.cfm, accessed January 2015.

7.5.2 Potential Emergency Interconnects

The existing water systems within the region were evaluated for potential to implement additional emergency interconnects. Due to the number of interconnects that have already been implemented, limited opportunity for additional interconnects are feasible. Table 7-6 provides information on the remaining emergency interconnects.

Table 7-6 Additional Emergency Interconnects

Receiver Public Water System	Provider WUG
Windthorst*	City of Wichita Falls via the City of Scotland
RRA Hinds-Wildcat	City of Vernon

* Note that this interconnect is in implementation.

7.6 Potential Emergency Drought Response Measures

Texas Statute §357.42(g) requires regional water planning groups to evaluate potential temporary emergency water supplies for all County-Other WUGs and municipalities with 2010 populations less than 7,500 that rely on a sole source of water. The purpose of this evaluation is to identify potential alternative water sources that may be considered for temporary emergency use in the event that the existing water supply sources become temporarily unavailable due to extreme hydrologic conditions such as emergency water right curtailment, unanticipated loss of reservoir conservation storage, or other localized drought impacts.

This section provides potential solutions that should act as a guide for municipal water users that are most vulnerable in the event of a loss of supply. This review was limited and did not require technical analyses or evaluations following in accordance with 31 TAC §357.34.

7.6.1 Emergency Responses to Local Drought Conditions

Table 7-7 presents temporary responses that may or may not require permanent infrastructure. It was assumed in the analysis that the entities listed would have approximately 180 days or less of remaining water supply.

Table 7-7 is followed by a discussion of the alternative drought water supply strategies.

Table 7-7: Emergency Responses to Local Drought Conditions in Region B

Entity											Implementation Requirements		
Water User Group Name	County	2010 Population	2020 Demand (AF/year)	Drill additional groundwater wells	Brackish groundwater limit treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked - in water	Voluntary transfer from irrigation	Type of infrastructure required	Entity providing supply	Emergency agreements already in place
Archer City	Archer	2,022	280	*	*		*		*				
Holliday	Archer	1,786	285	*	*		*		*			Wichita Falls	*
Lakeside City	Archer	1,077	136	*	*		*		*			Wichita Falls	*
Scotland	Archer	501	216	*	*		*		*			Wichita Falls	*
Wichita Valley WSC	Archer	2,994	291	*	*		*		*			Wichita Falls	*
Windthorst WSC	Archer	1,266	317	*	*		*		*			Bowie	*
Seymour	Baylor	2,692	496	*	*		*		*			Baylor WSC	*
Byers	Clay	534		*	*		*		*			Dean Dale WSC	*
Dean Dale WSC	Clay	2,151	172	*	*		*		*				
Henrietta	Clay	3,374	652	*	*		*		*				
Petrolia	Clay	808	68	*	*		*		*				
Windthorst WSC	Clay	227	70	*	*		*		*			Bowie	*
Paducah	Cottle	1,458	297	*	*		*		*				
Crowell	Foard	1,137	138	*	*		*		*			Greenbelt	*
Chillicothe	Hardeman	796	55	*	*		*		*			Greenbelt	*

Entity											Implementation Requirements		
Water User Group Name	County	2010 Population	2020 Demand (AF/year)	Drill additional groundwater wells	Brackish groundwater limit treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked - in water	Voluntary transfer from irrigation	Type of infrastructure required	Entity providing supply	Emergency agreements already in place
Quanah	Hardeman	2,981	397	*	*		*		*			Greenbelt	*
Bowie	Montague	5,305	927	*	*		*		*				
Nocona	Montague	3,321	740	*	*		*		*				
Saint Jo	Montague	898	161	*	*		*		*				
Dean Dale WSC	Wichita	1,248	86	*	*		*		*				
Electra	Wichita	3,206	946		*		*		*			Wichita Falls	*
Iowa Park	Wichita	6,678	893		*		*		*			Wichita Falls	*
Wichita Valley WSC	Wichita	3,159	400	*	*		*		*			Wichita Falls	*
Olney	Young	3,429	557	*	*		*		*				*
County Other													
Windthorst	Archer	409		*	*				*		Pipeline to Scotland	Wichita Falls	*
RRA Goodlett Water System	Hardeman			*	*				*			Greenbelt	*
RRA New Goodlett Water System	Hardeman			*	*				*			Greenbelt	*
RRA Northeast Quanah Water System	Hardeman			*	*				*			Greenbelt	*
RRA Southwest Quanah Water System	Hardeman			*	*				*			Greenbelt	*
RRA Foard County	Foard	477	75	*	*				*			Crowell/	*

Entity											Implementation Requirements		
Water User Group Name	County	2010 Population	2020 Demand (AF/year)	Drill additional groundwater wells	Brackish groundwater limit treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked - in water	Voluntary transfer from irrigation	Type of infrastructure required	Entity providing supply	Emergency agreements already in place
Water System												Greenbelt	
City Of Lakeside City	Wichita			*	*				*			Wichita Falls	*
RRA Lockett Water System	Wilbarger			*	*				*			Vernon	*
RRA Box Community Water System	Wilbarger			*	*				*			Vernon	*
RRA Hinds-Wildcat	Wilbarger			*	*				*		Pipeline and pump station	Vernon	

7.6.2 Voluntary Transfer of Irrigation Rights

An additional evaluation was conducted which considered voluntary transfer of irrigation rights as an emergency response to local drought conditions. Voluntary transfer of irrigation rights is the payment for temporary transfer of local irrigation supplies for other uses. Voluntary transfer or "irrigation suspension" programs have been implemented successfully in Edwards Aquifer near San Antonio. Similar strategies are not considered viable in Region B, as during drought the WCWID No. 2 has already curtailed water use, conserving the remaining surface water quantities for municipal use. In addition there are not groundwater systems that would allow for such a water transfer because the groundwater sources are not as regionally connected as the Edwards Aquifer.

7.6.3 Brackish Groundwater

Brackish groundwater was evaluated as a temporary source during an emergency water shortage. Some brackish groundwater is found in various locations throughout the region. Due to water quality concerns many system have abandoned or limited use of existing brackish groundwater sources. In some cases these could be utilized during severe drought and blended with other sources. Required infrastructure would include some additional wells, potential treatment facilities, and conveyance facilities.

7.6.4 Drill Additional Local Groundwater Wells and Trucking in Water

In the event that the existing water supply sources become temporarily unavailable, drilling additional groundwater wells and trucking in water are optimal solutions. Table 7-7 presents this option as viable for all entities listed.

7.7 Region-Specific Drought Response Recommendations and Model Drought Contingency Plans

As required by the TWDB, Region B shall develop drought recommendations regarding the management of existing groundwater and surface water sources. These recommendations must include factors specific to each source as to when to initiate drought response and actions to be taken as part of the drought response. These actions should be specified for the manager of a water source and entities relying on the water source. Region B has defined the manager of water sources as the entity that controls the water production and distribution of the water supply from the source. For purposes of this assessment, a manager must also meet the TCEQ requirements for development of Drought Contingency Plan. Entities that rely on the water sources include customers of the water source manager and direct users of the water sources. A list of each surface water source in Region B and the associated Drought triggers was provided in Section 7.3.

7.7.1 Drought Trigger Conditions for Groundwater Supplies

In general, groundwater supplies are somewhat localized to the users of these sources. As noted in Section 7.4, some public water providers utilize groundwater and have developed DCPs that are specific to their water supplies. However, there are many individual groundwater users not connected to a public water system or located within a groundwater conservation district. To convey drought conditions to all users of these resources in Region B, the RWPG proposes to use the Drought Monitor. This information is easily accessible and updated regularly. It does not require a specific entity to monitor well water levels or stream gages. It is also geographically specific so that drought triggers can be identified on a sub-county level that is consistent with the location of use. Region B adopted the nomenclature from the Drought Monitor for corresponding drought triggers. Table 7-8 shows the drought stages adopted by the U.S. Drought Monitor and the associated Palmer Drought Index.

For groundwater supplies, Region B recognizes that the initiation of drought response is the decision of the manager of the source and/or user of the source. Region B recommends the following actions based on each of the drought stages listed in Table 7-8:

Table 7 8 Drought Severity Classification

Category	Description or Stage	Possible Impacts	Palmer Drought Index
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less

U.S. Drought Monitor: http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx

- Abnormally Dry – Entities should begin to review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage is necessary.
- Moderate Drought – Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage is necessary.
- Severe Drought – Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. At this point if the review indicates current supplies may not be sufficient to meet reduced demands the entity should begin considering alternative supplies.

- Extreme Drought – Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. At this point if the review indicates current supplies may not be sufficient to meet reduced demands the entity should consider alternative supplies.
- Exceptional Drought – Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. At this point if the review indicates current supplies are not sufficient to meet reduced demands the entity should implement alternative supplies.

7.7.2 Model Drought Contingency Plans

Model drought contingency plans were developed for Region B and are available on line through the Region B website (http://www.rra.texas.gov/; select "Publications;" select "Region B Water Planning"). Each plan identifies four drought stages: mild, moderate, severe and emergency. Some plans also include a critical drought stage. The recommended responses range from notification of drought conditions and voluntary reductions in the "mild" stage to mandatory restrictions during an "emergency" stage. Each entity will select the trigger conditions for the different stages and the appropriate response. Entities should use the TAC 228 rules mandated by the TCEQ as the guideline in development of these plans.

7.8 Drought Management Water Management Strategies

Drought management is a temporary strategy to conserve available water supplies during times of drought or emergencies. This strategy is not recommended to meet long-term growth in demands, but rather acts as means to minimize the adverse impacts of water supply shortages during drought. The TCEQ requires drought contingency plans for wholesale and retail public water suppliers and irrigation districts. A drought contingency plan may also be required for entities seeking State funding for water projects. Region B does not recommend specific drought management strategies. Region B recommends the implementation of DCPs by suppliers when appropriate to reduce demand during drought and prolong current supplies. Region B also recommends the implementation of conservation measures for all users to conserve water resources for the future.

7.9 Other Drought Recommendations

One of the challenges with drought in Region B is that the response to drought and associated impacts can vary depending upon the timing of the drought. Droughts that occur during the growing season can have a greater impact than drought occurring at other times. Since irrigated agriculture accounts for a large percent of the water use in the region, the impacts of agricultural droughts on water supplies can be significant.

To be better prepared for future droughts, Region B has the following recommendations:

- Municipal water users that rely on groundwater should consider protecting water supplies from competition through the acquisition of additional water rights and/or expansion of current well fields.
- To minimize potential catastrophic failure of an entity's water system, the entity should provide sufficient resources to maintain its infrastructure in good condition. Region B recognizes that water main breaks and system failures do occur, but with proper maintenance these may be able to be reduced.
- Water users should continue to use water efficiently to conserve limited resources on a year round basis, so that conservation becomes standard practice.

References

[1] Texas Commission on Environmental Quality: Water Availability Models, URL: http://www.tceq.texas.gov/permitting/water_rights/wam.html, accessed May 2014.

[2] National Drought Mitigation Center: U.S. Drought Monitor, URL: http://droughtmonitor.unl.edu/, accessed May 2014.

[3] National Climatic Data Center: PHDI Divisional Data, URL: http://www1.ncdc.noaa.gov/pub/data/cirs/drd/drd964x.phdi.txt, accessed May 2014.

[4] Texas Water Development Board: East Texas Planning Region Reservoirs, URL: http://waterdatafortexas.org/reservoirs/region/east-texas, accessed May 2014.

[5] Texas Commission on Environmental Quality: Water Utility Database, URL: http://www14.tceq.texas.gov/iwud/index.cfm, accessed May 2014.

[6] Texas Commission on Environmental Quality: Water Utilities Map Viewer, URL: http://tceq4apmgwebp1.tceq.texas.gov:8080/iWudSpatial/Controller/?ccn=&zipCode=, accessed May 2014.

[7] Texas Administrative Code, Title 30, Chapter 36.

CHAPTER 8

UNIQUE STREAM SEGMENTS AND RESERVOIR SITES AND OTHER RECOMMENDATIONS

2016 FINAL PLAN

REGION B

DECEMBER 2015

CHAPTER 8

UNIQUE STREAM SEGMENTS AND RESERVOIR SITES AND OTHER RECOMMENDATIONS REGION B

8.1 Introduction

As a part of the revised plan, this chapter identifies and makes recommendations that the Regional Water Planning Group deems vital to the management and conservation of the water resources in Region B.

8.2 Discussion of Regional Issues

In addition to the specific water management strategies recommended for Region B in Chapter 5 of the plan, there were several other issues that the Regional Water Planning Group deemed to be significant water management concepts to be given further consideration as part of the Region B Plan. The Chloride Control Project on the Wichita and Pease Rivers is a water management strategy with high regional support. Other strategies that enhance and/or increase the existing supplies in the region, such as land stewardship (brush management), groundwater recharge enhancement, weather modification, and increased conservation storage for Lake Kemp, are each potentially feasible management strategies throughout and perhaps beyond the 50 year planning horizon.

Senate Bill 1 requires future projects to be consistent with the approved regional water plan to be eligible for TWDB funding and TCEQ permitting. However, it is the intention of the RWPG that surface water uses that will not have a significant impact on the region's water supply and water supply projects that do not involve the development of or connection to a new water source are deemed consistent with the regional water plan even though not specifically recommended in the plan.

8.2.1 Chloride Control Project

Improvement in the quality of this substantial water source would increase the reliability of the City of Wichita Falls system and reduce their treatment costs. It could also facilitate more diverse and expanded agricultural use and more efficient industrial use.

Also, in the long term, as chloride control facilities are constructed on the Pease River the potential exists for another freshwater supply reservoir on the Pease River near Crowell in Foard County, with an estimated yield of 138,000 acre-feet per year.

8.2.2 Land Stewardship

Land stewardship is the practice of managing land to conserve or enhance the ecosystem values of the land. It is a benefit to the state's natural resources by improving watershed productivity through increased surface water runoff and groundwater recharge. Land stewardship is a practice that is supported and encouraged by Region B.

Some land stewardship practices that are most applicable in Region B include managed grazing, water enhancement through brush control, erosion management, riparian management, and stream bank protection. One area of concern in Region B is the encroachment of brush in the watersheds of water supply reservoirs. The U.S. Natural Resource Conservation Service (NRCS) estimates that brush in Texas uses about 10 million acre-feet of water annually compared to the 15 million acre-feet per year currently required for human use.

Based on the results of the completed studies, the regional planning group will continue to evaluate the potential effects of land stewardship strategies, and in particular water enhancement through brush control. It is anticipated that the effectiveness of these strategies will be reflected through increased water flow and improved ecosystem components such as wildlife, livestock production, aesthetics and land values.

8.2.3 Recharge Enhancement

Recharge enhancement is the process in which surface water is purposefully directed to areas where permeable soils or fractured rock allow rapid infiltration of the surface water into the subsurface to increase localized groundwater recharge. This would include any man-made structure that would slow down or hold surface water to increase the probability of groundwater recharge.

In Region B, groundwater is a major source of water for much of the western portion of the region. The Seymour Aquifer, which is generally unconfined, is fairly responsive to local recharge and may benefit from enhanced recharge programs. Further study is needed to determine the applicability of such programs in Region B, the quantity of increased groundwater supplies that may result from enhanced recharge, and the potential impacts to existing surface water rights.

8.2.4 Weather Modification

Weather modification is an attempt to increase the efficiency of a cloud to produce precipitation. Efforts to enhance rainfall in Texas began in 1880 and have continued to present day. Several weather modification programs are in place in areas to the west of Region B. While research has suggested increases of 15 percent or more of rainfall in areas participating in weather modification, some areas in west Texas have shown greater increases in rainfall, particularly during non-drought years. Weather modification programs in Region B could potentially increase surface runoff to reservoirs, reduce irrigation demands, and increase recharge to groundwater sources.

8.2.5 Sediment Control Structures

The Wichita River Basin in Region B could potentially benefit from sediment control structures and other land management practices that reduce sediment loading to streams. The Region B Planning Group recommends that the state support both federal and state efforts to rehabilitate existing sediment control structures and encourage funding and support for the construction of new structures and other land management practices in watersheds that would produce the greatest benefits.

8.3 Designation of Unique Stream Segments and Reservoir Sites

In accordance with TAC Section 357.8, the Regional Water Planning Group is not required, but may include in the adopted regional water plan recommendations for river and stream segments of unique ecological value, in addition to unique sites for reservoir construction. Such designation would provide for protection of these specific sites to the extent that a state agency or political subdivision may not obtain a fee title or an easement that would destroy the unique ecological value of the designated stream segment or significantly prevent the construction of a reservoir on a designated site.

8.3.1 Unique Stream Segments

Within Region B, the Texas Parks & Wildlife (TPWD) has suggested that certain stream segments of the Middle Pease River in Cottle County, the Pease River in Foard County, and the Red River from the Wichita/Clay County line upstream through Hardeman County be considered for recommendation as stream and/or river segments of unique value. The TPWD believes that each of these segments satisfy at least one of the designation criteria defined in Senate Bill 1.

Of the stream segments suggested by the TPWD, two are located within areas that currently offer protections and one segment lies in Oklahoma:

- Middle Pease River segment is located in the Matador Wildlife Management Area
- Pease River segment is located in Copper Breaks State Park
- Red River segment is located in Oklahoma

The Region B Water Planning Group is committed to the protection and conservation of unique and sensitive areas within the region. To that end, the consensus of the planning group is that a more comprehensive study with supporting data is necessary to accurately characterize and evaluate the listed stream/river segments or other stream segments in order to determine whether it is appropriate to recommend segment for designation as being unique.

There is still some concern as to the impact of the designation and it is not clear what governmental or private activities, other than reservoir construction, might be subject to additional constraints or limitations as a result of unique stream segment designation. It is also not clear what geographic extent might be impacted by the designation. For example, is the entire watershed of the designated stream subject to additional limitations, and how far upstream of the designated stream would limitations apply? The Region B Water Planning Group suggests that the Legislature may wish to clarify their intent regarding the designations.

8.3.2 Reservoir Sites

It is generally recognized that studies over the last 40 years have identified perhaps the last remaining reservoir site within Region B in which the water quality of the watershed is adequate for municipal use. This site, known as the Ringgold Reservoir site, is located on the Little Wichita River in Clay County, approximately one half mile upstream from the confluence with the Red River.

This site is recognized as a site of unique value in the 2007 State Water Plan and is currently protected under the provisions of §16.051 of the Texas Water Code as amended by SB3 of the 80th Legislature. Lake Ringgold is a recommended water management strategy for Wichita Falls (Chapter 5). The Region B Water Planning Group suggests that the Legislature extend the protections for unique reservoir sites beyond the current expiration date of September 1, 2015, to ensure that reservoir sites such as Lake Ringgold that are identified as water management strategies but not required until late in the planning period remain protected until applications and permits are filed.

8.4 Discussion of Regulatory and Legislative Actions

To facilitate the orderly development, management, and conservation of water resources within the region, and to assist the region in preparing for and responding to drought conditions, the Region B Water Planning Group believes that the regulatory agencies and legislature should consider certain actions relating to water quality and funding issues which affect Region B.

8.4.1 Regulatory Review of Nitrate MCL

In Region B, there are a number of small user groups which utilize water with nitrate levels in excess of 10 mg/l. For the most part this supply is their only source of water, and advanced treatment for the removal of nitrates is very costly. Presently these systems employ bottled water programs for customers that may be sensitive to nitrate concentrations (pregnant women and infants). This program is considered an interim measure by TCEQ until the system can comply with the nitrate standards.

It is the consensus of the Region B Water Planning Group that the regulatory agency review its MCL standards for smaller systems which have no cost effective means to comply with the current nitrate MCL of 10 mg/l, and consider funding new studies to determine the health effects of nitrates in drinking water.

In addition, the planning group requests that the regulatory agencies consider bottled water programs as a long-term strategy to meet the nitrate water quality standards, or alternatively simply provide for a waiver process.

8.4.2 Funding for Comprehensive Studies

In preparing the Region B Water Plan there are several regional water planning, management, and conservation related issues which will require additional funding for data collection and administrative activities in order to adequately assess their viability or feasibility as a cost effective management strategy for Region B. For example, additional funds are needed to further evaluate and cost-share in the implementation of brush management programs in an effort to increase water yields, to identify and designate unique stream segments and/or reservoir sites for protection of these areas, and to implement various other chloride control measures and wastewater reuse programs throughout Region B.

8.4.3 Conservation

Region B supports the efforts of the State-appointed Water Conservation Task Force, and encourages the practices of water conservation within the region and state. The Regional Water Planning Group also recognizes the differences in water use and needs among water users and different regions. Region B encourages the Legislature to allow each region to establish realistic, appropriate and voluntary water conservation goals for the region. These goals should only be established after sufficient data on water use have been collected using consistent data reporting requirements. The use of the measurement of gallons per capita per day is appropriate only for residential water use or as a guideline for historical trends for a single entity. Region B does not support the establishment of statewide standards for water use.

8.5 Summary of Regional Recommendations

In accordance with 31 TAC 357.7 (a)(9), 31 TAC 357.8, and 31 TAC 357.9, the following recommendations are proposed to facilitate the orderly development, management, and conservation of the water resources available within Region B:

It is recommended that the Chloride Control Project on the Wichita River and the Pease River be made a regional priority in order to enhance the water quality of Lake Kemp and Lake Diversion, and reclaim those lakes as a viable cost effective short term and long term regional water supply source.

- Based on the results of the Lake Kemp and Lake Arrowhead brush management studies, it is recommended that the State consider providing adequate funding to implement brush management and other land stewardship programs in an attempt to increase watershed yields.

- Region B recommends that the state support both federal and state efforts to rehabilitate existing sediment control structures and encourage funding and support for the construction of new structures and other land management practices in watersheds that would produce the greatest sediment control benefits.

- Region B recommends that no segments be designated as "Unique Stream/River Segments" at this time. Pending the results of comprehensive studies and clarification of the significance and impacts of designation, the Regional Water Planning Group may consider designations within the region in the future.

- Region B requests that the Legislature extend the protections for unique reservoir sites beyond the current expiration date of September 1, 2015, to ensure that reservoir sites such as Lake Ringgold that are identified as water management strategies remain protected under the Texas Water Code until applications and permits are filed.

- It is recommended that the state regulatory agencies consider allowing continued long-term use of bottled water programs, and/or providing a waiver for small user groups that can demonstrate they have no reasonable cost-effective means to comply with the current nitrate MCL of 10 mg/l.

- It is recommended that the state fund the development, implementation, and evaluate the necessary management strategies adopted as part of this regional plan. This includes strategies identified to meet a specific need as well as general strategies to increase water supply in the region.

- It is recommended that the Legislature support the grass-roots regional water planning process enacted by SB1 and strongly encourages the process be continued with adequate state funding for all planning efforts including administrative activities and data collection. However, it is recommended that consideration be given to updating the Regional Water Plans every 10 years (Instead of every 5 years) so as to coincide with the published updated population census.

- It is recommended that the state continue to fund agricultural water use data collection and agricultural water use management/conservation projects.
- Senate Bill 1 requires future projects to be consistent with the approved regional water plan to be eligible for TWDB funding and TCEQ permitting. It is recommended that surface water uses that will not have a significant impact on the region's water supply and water supply projects that do not involve the development of or connection to a new water source should be deemed consistent with the regional water plan even though not specifically recommended in the plan.

- With regards to conservation it is recommended that the Legislature continue to allow each region to establish realistic, appropriate, and voluntary water conservation goals as opposed to the establishment of statewide standards.

- Region B recommends that the gallons per capita per day (gpcd) calculation of water use be based on residential water use only.

- Being in the midst of a new drought of record, firm water availability from existing and new surface water supplies may be overstated. Therefore it is recommended that funding be provided to update the hydrology for all Water Availability Models (WAMS) to extend through 2016 with additional funding for regular maintenance updates.

- With irrigation being such a large component of water use, it is recommended that the economic model be updated and that the future crop mix and base year irrigation demands be reevaluated.

- State should consider funding detailed studies with regards to determining the effectiveness of various forms of evaporation suppression utilizing and applying monolayers to surface water reservoirs.

- State should consider legislative action in support of studies and funding for cloud seeding operations.

CHAPTER 9

INFRASTRUCTURE FINANCING REPORT

2016 WATER PLAN

REGION B

DECEMBER 2015

CHAPTER 9

INFRASTRUCTURE FINANCING REPORT
2016 FINAL PLAN
REGION B

9.1 Introduction

Section 357.44 of the Texas Administrative Code requires that RWPGs assess how local governments, regional authorities, and other political subdivisions would finance the implementation of WMSs. This Infrastructure Financing Report (IFR) for Region B includes information on the costs and funding capabilities of the entities with preferred water management strategies recommended during this planning cycle. The purpose of this update is to:

- Determine the number of water user groups with identified needs for additional water supplies that will be unable to pay for their water infrastructure needs without some form of outside financial assistance;
- Determine how much of the infrastructure costs in the regional water plan cannot be paid solely using local utility revenue sources;
- Determine financing options proposed by political subdivisions to meet future water infrastructure needs (including the identification of any state funding sources considered);
- Determine what role(s) the RWPGs propose for the state in financing the recommended water supply projects; and

The two essential elements to the IFR are; (1) surveys and (2) RWPG recommendations on the State's role in financing water infrastructure projects.

9.2 Identification of Needs

As described in Chapter 4, water supply needs in Region B were identified for three different categories: quantity, quality, and reliability. The quantity category includes twenty four water user groups which were identified to have projected shortages totaling 49,253 acre-feet per year by 2070. In addition, twelve municipal and manufacturing water user groups were identified as having projected safe supply shortages. Safe supply is defined as being able to meet the projected demands plus 20 percent of the demand.

The quality category includes those water user groups which have been identified as being dependent on water which does not meet primary drinking water standards and those water user groups who are dependent on high chloride supplies from Lake Kemp for agricultural use.

The reliability category includes those water user groups with physical system limitations and/or limitations in available supplies as compared to contracted peak demands. Table 9-1 shows the 36 water user groups identified as having one or more of the categories of need.

Table 9-1
Water Users with Identified Needs

		Water Supply Needs		
User	**County**	**Quantity**	**Quality**	**Reliability**
Archer City	Archer	X		
Bowie	Montague			X
Burkburnett	Wichita			X
County Other	Montague			X
County Other	Baylor			X
County Other	Clay			X
County Other	Foard			X
County Other	Hardeman			X
County Other	Wichita	X	X	
County Other	Wilbarger		X	X
County Other	Young	X		
Crowell	Foard			X
Dean Dale SUD	Wichita	X		
Electra	Wichita	X		
Holliday	Archer	X		
Iowa Park	Wichita	X		
Irrigation	Archer	X	X	
Irrigation	Baylor	X		
Irrigation	Hardeman	X		
Irrigation	Wichita	X	X	
Irrigation	Wilbarger	X		
Lakeside City	Archer	X		
Livestock	Baylor	X		
Manufacturing	Hardeman			X
Manufacturing	Wichita	X		
Manufacturing	Wilbarger	X		
Mining	Archer	X		

		Water Supply Needs		
User	**County**	**Quantity**	**Quality**	**Reliability**
Mining	Montague	X		
Quanah	Hardeman			X
Scotland	Archer	X		
Steam Electric	Wichita	X		
Steam Electric	Wilbarger	X		
Vernon	Wilbarger	X		
Wichita Falls	Wichita	X		
Wichita Valley WSC	Wichita			X
Windthorst WSC	Archer	X		

9.3 Recommended Water Management Strategies

Water management strategies were developed for each of the 36 water user groups shown in Table 9-1, with input from each respective water user group. Conservation was a primary strategy for each of the water user groups indicating a need. However, in many cases it was evident that conservation alone would not meet the projected needs. Therefore, other strategies were developed based on the entities' need and supply availability and are further detailed in Section 5.5 of this plan. In some cases multiple strategies for the water user group were developed and presented as preferred and alternative strategies. However, for the purpose of the IFR, only the preferred strategies were considered.

In addition to the individual water user group strategies developed, the Region B Water Planning Group adopted a regional strategy which would benefit many of the water user groups in the planning area whether they indicated a need or not. This strategy is the Wichita River Basin Chloride Control Project. This project has been a major factor in area water planning for several years and once completed would increase the volume of water available for municipal and industrial purposes throughout the region, as well as making the Wichita River water available for a broader range of agricultural activities. A more detailed description of the project can be found in Section 4.4.2 of this plan.

The Wichita River Basin Chloride Control Project is a regional project dependent upon 100 percent federal funding and has been in development for more than 50 years. It was not included in the list of individual water user group strategies nor is the capital cost of the project included in the projected regional costs.

Water quality is a primary concern for many users in Region B and affects water use options and treatment requirements. For evaluation of the strategies, it was assumed that the final produced water would meet existing state water quality requirements for the specified use.

The total estimated capital cost for infrastructure to meet the identified needs and implement the preferred strategies less the Wichita Basin Chloride Control project is projected to be $534,345,000.

9.4 Infrastructure Financing Surveys for Preferred Water Management Strategies

Infrastructure Financing Surveys were emailed to user groups that were determined to have a projected water quality and/or water quantity need. Although 10 of the strategies developed were identified as preferred water management strategies, and four entities were formally surveyed for this report. All four entities responded. In addition to the initial response, follow-up phone calls or emails were conducted to develop a better understanding of strategy implementation. The results of the IFR Survey (Contacts and Survey Results) are provided in Appendix J.

The following Table 9-2 provides a summary of the water user groups preferred strategies, projected capital costs, proposed funding sources(s), and the amount each water user group is unable to finance internally.

Table 9-2
Preferred Water Management Strategies

Water User Group	Water Management Strategy	Capital Cost	Funding Source	Unable to Pay
City of Vernon	Direct Reuse (manufacturing)	$8,500,000	State Bonds	$0
City of Vernon	Additional Seymour Aquifer	$8,340,000	State Bonds	$0
City of Vernon	Water Conservation (Replace Transmission Pipeline)	$7,807,000	State Bonds	$0
City of Wichita Falls	Construct Lake Ringgold	$310,060,000	State Bonds	$0
City of Wichita Falls	Local Seymour Aquifer	$19,674,000	State Bonds	$0

Water User Group	Water Management Strategy	Capital Cost	Funding Source	Unable to Pay
City of Wichita Falls	Indirect Reuse to lake Arrowhead	$33,800,000	State Bonds	$0
City of Wichita Falls	Wichita River Diversion	$11,230,000	State Bonds	$0
City of Wichita Falls	Water Conservation (Water Line Replacement)	$36,656,000	State Bonds	$0
Steam Electric Power Wilbarger County (AEP)	Alternative Steam Electric Cooling Technology	$89,740,000	State Bonds	$0
Wichita Co. Irrigation	Enclose Canal Laterals in Pipe	$8,538,000	Grants = 80% Internal = 20%	$6,830,400
		$ 534,345,000		**$ 6,830,400**

9.5 Financing Policy Recommendations

Based on comments received from various water user groups, other entities, and the general public during this planning cycle, and keeping in line with previous Infrastructure Financing Reports, the Region B Water Planning Group recommends:

> "The state funds the development and the implementation of the management strategies adopted as part of this Regional Water Plan. This includes strategies identified to meet a specific need as well as general strategies to increase water supply in the region."

The Regional Water Planning Group believes that this recommendation can be accomplished through the Texas Water Development Board's current programs.

CHAPTER 10

ADOPTION OF PLAN AND PUBLIC PARTICIPATION

2016 FINAL PLAN

REGION B

DECEMBER 2015

CHAPTER 10

ADOPTION OF PLAN AND PUBLIC PARTICIPATION
2016 FINAL PLAN
REGION B

10.1 Introduction

This chapter describes the plan approval process for the Region B Water Plan and the efforts made to encourage public participation in the planning process.

Special efforts were made in seeking input from the general public, water suppliers, and others with special interest regarding the water planning process for Region B.

10.2 Regional Water Planning Group

As required by Senate Bill 1 regional water planning groups were formed to guide the planning process. These groups were comprised of representatives of twelve specific interests:

- General public
- Counties
- Municipalities
- Industrial
- Agricultural
- Environmental
- Small businesses
- Electric generating utilities
- River authorities
- Water districts
- Water utilities
- Groundwater Management Areas

Table 10-1 below lists the 18 members of the Region B Water Planning Group, the interests they represent, their organizations, and their counties.

Table 10-1

Regional Water Planning Group - Area B			
Name	**Organization**	**Interest**	**County**
Dale Hughes	W.T. Waggoner Estate	Agricultural	Wilbarger
Wilson Scaling	Scaling Ranch	Agricultural	Clay
Judge Mark Christopher	Foard County	Counties	Foard
Judge Kenneth Liggett	Clay County	Counties	Clay
Monte McMahon	American Electric Power	Electric Generating Utility	Wilbarger
J. K. (Rooter) Brite	J. A. Ranch	Environmental	Montague/All
Rebecca L. Dodge	Midwestern State University	Environmental	Wichita/All
Jerry L. Payne	Public	General Public	Clay
Jack Campsey	Gateway Groundwater Conservation District	Groundwater Management Areas	Hardeman
Tracy Messler	Upper Trinity Groundwater Conservation District	Groundwater Management Areas	Montague
Tamela Armstrong	Alliance Power Company	Industrial	Wichita
Russell Schreiber	City of Wichita Falls	Municipalities	Wichita
Mayor Gayle Simpson	City of Crowell	Municipalities	Foard
Curtis W. Campbell	Red River Authority of Texas	River Authorities	All
Dean Myers	Bowie Industries, Inc.	Small Business	Montague
Bobby Kidd	Greenbelt Municipal and Industrial Water Authority	Water Districts	Foard, Hardeman
Mike McGuire	Rolling Plains Groundwater Conservation District	Water Districts	Baylor
N. E. Deweber	Baylor Water Supply Corporation	Water Utilities	Baylor

The RWPG-B Planning Board unanimously pledged to support the interest of the entire region as the primary objective in meeting the needs of the region as a whole. During the first round of planning there was an extensive public education and participation program that included drought contingency planning workshops with local water suppliers, numerous civic group and local presentations, surveys of water users in the region, as well as planning group meetings, public hearings, and an internet web site. For this update, the public education and participation program consists of:

- Planning Group Meetings and Hearings
- Internet Web Site
- Coordination with Wholesale Water Providers and Water User Groups
- Implementation of the Water Plan

10.3 Planning Group Meetings

The RWPG-B held 13 open public meetings and hearings from January 12, 2011 through October 21, 2015 with invitations going to each category of interest groups and water use entities within the region, including a current agenda for each meeting and encouraging attendance and participation in the process. The RWPG Board participated actively as a group during each meeting, relying upon information provided by its consultant group and was well informed on all matters concerning the regional planning area. A list of the public meeting dates and locations held is shown in Table 10-2.

Representatives from the Texas Water Development Board (TWDB), the Texas Commission on Environmental Quality (TCEQ), the Texas Department of Agriculture (TDA), and the Texas Parks and Wildlife Department (TPWD) were regularly in attendance and other agencies were periodically represented and offered presentations. Some of these were agencies such as the U.S. Army Corps of Engineers, and State and Federal Legislators representing the local districts within the regional planning area. All meetings were posted in accordance with the Texas Open Meeting's Law, Article 6252-17, Section 3a, VATCS and 31 TAC, Section 357.12(a)(5).

During each meeting, a presentation of materials, discoveries, and relevant issues were provided for discussion and deliberation prior to receiving a vote on any specific measures, action, or strategies to be taken on the part of the RWPG-B. Members of the public were given an opportunity to participate in discussions of individual agenda items, as well as to provide public comments prior to the close of each meeting. Minutes were prepared of all meetings and filed with the secretary and the Texas Water Development Board.

Table 10-2

Region B Planning Group Meetings and Public Hearings		
DATE	**EVENT**	**LOCATION**
January 12, 2011	RWPG-B Public Hearing	RRA Office – Wichita Falls
August 17, 2011	RWPG-B Public Meeting	RRA Office – Wichita Falls
August 22, 2012	RWPG-B Public Meeting	RRA Office – Wichita Falls
March 13, 2013	RWPG-B Public Meeting	RRA Office – Wichita Falls
January 22, 2014	RWPG-B Public Meeting	RRA Office – Wichita Falls
April 23, 2014	RWPG-B Public Meeting	RRA Office – Wichita Falls
July 30, 2014	RWPG-B Public Meeting	RRA Office – Wichita Falls
January 7, 2015	RWPG-B Public Meeting	RRA Office – Wichita Falls
February 11, 2015	RWPG-B Public Meeting	RRA Office – Wichita Falls
March 25, 2015	RWPG-B Public Meeting	RRA Office – Wichita Falls
April 28, 2015	RWPG-B Public Meeting	RRA Office – Wichita Falls
June 16,2015	RWPG-B Public Hearing	RRA Office – Wichita Falls
October 21, 2015	RWPG-B Public Meeting	RRA Office – Wichita Falls

10.4 Media Communications

The RWPG-B Board members promoted numerous media coverage events before the board in an effort to encourage public involvement and heighten awareness of concerns vital to the regional planning area.

The Times Record News (TRN) was invited to each meeting and attended most, which produced good summary coverage of agenda items being considered together with actions taken by the RWPG-B Board.

10.5 Internet Web Page

An Internet Web Page was designed and is hosted by the RWPG's administrative agency, the Red River Authority of Texas. It is used to disseminate information about the water resources within the region and to publish notices of meetings, hearings, and issues being considered and addressed by the RWPG Planning Board.

The web pages are maintained and updated at least quarterly, or as needed, to publicize current information of interest and solicit input from the viewers. The web site is located under the Water Quality and Planning Section at www.rra.texas.gov.

The web site contains numerous links to other pages of common interest for the viewer and begins with a front page that includes a publications library, regional data inventories, names and contact information for the RWPG-B, public notices, maps of the region, and links to the regional water planning rules and statutes.

10.6 Regional Water Plan Implementation Issues

Implementation issues identified for the *Region B Water Plan* include: 1) financial issues associated with paying for the proposed capital improvements, 2) identification of the governing authorities for general regional strategies such as land stewardship, recharge enhancement and weather modification, 3) public acceptance of selected strategies, and 4) public participation in water conservation measures that were assumed in this plan.

Financial Issues

It is assumed that the entities for which strategies were developed will utilize existing financial resources, incur debt through bond sales and/or receive state-supported financial assistance. Most likely the funding of identified strategies will increase the cost of water to the customers. The economic feasibility to implement the strategies will depend on the cost increases the customer base can assume. Some strategies may not be able to be implemented without state assistance. The funding mechanisms for entities with shortages will be identified in the final plan as part of the report on the various financing mechanisms. This information is included as a part of Chapter 9.

Governing Authorities

In Region B there is an identified governing authority for each of the recommended strategies discussed in Chapter 5. However, for general strategies, such as land stewardship or weather modification, no governing authority has been identified. As part of the feasibility of these strategies for Region B, a governing authority will need to be identified to implement such strategies.

Public Participation

The recommended strategies developed for this plan include a significant level of conservation to be implemented over the planning period. These assumed demand reductions were applied to municipal water uses. Some of the demand reductions will occur simply through improvements in technology. However, a moderate level of public participation is required to fully realize the expected conservation. If the conservation is less than expected, then there may be additional shortages that were not identified in this plan.

10.7 Plan Adoption Process

In accordance with Texas Administrative Code Chapter 357 and the relevant rules governing the water planning process, the Region B RWPG conducted a formal process for the adoption of the Regional Water Plan. Activities under this section are primarily along two main lines. The first series of activities are directly related to the adoption of the Initially Prepared Plan (IPP) and the second series of activities are related to the final adoption of the completed Regional Water Plan.

10.7.1 Initially Prepared Plan Adoption

On April 28, 2015 the RWPG considered and approved the adoption of the IPP and set a Public Hearing date in addition to giving their approval for submission to and review by the TWDB.

10.7.2 Public Hearing

Subsequent to the approval of the IPP, the RWPG held a public hearing on June 16, 2015 at the offices of the Red River Authority of Texas to receive comments on the IPP. No one from the public attended this meeting and no comments were received as a part of the public hearing.

10.7.3 Response to Comments

By letter dated August 26, 2015 the TWDB notified the RWPG that they had completed their review of the IPP. As a part of their response, the TWDB documented twenty (20) Level 1 comments that had to be satisfactorily addressed in order to meet statutory, agency rules and/or contract requirements. Additionally, there were six (6) Level 2 comments documented in the letter that were suggestions to improve the readability and overall understanding of the plan. All comments along with the required responses are provided in Appendix I of the Final Plan.

10.7.4 Final Regional Water Plan Adoption

On October 21, 2015 the Region B RWPG reviewed and approved all responses to the TWDB comments and on that same date, approved the Final Plan for submission to the TWDB on or before December 1, 2015.

10.8 Conclusion

The Region B RWPG has attempted to maintain their commitment to public participation throughout the planning process, and believes that the public information and participation activities are important to the success of the regional planning initiatives in addition to all the data that was accumulated and analyzed. Finally, the RWPG recommends that both funding and public information/participation be encouraged throughout all subsequent planning processes.

CHAPTER 11

IMPLEMENTATION AND COMPARSION TO PREVIOUS REGIONAL WATER PLAN

2016 FINAL PLAN

REGION B

DECEMBER 2015

CHAPTER 11

IMPLEMENTATION AND COMPARSION TO PREVIOUS REGIONAL WATER PLAN
2016 FINAL PLAN
REGION B

11.1 Introduction

One of the new requirements for the 2016 Regional Water Plans is the inclusion of a chapter providing a comparison of the current Regional Water Plan to the previous Plan, and a discussion of the differences between the two. This chapter includes a discussion on the differences between the two Plans and a description of strategies that have been implemented since the publication of the 2011 Plan.

11.2 Differences Between Previous and Current Regional Water Plan

The following sections will provide a discussion of changes from the 2011 Plan to the 2016 Plan. Specifically, these section address differences in:

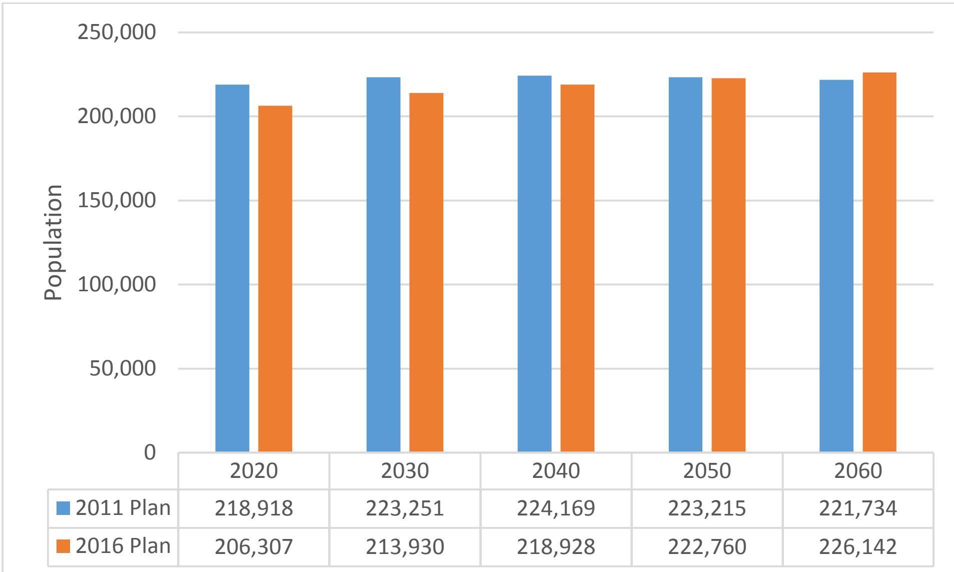
- Population Projections
- Water demand projections,
- Drought of record and hydrologic modeling and assumptions,
- Groundwater and surface water availability,
- Existing water supplies for water users,
- Identified water needs for WUGs and WWPs, and
- Recommended and alternative water management strategies.

11.2.1 Population Projections

Population projections for the 2016 plan were based on the 2010 census and were developed by the Texas State Data Center (TSDC) and the office of the State Demographer for 2011 to 2050. Then for the years of 2060 and 2070 the projections were based on the trend of average annual growth rates of the 2011 to 2050 projections. In comparison, population projections for the previous 2011 plan were based off of the latest information from the TSDC for city populations, surveying the cities, smaller communities and rural water supply corporations to determine the existing meter counts, in addition to using the population growth trends between 1990 and 2000.

The population comparison for Region B for the 2011 plan and the 2016 plan is shown in Figure 11-1.

Figure 11-1
Population Comparison of Region B for the 2011 and 2016 Plans



11.2.2 Water Demand Projections

The water demands in the Region B 2016 plan decreased in comparison to the 2011 plan by approximately 5 to 9 percent with the pattern of decline in the 2016 plan of approximately 5 percent throughout the planning period. For the most part, municipal, power, and livestock water demands are driving these decreases even though irrigation, mining and manufacturing showed some increase in water demand. Figure 11-2 shows the comparison of the water demands in the 2011 plan and 2016 plan and Table 11-1 shows the change in demands from the 2011 plan to the 2016 plan by use type.

Figure 11-2
Comparison of Region B Water Demand in 2011 and 2016 Plans

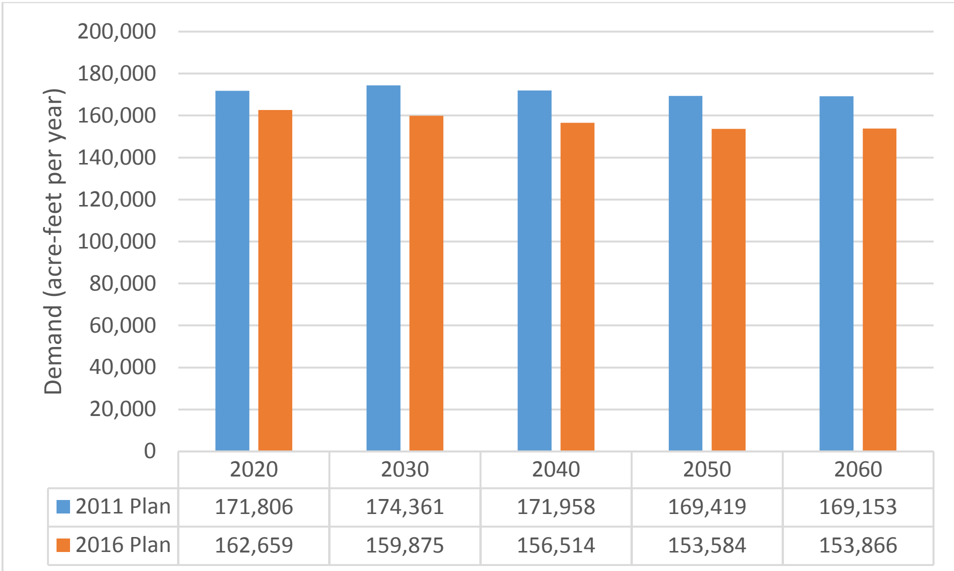


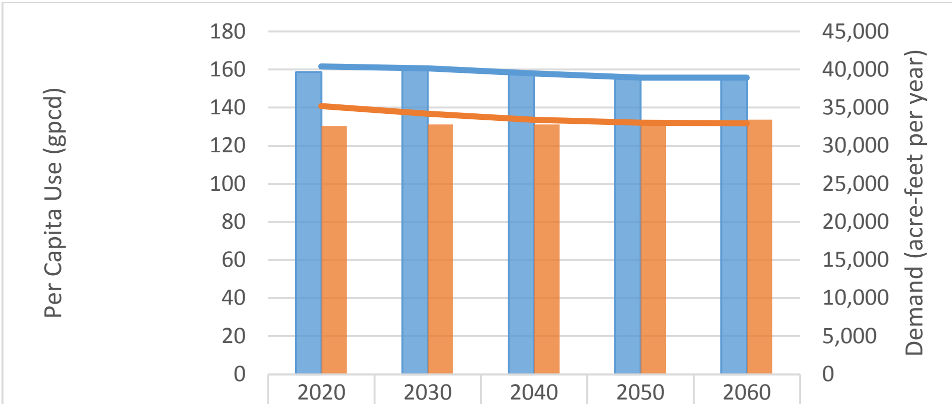
Table 11-1
Changes in Projected Demands from the 2011 Plan to the 2016 Plan by Use Type

Use Type	Change in Projected Water Demand (acre-feet per year)				
	2020	2030	2040	2050	2060
Irrigation	1,912	1,699	1,502	1,322	1,322
Livestock	-1,728	-1,728	-1,728	-1,728	-1,728
Manufacturing	403	424	460	492	492
Mining	4,358	3,531	2,193	1,045	909
Municipal	-7,092	-7,412	-6,871	-5,966	-5,282
Steam Electric Power	-7,000	-11,000	-11,000	-11,000	-11,000
Region B Total	**-9,147**	**-14,486**	**-15,444**	**-15,835**	**-15,287**

Note: Negative numbers indicate lower demand in the 2016 plan and positive numbers show higher demand in the 2016 plan.

Municipal demands for the 2016 plan are projected to increase over the planning period (2020-2070) by approximately 4 percent or 1,264 acre-feet per year. However, as compared to the 2011 plan the municipal water demand in the 2016 Plan is projected to be an average of 6,600 acre-feet per year or approximately 17 percent lower than in the 2011 plan. As shown in Figure 11-3, the per capita use for the Region is considerably less in the 2016 plan than in the 2011 plan. Much of this difference is due to the extreme drought conditions in this region and mandatory water use restrictions.

Figure 11-3
Comparison of the 2011 and 2016 Plan Projected Per Capita Use and Municipal Demand



	2020	2030	2040	2050	2060
2011 Plan	39,655	40,196	39,664	38,962	38,696
2016 Plan	32,563	32,784	32,793	32,996	33,414
2011 Plan gpcd	162	161	158	156	156
2016 Plan gpcd	141	137	134	132	132

11.2.3 Drought of Record and Hydrologic Modeling Assumptions

The Wichita and Little Wichita River Basins experienced a new drought of record since the previous planning cycle. This has significant impacts on the surface water availability in the region. The drought has also affected groundwater supplies as greater demands are placed on the Seymour aquifer and the lack of precipitation has impacted the recharge of this source. However, due to the planning requirement to use MAG values, which were adopted prior to the drought, the on-going drought does not affect the values for groundwater supplies used in this 2016 Plan.

Hydrologic Modeling Assumptions

For the 2011 Plan, the modeling assumptions for surface water supplies in Region B were based on the Red River WAM, which includes hydrology from 1948 through 1998. Both the firm yield and safe yield of each reservoir were determined. The safe yield was used for municipal reservoirs and the firm yield was used for the Lake Kemp/Diversion system. All run-of river supplies were estimated using the WAM.

For the 2016 Plan, different hydrological assumptions were used. The historical hydrology for

Lakes Arrowhead, Kemp, Kickapoo, Olney/Cooper, and Nocona were extended to include the period before and after the WAM (1940-1947, 1999-2013). Reservoir yields were calculated using a Microsoft Excel model based on the WAM hydrology and extended hydrology. For the Wichita Falls System, a conditional reliability assessment was used to assess the potential impacts of on-going drought on supply. This reliability analysis was the basis of the supply used for the Wichita Falls System for the 2016 Plan. For the other reservoirs, the safe yield was used as the available supply.

11.2.4 Groundwater and Surface Water Availability

Groundwater and surface water availability (not considering infrastructure or permit constraints) in Region B is significantly lower in the 2016 Plan than in the previous plan. Major differences in groundwater availability stem from the use of the MAG as a ceiling. Differences in surface water availability were the result of the new drought of record conditions that reduced the reliable yield. Overall, there was about a 51 percent decline in water availability throughout the Region between the 2011 and 2016 Plans. Figure 11-4 and Figure 11-5 show the differences in groundwater and surface water availability respectively.

In accordance with TWDB rules, the groundwater availability in the 2016 Plan is represented by the Modeled Available Groundwater (MAG) estimate. This is the first plan required to use groundwater estimates developed through groundwater joint planning process. In previous rounds of planning, the RWPG with technical input from its consultants developed availability estimates for groundwater. In Region B, the assumptions and approaches for the 2011 Plan differ from the DFCs adopted by the GMAs. Most of the difference centered on the acceptable amount of water depleted from storage (smaller drawdown goals). This resulted in overall lower groundwater availability in the 2016 Plan than in the 2011 Plan. This is especially evident in the Blaine and Seymour aquifers. Table 11-2 shows the changes in groundwater by county with every county showing lower supplies than the 2011 Plan.

The impacts of the drought on surface water supplies in Region B have been substantial. The amount of surface water supply shown in the 2016 plan is about 37 percent lower than amount of surface water shown in the 2011 plan. Table 11-3 shows the change in reservoir supply between the 2011 and 2016 Plans.

Figure 11-4
Comparison of Groundwater Availability in the 2011 and 2016 Plans

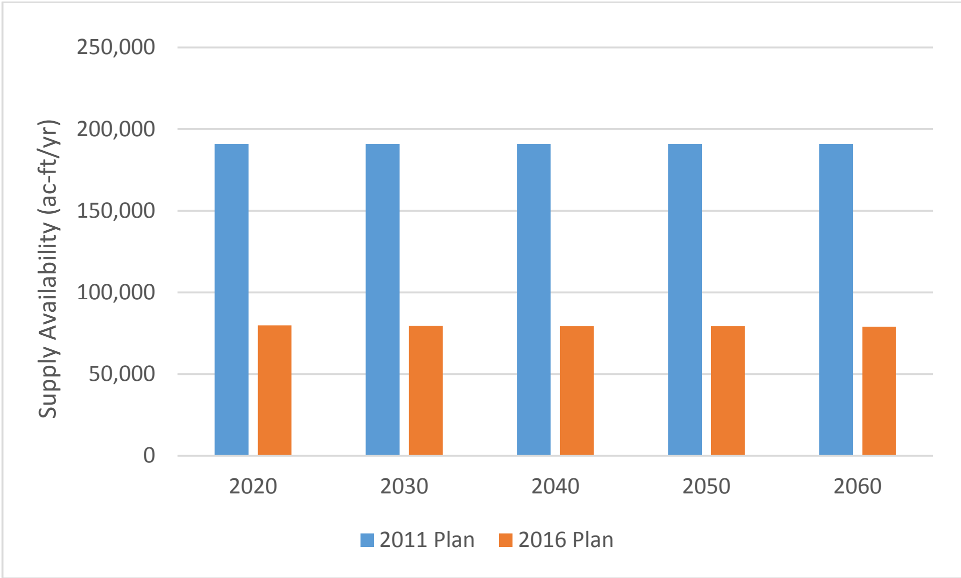


Table 11-2
Change in Groundwater Availability by County from the 2011 Plan to 2016 Plan
- Values are in Acre-Feet per Year -

County	2020	2030	2040	2050	2060
Archer	-841	-841	-841	-841	-841
Baylor	-5,820	-5,843	-5,843	-5,843	-5,843
Clay	-6,109	-6,109	-6,109	-6,109	-6,109
Cottle	-21,282	-21,282	-21,282	-21,282	-21,282
Foard	-22,391	-22,606	-22,635	-22,635	-22,606
Hardeman	-33,482	-33,482	-33,481	-33,481	-33,481
King	-6,328	-6,328	-6,328	-6,328	-6,328
Montague	2,582	2,582	2,582	2,582	2,582
Wichita	-11,443	-11,443	-11,450	-11,447	-11,447
Wilbarger	-5,990	-5,990	-5,990	-6,114	-6,486
Total	**-111,104**	**-111,342**	**-111,377**	**-111,498**	**-111,841**

Figure 11-5
Comparison of Surface Water Availability in the 2011 and 2016 Plans

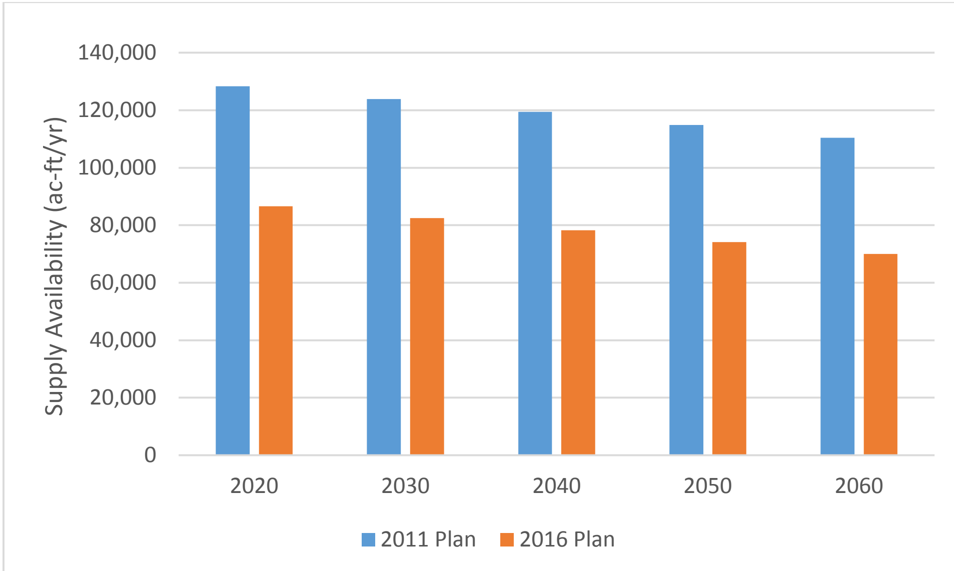


Table 11-3
Projected Change in Reservoir Supply from the 2011 to 2016 Plan in 2060

Reservoirs	2011 Plan (ac-ft/yr)	2016 Plan (ac-ft/yr)	Percent Change[1]
Lake Kemp/Diversion	44,800	26,575	-41%
Lake Kickapoo/Arrowhead	30,300	13,241	-56%
Amon Carter Lake	1,200	1,100	-8%
Lake Electra	420	0	-100%
Lake Nocona	1,260	1,260	0%
Olney Lake	760	620	-18%
Santa Rosa Lake	3,075	50	-98%
North Fork Buffalo Cr.	640	0	-100%
Lake Pauline[2]	1,200	0	-100%

[1] Negative numbers indicate lower supply in the 2016 Plan and positive numbers show higher supply in the 2016 Plan.
[2] Lake Pauline is no longer a supply source.

11.2.5 Existing Water Supplies of Water Users

Existing supplies to users are based on the source availability and infrastructure developed to provide the water. Due to changes in source availability, some sources are no longer used or reduced supplies were available from existing sources. On the contrary, increasing water demands and drought have caused water users to adopt new supplies, including several that were implemented as strategies from the 2011 Plan.

New Existing Sources of Supply for Water Users

Several entities in the region have developed new groundwater sources and one new direct reuse supply was identified since the 2011 Plan. Water users with new sources of existing supply are shown in Table 11-4

Table 11-4
Water Users with New Sources of Existing Supply in the 2016 Plan

Water User	New Existing Supply
Archer County Mining	Other Aquifer
Archer County Livestock	Lake Kemp/Diversion[1]
Cottle County Irrigation	Other Aquifer
Hardeman County Livestock	Blaine Aquifer
King County Mining	Other Aquifer
Bowie	Direct Reuse
Wilbarger County Irrigation	Other Aquifer

1. This supply is for the Dundee Fish Hatchery, which was considered in previous plans as a demand on Lake Diversion, but not directly reported in the State's database.

Reduced Existing Surface Water Supplies

As mentioned previously in this chapter the on-going drought has drastically reduced the available surface water supplies within Region B. Many of the water users with needs shown in the 2016 Plan without a need in the 2011 Plan are a result of reduced surface water supplies.

11.2.6 Identified Water Needs

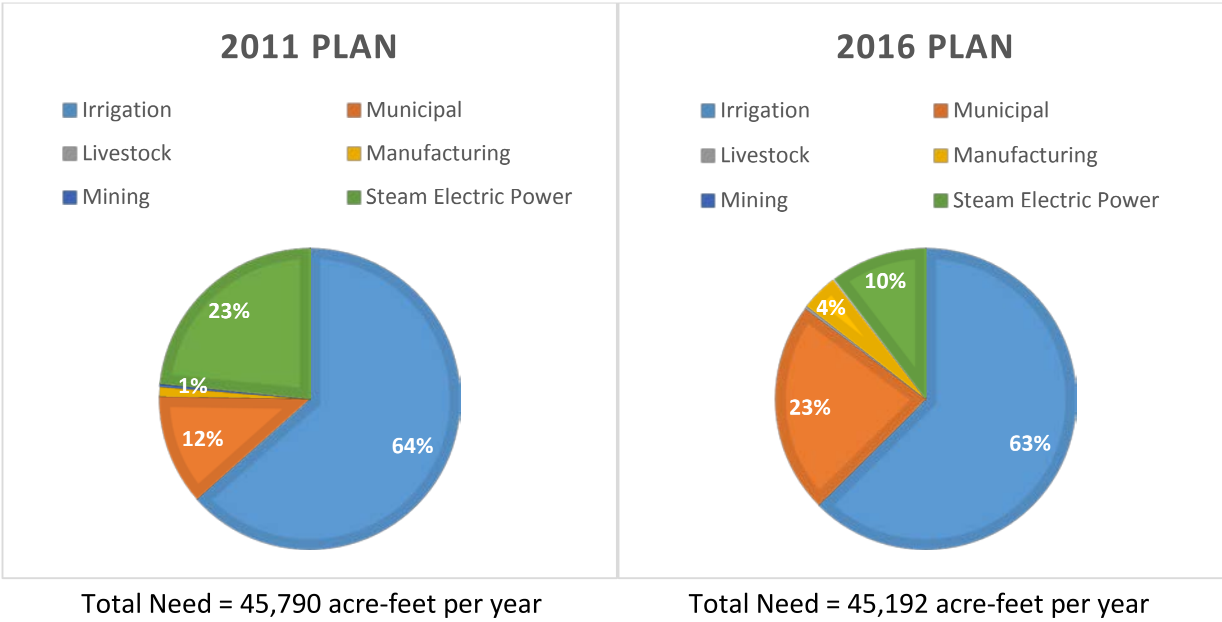
Due to increased demands and diminishing groundwater and surface water supplies, needs across Region B increased greater than thirty-five percent in 2020 down thirteen percent in 2060, from the 2011 Plan to the 2016 Plan. Table 11-5 shows the individual water user groups with new needs or no needs in the 2016 Plan. In the 2016 Plan, twenty-five water user groups with safe supply needs in the 2016 Plan were identified.

Table 11-5
Water Users with New Needs or No Needs for the 2016 Plan

New Need	No Need
Archer City	Archer County-Other
Holliday	Baylor WSC
Scotland	Charlie WSC
Windthorst WSC	Clay County Irrigation
Archer County Mining	Lockett Water System
Baylor County Irrigation	Hinds-Wildcat System
Baylor County Livestock	
Dean Dale SUD	
Foard County-Other	
Crowell	
Hardeman County-Other	
Quanah	
Hardeman County Irrigation	
Hardeman County Manufacturing	
Burkburnett	
Electra	
Wichita County-Other	
Wichita Valley WSC	
Wichita Steam Electric Power	
Wilbarger County-Other	
Vernon	
Wilbarger County Irrigation	
Wilbarger County Manufacturing	
Young County-Other	
Olney	

The composition of these needs also changed significantly with higher municipal and manufacturing needs and lower irrigation and steam electric power needs. Figure 11-6 below highlights the differences in need by use type in the two plans in the year 2060.

Figure 11-6
2060 Need by Use Type in the 2011 and 2016 Plans



11.2.7 Recommended and Alternative Water Management Strategies

New Water Management Strategies

Due to the new drought of record conditions, and the resulting diminishing surface water supplies, there is a substantial increase in water needs across the region which require new strategies. The majority of the new strategies were necessary to meet the needs of customers served by the City of Wichita Falls which provides for more than 65% of the total Region B municipal water demands. In the 2011 Plan there were 17 WUG's with needs and in the 2016 Plan that increased to a total of 35 WUG's with needs. Shown in Table 11-6 are the new strategies for WUG's that were not in the 2011 Plan.

Mining Conservation

Mining includes water use for four types of mining in Region B: crushed stone (Montague County), gypsum as crushed stone (Hardeman County), sand and gravel (Montague County), and oil and gas exploration and development in the Barnett Shale and related formations (primarily Montague County). All non-oil and gas demands were based on the June 2011 report Current and Projected Water Use in the Texas Mining and Oil and Gas Industry. For the crushed stone and sand and gravel operations water is used for production, dust control, and washing, with greater volumes being captured and recycled as more attention is focused on water and water resources become more limited. These mining operations comprise a small fraction of the total mining water use.

The oil and gas water use projections were based on the 2012 Oil & Gas Water Use in Texas: Update to the 2011 Mining Water Use Report, and direct communication with Dr. Nicot who was the lead author of the document. This document includes limited conservation in the water use projections for the Barnett shale area, where much (92 %) of the water used has been fresh water with limited amounts of recycling/reuse (5 %) and use of brackish water (3%). There is a significant trend in the oil and gas sector to recycle and reuse greater quantities of water and reduce the volume of fresh water required for drilling and development operations. It is estimated that recycled and brackish water could account for from 20 percent to 45 percent of the fracking water required for well development, as new processes and chemicals are developed. Similar conservation advances in drilling water use can be achieved. On this basis, an additional 20 percent of the projected demand could readily be conserved as recycling and reuse practices become accepted and adopted and alternative nonpotable water sources (reclaimed municipal wastewater and brackish water) by the industry. Therefore, the water conservation projections for mining water use were estimated at 20 percent of the projected demand for the 2016 plan.

Table 11-6
New Recommended Water Management Strategies in the 2016 Plan

Water User Group or Wholesale Provider	New Recommended Water Management Strategy
Archer City	Water Conservation/Contract/Voluntary Transfer
City of Holliday	Water Conservation/Contract/Voluntary Transfer
Scotland	Water Conservation/Contract/Voluntary Transfer
Windthorst WSC	Water Conservation/Contract/Voluntary Transfer
Mining (Archer Co.)	Water Conservation
Baylor Co. Other	Water Conservation
Irrigation (Baylor Co.)	Water Conservation
Dean Dale SUD	Water Conservation/Wichita Falls Contract
Foard Co. Other	Water Conservation/Voluntary Transfer
City of Crowell	Water Conservation/Voluntary Transfer
Irrigation (Hardeman Co.)	Water Conservation
Hardeman Co. Other	Water Conservation/Voluntary Transfer
City of Quanah	Water Conservation/Voluntary Transfer

Water User Group or Wholesale Provider	New Recommended Water Management Strategy
Manufacturing (Hardeman Co.)	Voluntary Transfer
Wichita County Other	Water Conservation/Contract/Voluntary Transfer
City of Burkburnett	Water Conservation/Contract
City of Electra	Water Conservation/Contract
Wichita Valley WSC	Water Conservation/Contract
City of Wichita Falls	Indirect Reuse Water to Lake Arrowhead
City of Wichita Falls	Local Seymour Aquifer Groundwater Development
City of Wichita Falls	Wichita River Supply
City of Wichita Falls	Precipitation Enhancement
Steam Electric Power (Wichita Co.)	Contract
Wilbarger Co. Other	Voluntary Transfer From Vernon
City of Vernon	Conservation/Direct Reuse/New Groundwater Development
Manufacturing (Wilbarger Co.)	Voluntary Transfer From Vernon
Young Co. Other	Water Conservation/Voluntary Transfer From Olney
City of Olney	Indirect Reuse

Municipal Conservation

A somewhat different approach was used to evaluate municipal conservation between the 2011 and 2016 plans. In both cases there are two categories of conservation. Basic conservation is included in the demand projections and advanced conservation is planned as conservation above the basic conservation. Basic conservation for the 2011 plan included consideration of conservation that will result from implementation and conversion to high efficiency plumbing fixtures that result from adoption of new plumbing codes. Advanced conservation included:

- Public and School Education.
- Reduction of Unaccounted for Water through Water Audits.
- Water Conservation Pricing.
- Passive Federal Clothes Washer Rules.

It was assumed that water systems with per capita usage greater than 140 gallons per capita per day (gpcd) would implement advanced conservation while those at or below 14 gpcd would only implement basic conservation.

Basic conservation for the 2016 plan includes conservation resulting from adoption of the water conserving plumbing code, but also includes consideration of the federal clothes washer rules. Advanced conservation for the 2016 plan includes conservation derived from:

- Public and School Education.

- Reduction of Unaccounted for Water through Water Audits.
- Water Conservation Pricing.
- Leak Detection and Repair Programs.

For the 2016 plan it was assumed that water systems with per capita demand greater than 100 gpcd could save 10 percent through advanced conservation by the end of the study period while those at or below 100 gpcd could save 5 percent through implementation of these conservation measures through the study period. The majority of advanced conservation is implemented in the latter portion of the planning period.

No Longer Considered Water Management Strategies

In addition the new strategies not included in the 2011 Plan, there were some strategies that were included in the 2011 Plan, however, they are no longer being considered for the entity for various reasons. These are outlined in 11-7.

Table 11-7
Strategies No Longer Considered in the 2016 Plan

Water User Group or Wholesale Provider	Strategies from the 2011 Plan No Longer in the 2016 Plan
Archer Co. Other	Purchase Water From Local Provider
Baylor WSC	Millers Creek Reservoir
Irrigation (Clay Co.)	Increase Water Conservation Elevation at Lake Kemp
Charlie WSC Clay Co.)	Nitrate Removal Plant
Lockett Water System (Wilbarger Co.)	Purchase Water From Vernon
Hinds-Wildcat System Wilbarger Co.)	Nitrate Removal Plant/Purchase Water From Vernon

11.3 Implementation of Previously Recommended Water Management Strategies

The following sections discuss those WMSs that were recommended in the 2011 Regional Water Plan, and have been partially or completely implemented since that plan was published. These WMSs are included in the 2016 Plan as currently available supply. Region B did not consider drought management as feasible strategy to meet long-term growth in demands or currently identified needs in either the 2011 or 2016 Plan so the implementation of this strategy is not relevant to the discussion in this Chapter. Implementation of the municipal conservation strategy is discussed under Section 11.2.1 with the discussion of differences in municipal demand projections.

11.3.1 City of Iowa Park

The City of Iowa Park is the construction phase of implementing a wastewater reuse project to convey approximately 150,000 gallons per day of Type 1 wastewater to Cryovac Sealed Air Corporation to be utilized as process water at their plant. The treated wastewater will be utilized in lieu of potable water purchase from the City of Wichita Falls.

11.3.2 City of Wichita Falls

The City of Wichita Falls has constructed and is currently operating a direct potable reuse treatment facility at their existing Cypress Water Treatment Plant. Treated wastewater is conveyed from the River Road Wastewater Treatment Plant through a 13 mile pipeline and into the existing Cypress WTP for treatment by microfiltration and reverse osmosis, prior to being mixed with their existing surface water and treated conventionally prior to going into the distribution system. Wichita Falls, has approval from TCEQ to treat and distribute up 5 MGD of wastewater and to utilize a 50/50 mix of treated wastewater and surface water for a total treatment capacity of 10 MGD. This system was placed in operation in about July, 2014.

11.3.3 Montage County Mining

With the large amount of oil and gas exploration in the Montague County area, there were a number of groundwater supply wells that developed and utilized to provide fracking water for the mining drilling industry. In addition, the City of Bowie has contracted with some of the area exploration companies to provide wastewater from their treatment plant for fracking water.

As previously noted in the discussion of mining conservation, the water use to date in the Barnett Shale area has shown almost all (92%) fresh water use. However, it is estimated that significant reuse and recycling strategies will be implemented over the next 20 years, reducing the demand for fresh water. Reuse and recycling in conjunction with use of alternative water sources, such as brackish groundwater and reclaimed municipal wastewater, is estimated to supply approximately 20 percent of the water demand by 2020 and through the remainder of the planning period.

11.4 Conclusion

Due to the extreme drought conditions, the 2016 Region B Water Plan is quite different from the 2011 Region B Plan. Many of the surface water supplies are at the lowest levels that they have ever been in their history, all due the new drought of record conditions throughout the region. In addition, groundwater supplies have been reduced specifically due to the use of the MAG's as a ceiling. Therefore, due to the reduction in water supplies, many water users that previously showed no needs, are now showing needs and those that had needs in the 2011 Plan now have much greater needs. Consequently, 28 new strategies were developed for the 2016 plan.

APPENDIX A

WATER AVAILABILITY MODELING

2016 FINAL PLAN

REGION B

DECEMBER 2015

APPENDIX A

WATER AVAILABILITY MODELING
2016 FINAL PLAN
REGION B

A.1 Yield Calculation Using Extended Hydrology and Evaporation

Due to recent drought conditions within Region B, the Region B Planning Group requested to use extended hydrology for several water supply reservoirs within the region to reflect the impact on water supply availability. In a letter dated September 9, 2014, the Texas Water Development Board approved this request. The reservoirs which were extended include Lakes Arrowhead, Kemp, Kickapoo, Olney/Cooper, and Nocona. The hydrology was extended using USGS gages, existing diversion data and drainage area ratios. The net evaporation which is the evaporation minus precipitation was developed using TWDB Quadrangle data. The yields were calculated using a Microsoft Excel model based on the hydrology from the Red River Water Availability Model (WAM) for the period of record (1948-1998). The extended hydrology includes the period before and after the WAM (1940-1947, 1999-2013). Table A-1 through Table A-10 show the extended hydrology and net evaporation for each lake.

The yield for Lakes Arrowhead and Kickapoo were calculated using a conditional reliability model. The conditional reliability analysis, uses all sequences of historical hydrology rather than just selected drought sequences. The model is executed multiple times, and statistics taken from the model output give an indication of the relative probability of future conditions. For the analysis, all historical 5-year sequences of hydrology with demands varying according to drought stage. For example, the first run projects lake levels with hydrology from 1940 through 1945, the second uses the hydrology from 1941 through 1946, etc. For 5-year periods starting after 2009 (where a full five years of data would not be available), the model uses only the data available. The result is a set of 74 possible lake level projections based on historical data. These projections allow an estimate of the probability of being at a given elevation at a given time in the near future. The yield for the Lake Kemp-Diversion system was based on the safe yield of the system using hydrology through May 2013.

Table A-1: Extended Inflows - Lake Arrowhead

-Values are in Acre-Feet per Month-

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1940	1	1,410	3	7,271	15,336	17,541	7,579	4,976	0	0	5,979	1,758
1941	75	12,922	499	12,813	44,567	46,474	5,314	10,201	8,165	86,513	23,461	4,648
1942	4	6	82	67,521	411	2,722	14	255	879	15,564	8,214	2,652
1943	61	6	3,576	11,939	2,165	2,890	950	0	0	352	0	368
1944	937	3,943	1,093	269	1,182	4,092	524	797	357	8,741	874	380
1945	646	3,357	20,848	16,935	188	486	17,263	285	5,473	8,704	0	0
1946	25	1,342	879	8	0	0	59	1,173	30,113	3,872	11,662	21,331
1947	0	0	0	4,019	41,153	1,248	4,535	722	1,155	4,436	2,136	3,696
1948	706	1,618	766	0	634	15,495	3,286	1,325	183	126	334	440
1949	2,611	4,007	1,929	0	20,273	20,760	970	1,986	7,760	6,486	224	629
1950	1,019	0	0	5,705	28,706	4,250	50,626	85,940	12,904	0	0	0
1951	0	0	326	0	11,810	4,434	491	0	3,413	713	0	0
1952	406	0	0	48	4,798	268	1,598	2,920	964	453	2	356
1953	0	0	3,126	232	1,263	0	4,595	2,112	292	48,717	2,966	455
1954	69	112	0	4,473	39,547	11,128	0	0	0	0	0	0
1955	531	1,556	998	2,514	16,118	23,196	704	0	26,455	19,840	0	0
1956	0	0	0	0	7,929	1,231	78	0	0	3,656	1,036	839
1957	0	2,268	4,191	40,173	110,309	21,794	789	0	0	7,078	30,352	0
1958	0	0	501	1,175	13,690	100	7,825	984	1,233	0	0	0
1959	0	0	0	0	1,060	14,992	1,692	0	1,111	18,282	0	4,055
1960	1,818	4,618	353	0	1,512	962	208	0	0	12,004	0	3,385
1961	151	1,270	4,379	0	4,637	3,895	1,546	0	5,022	87	3,427	643
1962	0	0	181	1,795	2,822	20,393	2,285	0	31,189	7,706	12,216	17,469
1963	0	0	0	3,019	1,203	2,781	0	0	340	363	1,582	0
1964	492	3,014	1,240	1,246	3,427	6,285	0	1,081	14,838	429	4,195	478
1965	659	688	0	2,301	9,036	4,812	0	2,469	1,465	3,355	355	422
1966	0	0	930	30,724	29,541	0	3,477	10,956	25,938	2,323	161	0
1967	249	195	149	6,317	86	7,628	1,811	0	3,492	0	408	273
1968	12,421	233	15,132	5,344	14,122	3,180	4,321	725	0	0	1,847	860
1969	413	4,851	19,046	2,223	31,282	2,230	366	659	13,727	0	371	2,562
1970	2,953	1,219	11,205	3,355	5,118	3,131	0	0	0	0	0	0
1971	0	0	0	1,011	0	269	722	13,093	5,902	4,595	0	6,858
1972	0	1,004	616	3,474	34,411	2,244	836	0	0	7,386	13,707	793
1973	8,551	2,701	7,807	8,907	0	3,013	5,573	3,234	1,273	1,423	5,867	0
1974	0	1,311	1,556	374	2,838	4,637	0	0	22,637	3,725	8,178	268
1975	1,432	2,191	837	1,930	47,909	16,564	8,449	2,442	5,041	1,087	0	0
1976	0	0	0	0	2,675	3,430	0	394	11,926	9,428	5,203	0
1977	0	1,967	6,598	7,454	5,973	1,624	0	755	0	0	0	0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1978	0	0	759	720	211	1,592	625	5,699	0	0	0	0
1979	0	0	2,679	870	4,776	2,985	1,121	3,777	1,277	0	0	0
1980	0	0	715	128	3,797	1,575	0	0	23,155	10,400	1,714	4,160
1981	642	3,649	19,100	2,319	0	4,806	0	0	1,327	103,940	0	0
1982	0	0	1,350	0	90,738	41,011	3,344	440	0	700	0	0
1983	0	3,484	1,006	4,451	0	3,781	0	602	0	9,268	0	0
1984	0	0	3,371	1,401	0	0	0	0	0	13,994	2,218	18,770
1985	8,638	15,588	32,445	35,516	5,301	29,865	424	863	0	1,698	0	0
1986	0	1,040	2,792	1,526	4,921	21,217	1,107	887	41,027	3,476	6,334	2,349
1987	4,007	11,603	16,060	1,772	14,544	5,116	0	489	0	550	0	18,048
1988	130	419	2,091	1,888	0	373	0	0	951	0	0	0
1989	0	2,104	1,267	436	56,446	35,517	226	2,684	26,587	1,991	0	0
1990	3,446	5,048	36,242	80,990	67,362	16,911	1,388	3,245	0	0	0	0
1991	404	1,129	1,498	437	6,252	7,057	1,746	2,268	7,673	5,545	743	47,412
1992	10,423	11,587	9,446	344	10,628	58,162	21,056	0	0	69	4,296	2,345
1993	1,810	10,565	14,451	1,490	32,693	14,157	4,426	1,005	2,715	0	0	4,131
1994	0	0	2,642	201	9,721	3,243	2,323	5,430	0	13,141	2,396	2,460
1995	152	0	1,977	2,215	31,882	18,048	0	7,307	0	667	0	0
1996	604	872	2,240	0	0	1,038	0	358	4,799	0	3,893	1,862
1997	1,062	16,930	540	3,089	26,830	3,225	0	0	0	0	0	0
1998	3,154	4,339	26,084	2,667	860	1,906	1,490	2,412	1,137	0	1,860	0
1999	3,151	0	8,885	1,351	2,621	2,404	0	0	0	0	0	0
2000	1,427	494	1,724	1,041	261	202	646	0	0	0	18,499	1,283
2001	5,537	40,651	34,431	2,017	4,007	665	865	275	0	0	0	0
2002	0	1,577	1,820	17,195	0	12,788	3,327	0	0	604	1,548	1,186
2003	847	0	1,128	1,231	3,456	2,720	742	152	0	0	0	0
2004	0	2,341	2,945	0	0	316	31,222	6,792	1,817	6,502	29,581	979
2005	6,046	2,308	352	707	142	4,198	16,713	31,503	1,461	16,494	1,262	403
2006	1,942	581	1,491	811	1,023	0	0	2,032	4,400	542	3,234	1,528
2007	2,355	1,455	4,172	5,815	12,512	42,239	15,136	1,252	0	0	0	0
2008	0	0	3,735	2,414	0	0	177	1,154	328	0	0	0
2009	581	649	1,731	10,553	16,823	545	3,531	524	2,490	711	120	1,689
2010	7,922	7,037	5,164	31,567	36,451	0	2,556	0	1,942	1,122	0	99
2011	0	1,387	825	978	1,110	0	0	1,750	390	5,820	2,279	995
2012	6,383	0	2,529	2,444	0	891	674	1,100	2,308	3,057	441	0
2013	0	188	126	3,520	0	0	0	608	427	0	0	0

Table A-2: Extended Net Evaporation Rate - Lake Arrowhead

-Values are in Feet per Month -

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1940	0.14	0.05	0.46	0.24	0.32	0.23	0.83	0.50	0.54	0.46	-0.10	-0.07
1941	0.04	-0.09	0.16	-0.06	0.09	-0.01	0.55	0.42	0.42	-0.20	0.26	0.14
1942	0.16	0.21	0.31	-0.14	0.43	0.42	0.78	0.61	0.35	0.00	0.35	0.02
1943	0.19	0.27	0.10	0.27	0.22	0.40	0.88	1.03	0.63	0.45	0.31	-0.07
1944	-0.03	-0.10	0.20	0.29	0.26	0.61	0.72	0.76	0.59	0.20	0.05	0.02
1945	0.05	-0.04	-0.02	0.05	0.56	0.47	0.38	0.74	0.53	0.30	0.35	0.21
1946	-0.06	0.14	0.18	0.33	0.31	0.58	1.00	0.84	0.26	0.34	0.01	-0.05
1947	0.10	0.19	0.11	0.01	0.05	0.65	0.86	1.01	0.87	0.43	0.10	0.02
1948	0.15	-0.07	0.19	0.43	0.14	0.40	0.78	0.90	0.91	0.47	0.43	0.25
1949	-0.15	-0.03	0.15	0.23	-0.09	0.48	0.83	0.66	0.31	0.15	0.35	0.11
1950	0.07	0.15	0.45	0.18	0.00	0.44	-0.01	0.53	0.25	0.58	0.45	0.22
1951	0.19	0.07	0.28	0.28	0.07	0.13	0.73	0.88	0.61	0.42	0.19	0.26
1952	0.18	0.22	0.24	0.17	0.21	0.77	0.80	1.36	1.00	0.82	0.15	0.15
1953	0.17	0.20	0.17	0.29	0.41	0.95	0.69	0.64	0.80	0.17	0.21	0.25
1954	0.05	0.28	0.34	-0.05	-0.08	0.45	0.64	0.70	0.59	0.30	0.17	0.06
1955	0.01	0.08	0.15	0.36	0.08	0.18	0.60	0.59	-0.04	0.36	0.26	0.15
1956	0.06	0.07	0.39	0.40	0.21	0.67	0.76	0.80	0.74	0.18	0.19	0.05
1957	0.04	-0.11	0.05	-0.18	-0.25	0.24	0.53	0.59	0.24	-0.02	-0.25	0.11
1958	-0.01	0.08	-0.04	0.03	0.14	0.40	0.34	0.47	0.18	0.23	0.16	0.06
1959	0.09	0.12	0.31	0.29	0.07	-0.15	0.23	0.45	0.35	-0.20	0.18	-0.07
1960	-0.03	0.03	0.12	0.24	0.16	0.41	0.24	0.43	0.11	-0.07	0.28	-0.10
1961	0.00	0.00	0.04	0.35	0.25	0.07	0.25	0.42	-0.01	0.20	-0.08	0.03
1962	0.12	0.15	0.16	0.03	0.35	-0.12	0.11	0.37	-0.39	0.12	-0.04	0.03
1963	0.09	0.07	0.15	0.08	0.03	0.22	0.34	0.32	0.14	0.16	-0.02	0.04
1964	0.03	0.02	0.28	0.32	-0.02	0.57	0.84	0.42	0.06	0.35	-0.10	0.15
1965	0.03	0.08	0.21	0.22	-0.04	0.43	0.89	0.46	0.28	0.14	0.31	0.24
1966	0.01	0.04	0.34	-0.14	0.40	0.58	0.70	0.07	-0.16	0.41	0.36	0.14
1967	0.24	0.24	0.40	0.15	0.14	0.55	0.51	0.73	-0.03	0.37	0.17	0.05
1968	-0.29	0.02	0.02	0.23	0.05	0.38	0.22	0.57	0.35	0.28	-0.06	0.14
1969	0.12	-0.03	-0.01	0.20	0.09	0.41	0.72	0.36	-0.08	0.07	0.18	-0.08
1970	0.16	0.01	0.03	0.07	0.38	0.58	0.74	0.60	0.20	0.22	0.33	0.24
1971	0.22	0.17	0.46	0.51	0.40	0.58	0.59	-0.03	0.03	0.05	0.18	-0.11
1972	0.14	0.18	0.43	0.28	0.21	0.42	0.61	0.43	0.24	-0.12	0.12	0.16
1973	-0.11	0.04	0.14	0.08	0.33	0.30	0.30	0.60	-0.07	0.07	0.17	0.23
1974	0.14	0.20	0.32	0.24	0.36	0.57	0.63	0.28	-0.25	-0.03	0.16	0.05
1975	0.10	-0.01	0.18	0.24	-0.33	0.34	0.19	0.37	0.18	0.46	0.17	0.11
1976	0.23	0.38	0.36	0.09	0.11	0.42	0.36	0.54	-0.15	-0.14	0.17	0.11
1977	-0.05	0.18	0.28	0.17	0.08	0.43	0.64	0.35	0.51	0.36	0.22	0.29

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1978	0.07	-0.05	0.18	0.41	0.19	0.45	0.83	0.21	0.33	0.28	-0.04	0.19
1979	-0.03	0.08	0.12	0.17	0.09	0.28	0.38	0.31	0.48	0.43	0.18	-0.01
1980	0.07	0.10	0.31	0.42	-0.22	0.67	0.93	0.78	-0.07	0.30	0.11	0.04
1981	0.18	0.03	0.14	0.14	0.10	0.18	0.62	0.48	0.34	-0.17	0.18	0.16
1982	0.13	0.09	0.18	0.24	-0.41	0.04	0.49	0.58	0.37	0.29	0.04	-0.01
1983	0.04	0.03	0.07	0.26	0.04	0.15	0.62	0.64	0.63	0.10	0.14	0.06
1984	0.19	0.20	0.19	0.50	0.37	0.57	0.71	0.50	0.41	-0.22	0.06	-0.15
1985	0.12	-0.05	0.03	0.17	0.26	0.22	0.57	0.66	0.38	-0.03	0.11	0.15
1986	0.28	0.10	0.32	0.17	-0.05	0.09	0.67	0.50	0.16	-0.16	-0.01	-0.01
1987	0.05	-0.13	0.30	0.41	-0.09	0.24	0.55	0.43	0.23	0.45	0.16	-0.20
1988	0.09	0.18	0.21	0.23	0.47	0.25	0.44	0.58	0.04	0.33	0.25	0.14
1989	0.07	-0.10	0.17	0.44	-0.16	0.15	0.54	0.29	0.10	0.39	0.32	0.22
1990	0.04	-0.15	-0.02	0.05	0.28	0.62	0.40	0.43	0.12	0.36	-0.01	0.07
1991	-0.09	0.23	0.33	0.41	0.26	0.29	0.73	0.41	0.22	0.20	0.26	0.02
1992	0.01	0.07	0.19	0.30	0.08	0.23	0.51	0.46	0.34	0.44	-0.04	0.04
1993	0.05	0.00	0.19	0.23	0.35	0.43	1.02	0.72	0.34	0.18	0.28	0.02
1994	0.09	-0.06	0.26	0.17	0.12	0.74	0.59	0.81	0.35	-0.25	0.12	0.08
1995	0.00	0.00	0.07	0.26	-0.03	0.25	0.45	0.29	0.17	0.49	0.30	0.17
1996	0.18	0.32	0.21	0.43	0.59	0.34	0.55	0.12	-0.09	0.21	-0.32	0.18
1997	0.21	0.01	0.34	0.01	0.14	0.25	0.58	0.38	0.49	0.23	0.19	-0.27
1998	-0.05	0.02	0.28	0.38	0.46	0.64	0.78	0.66	0.62	0.21	0.12	0.04
1999	-0.05	0.12	-0.20	0.21	0.06	0.20	0.59	0.70	0.57	0.21	0.29	0.26
2000	0.40	0.16	0.27	0.15	0.41	0.19	0.61	0.77	0.33	-0.26	-0.34	0.12
2001	-0.05	-0.03	0.08	0.35	0.22	0.71	0.90	0.61	0.34	0.32	0.19	0.13
2002	0.15	0.16	0.09	0.06	0.25	0.21	0.20	0.68	0.39	-0.15	0.21	-0.01
2003	0.19	0.08	0.29	0.43	0.18	-0.05	0.77	0.50	0.19	0.44	0.15	0.26
2004	0.09	-0.12	0.21	0.13	0.32	-0.14	0.24	0.32	0.48	0.06	-0.32	0.13
2005	0.06	0.04	0.28	0.46	0.24	0.49	0.44	-0.02	0.48	0.06	0.38	0.24
2006	0.31	0.14	0.22	0.34	0.27	0.63	0.82	0.69	0.32	0.13	0.19	0.06
2007	0.01	0.21	-0.02	0.19	-0.23	-0.22	0.30	0.59	0.13	0.48	0.25	0.09
2008	0.25	0.19	0.06	0.28	0.28	0.47	0.72	0.25	0.23	0.22	0.30	0.23
2009	0.22	0.31	0.38	0.12	0.26	0.42	0.33	0.71	0.04	-0.10	0.26	0.01
2010	-0.04	0.01	0.22	0.03	0.21	0.38	0.27	0.69	0.06	0.35	0.35	0.14
2011	0.13	0.11	0.43	0.61	0.48	0.66	1.07	1.07	0.63	0.19	0.19	0.03
2012	-0.18	0.09	0.12	0.46	0.46	0.57	0.82	0.49	0.34	0.31	0.36	0.13
2013	0.08	0.08	0.20	0.22	0.17	0.37	0.59	0.55	0.30	0.20	0.15	0.09

Table A-3: Extended Inflows - Lake Kemp

-Values are in Acre-Feet per Month-

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1940	0	2,980	0	8,000	14,400	12,400	3,430	39,200	9,610	4,060	36,700	2,960
1941	4,520	14,350	3,900	29,000	241,000	119,200	17,800	31,800	8,050	116,000	10,700	12,100
1942	4,650	5,900	1,750	48,000	16,900	5,920	1,110	8,120	17,600	40,000	3,130	7,520
1943	930	0	6,950	15,500	19,600	21,800	0	0	0	0	0	1,550
1944	5,980	10,500	6,650	860	3,970	20,650	4,960	0	1,510	16,200	7,800	4,740
1945	6,650	1,790	10,600	7,750	1,400	7,100	48,400	22,150	36,600	14,720	0	0
1946	330	2,710	0	0	7,470	9,500	37,400	32,000	71,500	8,210	11,300	22,000
1947	3,960	0	3,000	4,950	165,500	36,000	3,970	26,000	0	0	7,690	15,000
1948	1,091	10,739	9,662	12,336	25,262	46,631	52,150	23,702	10,509	14,876	4,476	1,951
1949	1,830	7,974	13,786	4,834	37,636	44,117	33,679	32,691	37,098	19,036	20,835	31,737
1950	23,261	4,850	9,953	24,257	50,386	22,405	52,565	160,536	100,386	40,127	168	3,237
1951	1,553	13,865	3,166	8,320	51,965	21,364	8,867	15,409	18,635	3,858	4,733	2,823
1952	9,330	5,589	3,571	7,755	25,595	7,945	16,088	13,377	7,468	2,072	1,214	4,696
1953	2,759	4,593	4,721	4,689	4,084	4,554	22,627	38,018	3,612	86,956	6,688	1,592
1954	1,613	2,311	5,609	14,867	158,280	57,906	9,040	8,548	0	2,385	2,290	5,924
1955	1,540	3,283	10,430	6,705	56,396	35,389	11,319	12,864	31,548	169,851	4,031	1,943
1956	1,409	3,605	2,483	13,132	9,334	4,303	15,551	11,052	6,164	8,236	60	3,180
1957	0	3,745	3,605	63,282	212,138	64,042	15,481	3,666	0	12,379	23,458	942
1958	0	1,462	3,386	47,172	44,867	5,714	19,602	6,139	3,687	5,691	2,086	0
1959	6,299	3,812	0	8,300	16,957	40,093	14,589	31,690	9,980	52,818	3,783	15,517
1960	2,896	2,727	2,987	2,344	20,890	27,436	30,701	9,178	2,561	104,236	5,426	12,699
1961	3,106	3,484	27,283	6,147	37,463	6,858	26,452	7,025	10,257	3,355	10,958	2,013
1962	2,127	1,147	8,793	9,462	5,015	47,274	7,081	2,909	54,809	10,424	10,531	3,420
1963	1,350	1,286	2,829	4,400	16,647	34,180	5,929	5,371	4,429	4,496	7,614	967
1964	1,513	9,173	4,328	3,456	10,485	28,964	4,731	285	49,958	4,903	14,605	1,481
1965	2,728	896	1,800	16,035	11,578	11,369	1,583	25,415	64,943	63,957	7,172	6,252
1966	2,799	3,535	6,038	19,460	8,127	25,334	14,203	101,412	82,620	12,251	3,015	2,179
1967	2,461	1,267	4,774	64,964	14,037	55,203	61,542	7,441	14,645	7,387	1,108	1,594
1968	29,916	13,082	40,582	14,583	10,100	20,926	19,398	7,683	2,686	1,846	6,221	1,639
1969	3,479	6,338	8,247	4,984	32,020	19,266	3,135	10,114	55,858	29,638	8,168	4,043
1970	2,876	4,209	31,832	8,380	9,261	12,446	12,999	2,070	8,051	3,612	1,338	1,475
1971	1,047	727	555	1,504	23,033	12,700	2,354	14,664	19,202	25,649	3,703	7,802
1972	2,180	3,546	2,454	30,357	54,951	25,299	7,835	15,833	40,836	46,474	22,932	2,544
1973	14,742	5,138	36,601	28,819	6,289	2,496	9,784	5,115	23,111	2,693	3,597	1,360
1974	2,722	3,166	7,832	18,397	14,990	29,830	1,301	2,824	33,020	14,967	4,243	2,463
1975	8,164	7,322	5,889	9,897	41,770	20,621	39,877	17,289	19,753	4,044	8,365	5,272
1976	2,978	4,354	4,670	16,497	11,371	4,972	4,389	7,730	11,361	34,688	3,752	2,007
1977	2,301	5,427	3,871	17,498	48,484	8,157	3,815	6,546	1,832	1,824	1,037	1,092

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1978	1,549	3,880	4,456	3,072	10,015	17,632	7,041	33,150	19,877	3,216	3,574	1,705
1979	4,552	3,168	10,737	4,384	17,618	19,797	10,419	20,163	3,144	1,644	6,028	3,510
1980	2,975	4,990	3,031	4,993	52,189	8,532	5,363	4,295	17,008	2,278	2,585	5,894
1981	1,649	10,684	6,949	11,048	19,501	52,260	1,339	5,353	5,088	11,466	1,635	1,784
1982	2,557	3,701	7,105	3,709	71,772	61,993	7,844	4,900	3,205	1,216	1,567	2,673
1983	6,713	5,015	6,460	7,888	10,545	12,159	2,894	416	478	147,250	17,200	4,975
1984	6,365	7,018	7,291	5,521	5,928	3,836	1,626	4,946	4,917	7,772	8,860	18,191
1985	12,800	15,163	18,542	12,399	10,772	34,692	3,451	3,031	2,895	47,750	4,162	2,543
1986	4,612	3,381	3,627	8,216	16,544	26,656	22,946	22,695	62,303	96,524	31,673	8,955
1987	12,716	26,615	26,941	11,051	93,471	48,051	21,248	6,584	5,088	9,969	2,357	3,804
1988	8,267	4,187	8,810	4,861	2,855	3,199	9,568	2,533	31,750	1,932	2,135	2,134
1989	1,043	6,123	5,314	3,370	73,624	46,517	2,640	13,867	66,251	4,824	1,833	2,672
1990	7,358	10,559	36,868	71,126	41,628	81,907	21,891	8,560	7,654	2,550	7,711	2,351
1991	10,470	4,541	3,506	5,077	20,515	69,951	6,819	9,643	38,501	13,814	4,117	29,764
1992	23,537	55,414	22,719	20,601	15,233	124,280	19,988	9,094	4,958	2,727	12,152	10,638
1993	5,201	35,015	30,765	18,003	26,267	18,827	7,062	5,992	5,555	2,946	2,344	6,722
1994	2,621	12,133	8,515	3,473	42,885	5,044	6,805	1,594	10,848	25,590	24,138	4,537
1995	3,773	2,796	5,618	7,509	61,452	101,632	17,689	115,146	20,101	14,676	4,734	3,435
1996	4,448	6,255	6,827	4,766	2,761	9,309	2,955	15,174	44,872	5,054	6,128	4,612
1997	4,524	27,654	7,978	46,690	50,418	13,487	8,385	23,651	11,057	10,558	3,277	10,521
1998	10,829	25,042	35,631	9,381	9,238	9,047	2,079	1,730	1,160	2,480	4,654	1,605
1999	9,716	2,894	13,187	10,047	35,681	20,521	7,818	0	0	0	0	0
2000	0	676	27,418	5,862	0	10,030	3,169	618	0	12,098	25,636	1,949
2001	5,597	12,741	26,768	3,806	11,113	21	0	2,472	4,026	2,151	17,153	3,893
2002	1,343	1,113	6,109	20,794	9,703	15,189	43,178	10,692	5,400	14,121	5,413	8,776
2003	3,078	950	2,325	8,928	3,777	7,702	4,022	3,947	3,716	0	0	0
2004	2,689	3,954	15,156	2,130	0	15,612	18,448	17,731	2,589	6,597	35,393	3,267
2005	2,014	4,241	3,573	2,786	3,909	2,632	5,086	32,186	26,560	5,961	885	1,011
2006	2,420	2,026	4,423	5,665	7,545	11,502	5,046	0	2,701	39,114	4,645	2,705
2007	5,043	3,027	4,709	2,562	6,933	43,484	13,895	17,681	1,582	0	0	0
2008	367	2,013	4,214	14,699	6,236	8,206	3,628	1,720	2,983	4,736	0	0
2009	34	1,125	66	1,733	16,609	22,572	0	577	7,849	8,878	2,121	3,625
2010	9,921	11,321	9,166	39,540	19,263	3,201	39,881	384	16,011	4,877	1,073	1,616
2011	0	351	3,354	3,400	1,647	0	1,621	0	0	149	751	1,117
2012	259	534	1,592	694	1,833	8,914	0	247	3,178	927	50	0
2013	0	1,969	738	1,180	956							

Table A-4: Extended Net Evaporation Rate - Lake Kemp

-Values are in Feet per Month-

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1940	0.15	0.07	0.48	0.29	0.34	0.29	0.89	0.51	0.65	0.50	0.06	0.06
1941	0.10	-0.08	0.18	-0.03	-0.15	0.09	0.55	0.53	0.43	-0.35	0.25	0.13
1942	0.18	0.24	0.36	-0.18	0.48	0.54	0.76	0.61	0.35	0.04	0.14	0.02
1943	0.20	0.31	0.17	0.30	0.26	0.44	0.81	1.05	0.65	0.50	0.31	-0.05
1944	0.00	-0.06	0.23	0.36	0.32	0.59	0.66	0.76	0.60	0.21	0.11	0.04
1945	0.04	0.01	0.06	0.14	0.62	0.46	0.41	0.68	0.55	0.29	0.37	0.23
1946	-0.12	0.16	0.28	0.46	0.36	0.56	1.01	0.89	0.27	0.38	0.13	-0.02
1947	0.14	0.20	0.14	0.12	-0.09	0.64	0.90	0.94	0.85	0.49	0.12	0.07
1948	0.06	0.04	0.30	0.75	0.35	0.62	0.82	0.93	0.79	0.36	0.41	0.36
1949	-0.15	-0.09	0.36	0.45	-0.36	0.52	1.01	0.60	0.18	0.24	0.37	0.15
1950	0.20	0.02	0.78	0.54	0.12	0.51	0.13	0.12	0.09	0.54	0.39	0.12
1951	0.11	0.04	0.31	0.67	0.38	0.49	0.92	0.74	0.52	0.42	0.18	0.12
1952	0.09	0.15	0.41	0.45	0.49	1.04	0.81	1.00	0.75	0.68	0.17	0.02
1953	0.17	0.17	0.26	0.54	0.72	0.94	0.70	0.41	0.81	-0.07	0.12	0.17
1954	0.13	0.36	0.47	-0.01	-0.07	0.73	0.99	1.01	0.80	0.46	0.24	0.14
1955	0.03	0.17	0.11	0.61	0.34	0.24	0.70	0.77	-0.13	0.29	0.30	0.17
1956	0.09	0.13	0.47	0.63	0.46	0.93	1.06	1.16	0.92	0.37	0.29	0.15
1957	0.10	0.02	0.09	-0.20	-0.16	0.35	0.70	0.65	0.37	-0.05	-0.30	0.15
1958	-0.06	0.06	0.01	0.16	0.18	0.54	0.26	0.58	0.25	0.26	0.21	0.13
1959	0.13	0.18	0.39	0.33	0.14	0.09	0.35	0.56	0.44	-0.01	0.16	-0.05
1960	-0.02	0.10	0.22	0.41	0.27	0.56	0.34	0.55	0.26	-0.13	0.29	-0.11
1961	0.12	0.01	0.06	0.44	0.38	0.17	0.26	0.55	0.05	0.30	-0.02	0.06
1962	0.13	0.25	0.33	0.11	0.73	0.04	0.45	0.44	-0.27	0.15	-0.03	0.06
1963	0.10	0.12	0.23	0.33	0.13	0.36	0.54	0.39	-0.10	0.29	0.06	0.11
1964	0.24	0.09	0.51	0.67	0.62	0.88	1.19	0.85	0.09	0.38	-0.02	0.21
1965	0.09	0.15	0.35	0.51	0.41	0.81	1.22	0.85	0.69	0.14	0.39	0.33
1966	0.06	0.10	0.57	0.23	0.69	0.91	0.93	0.32	0.13	0.48	0.31	0.20
1967	0.26	0.28	0.55	0.15	0.53	0.66	0.57	0.86	0.35	0.51	0.16	0.09
1968	-0.21	0.06	0.18	0.34	0.28	0.62	0.45	0.76	0.57	0.23	-0.02	0.19
1969	0.22	0.05	0.19	0.46	0.24	0.65	1.00	0.57	0.02	0.06	0.21	0.07
1970	0.16	0.16	0.09	0.27	0.65	0.95	1.06	0.88	0.36	0.23	0.37	0.30
1971	0.29	0.29	0.64	0.57	0.63	0.84	0.92	0.19	0.10	0.08	0.23	-0.01
1972	0.19	0.32	0.59	0.48	0.44	0.69	0.84	0.69	0.33	-0.11	0.06	0.23
1973	-0.06	0.15	0.27	0.22	0.61	0.60	0.56	0.68	0.00	0.26	0.25	0.27
1974	0.20	0.38	0.49	0.38	0.55	0.60	0.85	0.51	-0.05	0.18	0.21	0.11
1975	0.12	0.09	0.39	0.44	0.02	0.50	0.27	0.68	0.21	0.50	0.21	0.10
1976	0.25	0.38	0.40	0.21	0.40	0.81	0.64	0.83	0.13	-0.15	0.26	0.22
1977	-0.03	0.25	0.45	0.20	0.27	0.76	0.82	0.29	0.68	0.37	0.27	0.28

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1978	0.06	-0.07	0.43	0.66	0.58	0.94	1.14	0.23	0.35	0.40	0.12	0.18
1979	0.16	0.15	0.19	0.40	0.45	0.53	0.76	0.44	0.54	0.69	0.09	0.07
1980	0.12	0.29	0.47	0.55	0.33	0.94	1.35	1.07	0.21	0.51	0.15	0.11
1981	0.19	-0.06	0.28	0.34	0.37	0.52	1.05	0.72	0.69	-0.02	0.23	0.22
1982	0.15	0.25	0.32	0.48	-0.12	0.10	0.77	0.78	0.61	0.49	0.09	0.11
1983	0.06	0.13	0.19	0.36	0.37	0.30	0.94	0.88	0.61	-0.06	0.15	0.14
1984	0.15	0.29	0.25	0.61	0.74	0.76	0.84	0.55	0.73	0.06	0.09	-0.16
1985	0.12	-0.07	0.11	0.41	0.56	0.46	0.81	0.89	0.64	0.05	0.18	0.14
1986	0.29	0.18	0.31	0.50	0.28	0.16	0.99	0.75	-0.27	-0.14	-0.03	0.08
1987	0.08	0.02	0.26	0.52	0.23	0.52	0.82	0.56	0.41	0.50	0.28	-0.05
1988	0.15	0.25	0.42	0.49	0.83	0.38	0.66	0.85	0.09	0.40	0.30	0.14
1989	0.12	-0.01	0.41	0.69	0.31	0.26	0.74	0.46	0.15	0.53	0.37	0.32
1990	0.10	0.00	0.15	0.05	0.46	0.78	0.67	0.50	0.33	0.42	0.09	0.20
1991	-0.01	0.29	0.54	0.64	0.28	0.34	0.60	0.37	-0.02	0.29	0.20	-0.19
1992	0.00	0.12	0.21	0.34	0.29	-0.06	0.69	0.57	0.41	0.47	-0.15	0.04
1993	0.08	-0.06	0.24	0.49	0.35	0.60	1.13	0.85	0.41	0.14	0.21	0.09
1994	0.21	0.07	0.35	0.58	0.06	0.81	0.75	0.77	0.39	0.06	0.10	0.07
1995	0.19	0.26	0.24	0.45	0.00	0.36	0.74	0.30	0.17	0.60	0.23	0.18
1996	0.22	0.44	0.49	0.76	1.00	0.64	0.92	0.20	-0.04	0.40	-0.01	0.28
1997	0.32	-0.04	0.46	0.15	0.32	0.25	0.99	0.46	0.63	0.29	0.15	-0.01
1998	0.11	0.00	0.17	0.52	0.74	0.88	1.05	0.79	0.61	0.26	0.00	0.12
1999	-0.01	0.18	-0.05	0.24	0.04	0.20	0.67	0.64	0.43	0.25	0.27	0.14
2000	0.24	0.14	0.13	0.24	0.41	0.09	0.56	0.67	0.58	-0.17	-0.06	0.08
2001	-0.03	-0.06	0.04	0.38	0.11	0.69	0.92	0.54	0.30	0.42	0.12	0.17
2002	0.15	0.17	0.18	0.08	0.30	0.31	0.27	0.65	0.41	-0.13	0.23	0.02
2003	0.19	0.11	0.29	0.39	0.25	-0.02	0.79	0.52	0.31	0.45	0.19	0.26
2004	0.06	-0.02	0.18	0.14	0.42	-0.02	0.30	0.32	0.48	0.03	-0.35	0.16
2005	0.05	0.06	0.28	0.45	0.19	0.47	0.42	0.07	0.43	0.15	0.41	0.27
2006	0.38	0.24	0.25	0.38	0.29	0.63	0.77	0.63	0.29	0.08	0.27	0.05
2007	0.05	0.25	-0.03	0.18	-0.18	-0.16	0.38	0.43	0.29	0.48	0.28	0.13
2008	0.23	0.19	0.23	0.34	0.27	0.55	0.70	0.32	0.27	0.22	0.31	0.25
2009	0.22	0.32	0.42	0.17	0.15	0.39	0.42	0.72	0.06	-0.02	0.31	0.05
2010	-0.03	0.06	0.25	0.17	0.17	0.44	0.10	0.67	0.14	0.34	0.38	0.28
2011	0.23	0.25	0.43	0.62	0.48	0.88	1.04	1.03	0.62	0.25	0.25	0.02
2012	0.09	0.17	0.18	0.38	0.40	0.51	0.81	0.58	0.33	0.37	0.39	0.19
2013	0.13	0.15	0.20	0.29	0.23							

Table A-5: Extended Inflows - Lake Kickapoo

-Values are in Acre-Feet per Month-

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1940	1	812	2	4,185	8,827	10,097	4,362	2,864	0	0	3,442	1,012
1941	43	7,438	287	7,375	25,653	26,751	3,059	5,872	4,700	49,797	13,504	2,676
1942	2	3	47	38,866	237	1,567	8	147	506	8,959	4,728	1,527
1943	35	3	2,058	6,872	1,246	1,664	547	0	0	202	0	212
1944	539	2,270	629	155	680	2,356	302	459	205	5,031	503	219
1945	372	1,932	12,001	9,748	108	280	9,937	164	3,150	5,010	0	0
1946	14	772	506	5	0	0	34	675	17,333	2,229	6,713	12,278
1947	0	0	0	2,313	23,688	718	2,610	416	665	2,553	1,230	2,127
1948	406	931	441	0	365	8,919	1,891	763	105	73	192	253
1949	1,503	2,306	1,110	0	11,669	11,950	559	1,143	4,467	3,733	129	362
1950	587	0	0	3,284	16,523	2,446	29,141	49,468	7,428	0	0	0
1951	0	0	188	0	6,798	2,552	282	0	1,964	410	0	0
1952	234	0	0	27	2,762	154	920	1,681	555	604	99	726
1953	0	0	3,071	460	1,209	0	4,859	2,582	456	27,949	1,481	353
1954	93	149	0	3,838	19,805	6,182	0	0	0	0	0	0
1955	0	1,078	1,046	2,131	12,002	19,978	211	0	28,316	8,153	0	0
1956	0	0	0	0	4,564	709	45	0	0	2,105	596	483
1957	0	1,305	2,412	23,124	63,495	12,545	454	0	0	4,074	17,471	0
1958	0	0	288	676	7,880	58	4,504	567	710	0	0	0
1959	0	0	0	0	610	8,630	974	0	639	10,523	0	2,334
1960	1,047	2,658	203	0	870	554	120	0	0	6,910	0	1,948
1961	87	731	2,521	0	2,669	2,242	890	0	2,891	50	1,972	370
1962	0	0	104	1,033	1,624	11,738	1,315	0	17,953	4,436	7,031	10,055
1963	0	0	0	1,738	692	1,601	0	0	196	209	911	0
1964	283	1,735	714	717	1,972	3,618	0	622	8,541	247	2,415	275
1965	379	396	0	1,324	5,201	2,770	0	1,421	843	1,931	204	243
1966	0	0	535	17,685	17,004	0	2,001	6,306	14,281	182	218	0
1967	332	261	200	3,787	551	2,745	2,760	284	2,389	225	603	541
1968	8,646	1,057	10,415	5,669	7,579	2,189	6,236	1,105	0	0	21	1,571
1969	196	2,568	8,093	798	14,062	2,863	757	0	15,076	546	453	1,384
1970	1,462	896	7,702	787	3,953	1,073	0	0	0	0	1,572	0
1971	1,956	0	2,272	972	0	1,837	89	28,345	6,030	3,678	0	2,351
1972	206	586	835	635	7,279	1,628	328	0	0	3,259	12,312	268
1973	3,708	580	5,326	3,251	832	1,237	1,319	3,502	1,122	795	1,107	796
1974	0	1,070	291	581	3,106	4,744	0	625	14,136	4,182	4,653	0
1975	416	1,336	60	1,541	24,157	15,396	3,796	1,098	802	1,604	888	0
1976	0	0	0	0	532	1,858	0	1,386	4,004	6,878	4,179	0
1977	0	0	1,426	5,843	5,701	2,314	78	261	1,201	0	0	0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1978	0	0	0	0	0	346	744	7,961	0	0	0	0
1979	0	0	893	990	5,154	1,635	1,963	1,627	1,653	0	0	0
1980	0	0	306	210	4,067	2,433	0	504	15,939	4,329	891	2,736
1981	386	547	8,843	2,205	0	6,265	173	0	2,331	44,760	0	0
1982	0	0	179	0	50,741	20,635	0	0	0	0	0	0
1983	0	2,685	941	1,297	1,488	4,719	0	0	262	3,376	0	0
1984	0	0	0	0	0	0	0	0	0	2,042	1,647	3,286
1985	6,238	12,021	9,176	31,088	6,886	32,811	170	219	0	2,529	0	137
1986	0	535	561	1,776	4,332	11,126	1,240	0	22,958	6,131	6,614	1,012
1987	3,144	2,807	9,671	0	10,025	3,990	79	529	0	635	0	4,124
1988	2,978	284	209	1,240	0	429	447	0	1,376	0	0	196
1989	0	3,045	883	0	49,193	11,226	0	3,306	24,319	1,743	0	25
1990	2,191	3,642	17,409	30,163	35,668	11,113	0	0	0	0	176	0
1991	1,533	59	49	378	3,451	5,662	0	1,683	2,594	3,836	267	19,696
1992	4,658	9,872	4,023	0	2,393	26,438	5,433	0	2,803	487	5,515	2,497
1993	245	7,874	8,562	2,987	18,594	5,690	366	906	2,479	544	0	4,558
1994	0	0	856	0	7,339	932	2,784	2,368	0	1,773	1,056	342
1995	0	0	0	1,147	15,646	11,842	257	4,526	65	180	0	0
1996	0	31	264	712	0	232	0	663	1,195	0	2,615	135
1997	379	5,784	437	1,373	3,309	2,926	0	0	0	0	0	739
1998	513	2,536	11,317	58	337	1,125	866	523	457	691	969	0
1999	1,431	0	10,599	863	3,964	917	0	0	0	0	0	0
2000	182	157	1,639	276	780	192	1,933	0	0	1,231	13,681	365
2001	2,265	15,431	21,282	955	2,820	101	509	214	0	214	0	51
2002	230	0	1,396	10,840	503	9,671	2,776	0	0	800	884	1,322
2003	305	0	202	264	5,591	4,016	509	212	196	99	0	154
2004	9	1,695	1,847	142	63	383	15,762	0	1,826	5,828	4,699	300
2005	1,587	408	0	0	0	0	22,953	14,558	2,179	6,025	887	10
2006	1,016	435	0	197	0	0	0	574	3,972	443	482	838
2007	93	854	501	3,534	15,317	7,018	1,119	1,713	0	636	119	0
2008	27	454	822	1,212	0	0	305	513	967	192	174	60
2009	132	400	1,244	1,026	6,816	1,237	1,581	96	2,811	1,361	0	1,336
2010	8,268	2,856	1,845	13,783	12,213	33	3,273	0	1,127	383	0	0
2011	0	195	178	275	83	0	142	402	0	3,131	1,674	588
2012	274	20	1,410	881	108	1,342	342	596	2,910	61	61	0
2013	0	0	0	717	0	340	1,409	187	765	0	0	123

Table A-6: Extended Net Evaporation Rate - Lake Kickapoo

-Values are in Feet per Month-

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1940	0.14	0.05	0.47	0.27	0.32	0.29	0.88	0.50	0.60	0.49	-0.03	-0.01
1941	0.07	-0.07	0.17	-0.04	-0.01	0.06	0.56	0.46	0.42	-0.14	0.29	0.15
1942	0.17	0.22	0.34	-0.06	0.45	0.48	0.77	0.60	0.34	0.03	0.37	0.02
1943	0.20	0.29	0.13	0.30	0.23	0.40	0.84	1.04	0.64	0.47	0.31	-0.05
1944	-0.01	-0.09	0.21	0.33	0.28	0.58	0.68	0.75	0.60	0.22	0.06	0.03
1945	0.05	-0.01	0.04	0.12	0.59	0.51	0.39	0.72	0.56	0.30	0.36	0.22
1946	-0.01	0.16	0.23	0.39	0.35	0.57	1.01	0.86	0.27	0.36	0.06	-0.03
1947	0.12	0.20	0.13	0.08	0.02	0.67	0.89	0.96	0.87	0.45	0.11	0.03
1948	0.16	-0.05	0.22	0.47	0.22	0.40	0.74	0.91	0.89	0.46	0.43	0.28
1949	-0.15	0.00	0.19	0.22	-0.01	0.48	0.82	0.63	0.31	0.19	0.37	0.13
1950	0.09	0.16	0.45	0.21	0.00	0.42	0.06	0.57	0.24	0.57	0.45	0.22
1951	0.19	0.09	0.29	0.32	0.10	0.21	0.74	0.83	0.60	0.43	0.22	0.27
1952	0.19	0.24	0.28	0.19	0.26	0.83	0.77	1.31	0.95	0.81	0.19	0.16
1953	0.20	0.20	0.19	0.32	0.47	0.91	0.63	0.57	0.80	0.20	0.22	0.26
1954	0.06	0.30	0.35	0.02	-0.12	0.49	0.69	0.69	0.62	0.34	0.18	0.06
1955	0.01	0.10	0.20	0.41	0.11	0.20	0.60	0.60	0.01	0.33	0.27	0.16
1956	0.09	0.10	0.40	0.43	0.26	0.69	0.79	0.81	0.75	0.23	0.22	0.09
1957	0.07	-0.06	0.10	-0.02	-0.17	0.30	0.60	0.60	0.30	0.00	-0.21	0.15
1958	0.00	0.07	-0.02	0.08	0.15	0.44	0.34	0.50	0.16	0.23	0.17	0.08
1959	0.11	0.14	0.32	0.27	0.06	-0.10	0.23	0.49	0.38	-0.15	0.19	-0.06
1960	-0.03	0.03	0.16	0.24	0.19	0.39	0.22	0.44	0.15	-0.11	0.28	-0.09
1961	0.02	0.00	0.05	0.38	0.23	0.04	0.17	0.45	0.03	0.21	-0.06	0.04
1962	0.13	0.19	0.22	0.08	0.39	-0.06	0.16	0.38	-0.41	0.13	-0.01	0.05
1963	0.10	0.09	0.16	0.13	0.00	0.19	0.37	0.34	0.18	0.23	0.01	0.05
1964	0.09	0.01	0.31	0.39	0.08	0.54	0.86	0.48	0.04	0.35	-0.05	0.16
1965	0.06	0.10	0.22	0.23	0.02	0.46	0.89	0.49	0.31	0.12	0.33	0.25
1966	0.01	0.05	0.37	-0.05	0.42	0.59	0.73	0.07	-0.12	0.42	0.37	0.18
1967	0.26	0.26	0.41	0.13	0.21	0.54	0.45	0.71	0.06	0.38	0.17	0.05
1968	-0.28	0.02	0.05	0.25	0.07	0.40	0.22	0.56	0.39	0.31	-0.02	0.16
1969	0.12	-0.01	0.03	0.25	0.07	0.44	0.78	0.41	-0.08	0.06	0.20	-0.04
1970	0.15	0.04	0.02	0.13	0.39	0.62	0.70	0.60	0.21	0.23	0.33	0.24
1971	0.25	0.18	0.49	0.52	0.38	0.62	0.65	0.00	0.06	0.04	0.18	-0.07
1972	0.14	0.20	0.44	0.32	0.24	0.44	0.60	0.45	0.21	-0.13	0.10	0.18
1973	-0.10	0.04	0.11	0.12	0.36	0.33	0.37	0.63	-0.06	0.11	0.20	0.24
1974	0.15	0.24	0.34	0.29	0.36	0.55	0.71	0.33	-0.22	0.00	0.19	0.06
1975	0.11	0.01	0.20	0.28	-0.24	0.38	0.18	0.39	0.15	0.46	0.15	0.11
1976	0.23	0.39	0.36	0.10	0.16	0.46	0.38	0.56	-0.10	-0.17	0.19	0.14
1977	-0.03	0.18	0.33	0.15	0.04	0.46	0.62	0.36	0.52	0.36	0.24	0.31

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1978	0.07	-0.04	0.22	0.46	0.22	0.50	0.84	0.13	0.25	0.30	0.00	0.19
1979	-0.01	0.09	0.12	0.21	0.12	0.25	0.42	0.33	0.48	0.49	0.18	0.01
1980	0.08	0.11	0.33	0.45	-0.20	0.67	0.98	0.79	-0.04	0.34	0.13	0.06
1981	0.19	0.05	0.17	0.15	0.11	0.23	0.65	0.45	0.39	0.01	0.20	0.17
1982	0.12	0.10	0.21	0.26	-0.37	0.01	0.54	0.56	0.40	0.32	0.10	0.01
1983	0.02	0.04	0.08	0.27	0.06	0.17	0.63	0.65	0.62	0.02	0.15	0.05
1984	0.19	0.22	0.21	0.50	0.42	0.54	0.69	0.50	0.42	-0.11	0.06	-0.13
1985	0.14	-0.04	0.06	0.16	0.28	0.26	0.59	0.66	0.39	-0.01	0.15	0.15
1986	0.29	0.11	0.35	0.21	0.00	0.12	0.67	0.48	0.11	-0.22	0.02	0.00
1987	0.06	-0.10	0.29	0.41	-0.10	0.23	0.58	0.46	0.26	0.46	0.19	-0.15
1988	0.09	0.18	0.23	0.25	0.49	0.26	0.43	0.62	0.03	0.35	0.28	0.16
1989	0.11	-0.08	0.22	0.47	-0.01	0.20	0.56	0.34	0.11	0.42	0.32	0.22
1990	0.06	-0.10	0.03	0.10	0.31	0.60	0.42	0.41	0.14	0.36	0.01	0.07
1991	-0.07	0.25	0.36	0.42	0.25	0.27	0.74	0.41	0.18	0.27	0.27	0.05
1992	0.01	0.04	0.20	0.28	0.14	0.20	0.54	0.47	0.36	0.45	-0.01	0.05
1993	0.07	0.00	0.19	0.26	0.37	0.47	1.02	0.74	0.38	0.29	0.27	0.06
1994	0.14	-0.01	0.27	0.25	0.15	0.76	0.49	0.83	0.28	-0.10	0.15	0.10
1995	0.00	0.00	0.14	0.29	-0.06	0.24	0.48	0.25	0.12	0.49	0.29	0.19
1996	0.19	0.35	0.23	0.47	0.62	0.38	0.59	0.10	-0.07	0.28	-0.14	0.25
1997	0.23	0.04	0.35	0.00	0.17	0.22	0.61	0.38	0.45	0.21	0.20	-0.21
1998	-0.01	0.03	0.28	0.40	0.47	0.61	0.75	0.66	0.63	0.22	0.13	0.08
1999	-0.04	0.15	-0.12	0.24	0.06	0.20	0.63	0.68	0.53	0.25	0.29	0.23
2000	0.32	0.16	0.22	0.19	0.42	0.17	0.61	0.76	0.44	-0.18	-0.22	0.13
2001	-0.04	0.01	0.07	0.37	0.21	0.71	0.92	0.60	0.32	0.37	0.15	0.14
2002	0.16	0.16	0.12	0.08	0.28	0.27	0.17	0.67	0.40	-0.14	0.21	0.00
2003	0.19	0.09	0.29	0.42	0.21	-0.04	0.78	0.53	0.24	0.46	0.17	0.26
2004	0.08	-0.10	0.21	0.15	0.37	-0.09	0.26	0.33	0.48	0.04	-0.33	0.15
2005	0.09	0.05	0.27	0.47	0.24	0.48	0.42	-0.04	0.45	0.10	0.40	0.26
2006	0.34	0.17	0.23	0.36	0.29	0.64	0.81	0.69	0.32	0.09	0.22	0.06
2007	0.02	0.23	0.00	0.19	-0.20	-0.21	0.32	0.55	0.19	0.50	0.26	0.13
2008	0.23	0.19	0.13	0.31	0.26	0.51	0.73	0.32	0.24	0.23	0.31	0.24
2009	0.23	0.31	0.40	0.19	0.25	0.40	0.37	0.74	0.04	-0.07	0.29	0.03
2010	-0.04	0.03	0.23	0.07	0.24	0.43	0.17	0.68	0.07	0.36	0.38	0.20
2011	0.19	0.19	0.43	0.63	0.51	0.79	1.08	1.07	0.64	0.21	0.23	0.01
2012	-0.06	0.13	0.18	0.49	0.45	0.56	0.83	0.53	0.34	0.33	0.38	0.17
2013	0.09	0.10	0.22	0.26	0.19	0.39	0.59	0.55	0.30	0.22	0.17	0.10

Table A-7: Extended Inflows – Lake Olney/Cooper

-Values are in Acre-Feet per Month-

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1948	92	93	42	7	78	457	105	36	0	0	1	13
1949	76	98	53	9	491	514	3	31	164	168	0	15
1950	35	0	0	200	768	108	1,853	3,270	461	0	0	0
1951	0	0	64	30	384	152	23	0	73	2	0	0
1952	7	0	3	52	154	11	16	8	0	0	0	25
1953	0	0	144	26	58	0	221	113	0	1,243	58	9
1954	11	14	0	169	931	307	0	0	8	0	0	42
1955	48	69	39	104	571	923	15	7	1,454	528	0	0
1956	0	5	9	4	228	51	22	7	7	111	25	25
1957	0	61	105	988	4,255	801	27	0	0	173	952	0
1958	0	8	23	35	367	8	183	26	38	0	0	0
1959	0	0	1	0	68	380	55	2	38	463	0	112
1960	39	120	9	3	44	29	13	0	14	300	0	87
1961	9	36	111	7	127	110	45	0	139	6	91	19
1962	0	0	11	51	72	511	63	0	782	175	292	530
1963	0	0	46	89	53	134	0	14	11	6	45	3
1964	14	82	36	38	114	178	1	40	389	8	112	11
1965	19	23	6	67	246	129	11	69	50	88	10	13
1966	0	19	34	786	749	8	90	290	689	15	16	0
1967	45	0	29	187	46	135	149	22	101	5	19	21
1968	416	39	399	257	365	113	326	61	0	2	56	68
1969	6	113	383	53	676	158	56	0	646	27	16	64
1970	65	50	367	53	214	88	42	0	13	15	59	0
1971	53	0	53	22	15	72	25	1,021	276	180	2	119
1972	12	37	54	58	364	104	46	0	57	162	570	0
1973	177	43	262	160	78	101	81	167	68	59	47	42
1974	0	82	17	31	169	227	0	66	674	230	215	6
1975	27	78	12	93	1,132	728	199	82	47	86	51	0
1976	0	24	46	21	113	122	27	97	177	333	200	0
1977	16	41	79	286	306	159	19	14	78	0	9	0
1978	0	0	91	46	41	68	46	408	6	0	0	3
1979	24	31	97	66	270	99	107	98	72	0	0	15
1980	15	54	21	5	240	122	0	60	745	196	41	136
1981	13	28	428	116	20	336	35	0	178	1,229	19	17
1982	20	19	21	25	2,124	1,552	62	38	28	54	0	0
1983	17	153	61	64	110	239	0	41	28	153	0	0
1984	0	0	68	4	0	66	0	37	0	112	75	154
1985	295	606	430	1,763	522	2,337	42	26	0	163	0	14

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1986	0	44	20	100	225	531	77	0	1,428	456	440	66
1987	194	221	637	12	724	530	39	48	38	38	36	220
1988	51	15	35	86	8	55	40	0	86	0	0	10
1989	0	154	48	0	2,913	788	10	181	1,624	87	0	12
1990	96	174	1,245	2,198	2,548	746	37	112	0	0	31	0
1991	104	5	7	15	186	279	0	86	97	176	0	909
1992	288	706	254	11	124	1,818	328	0	157	31	249	109
1993	10	487	598	180	1,247	346	19	29	99	68	23	39
1994	22	38	26	46	134	39	75	52	41	36	35	7
1995	7	9	30	66	743	585	0	274	15	0	0	0
1996	0	17	35	48	0	53	0	33	68	0	74	68
1997	12	267	32	71	184	164	0	142	0	0	0	68
1998	29	136	536	8	64	69	22	30	6	23	49	0
1999	58	3	448	34	132	83	1	2	1	0	6	0
2000	0	1	34	13	94	7	123	0	0	69	576	10
2001	136	890	877	7	67	15	0	1	7	6	0	1
2002	0	1	15	352	19	287	81	3	0	124	50	56
2003	22	0	0	0	302	146	35	33	23	0	0	0
2004	0	41	77	6	2	31	1410	39	0	8	615	21
2005	26	72	13	0	0	10	11	1645	2	764	2	0
2006	0	2	18	0	65	3	0	0	2	75	2	10
2007	26	0	48	39	254	916	260	0	104	0	0	0
2008	0	0	80	7	23	5	4	14	40	58	0	0
2009	0	0	0	78	405	45	70	8	49	36	4	23
2010	173	109	76	1355	1121	8	84	0	57	18	0	1
2011	0	4	0	0	0	0	0	0	0	146	146	8
2012	163	1	24	4	10	19	0	6	110	123	0	0

Table A-8: Extended Net Evaporation Rate – Lake Olney/Cooper

-Values are in Feet per Month-

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1948	0.14	-0.07	0.19	0.43	0.14	0.37	0.76	0.90	0.91	0.48	0.43	0.25
1949	-0.14	-0.03	0.15	0.23	-0.16	0.42	0.84	0.66	0.30	0.13	0.35	0.11
1950	0.07	0.15	0.45	0.17	-0.05	0.43	-0.06	0.27	0.22	0.58	0.45	0.22
1951	0.19	0.07	0.28	0.28	0.03	0.12	0.72	0.88	0.61	0.42	0.19	0.26
1952	0.18	0.22	0.25	0.17	0.22	0.77	0.80	1.36	1.00	0.82	0.16	0.15
1953	0.17	0.20	0.17	0.30	0.42	0.95	0.68	0.63	0.80	0.04	0.21	0.25
1954	0.05	0.28	0.34	-0.08	-0.18	0.42	0.65	0.70	0.59	0.30	0.18	0.06
1955	0.01	0.08	0.15	0.35	0.06	0.14	0.60	0.59	-0.13	0.31	0.26	0.15
1956	0.06	0.07	0.39	0.40	0.21	0.65	0.76	0.80	0.74	0.17	0.18	0.05
1957	0.05	-0.14	0.05	-0.59	-0.56	0.18	0.53	0.59	0.25	-0.03	-0.30	0.11
1958	-0.01	0.08	-0.05	0.02	0.09	0.40	0.33	0.47	0.18	0.23	0.17	0.06
1959	0.10	0.12	0.31	0.29	0.08	-0.16	0.23	0.45	0.35	-0.27	0.18	-0.07
1960	-0.05	0.02	0.13	0.24	0.17	0.41	0.24	0.44	0.11	-0.08	0.28	-0.10
1961	-0.02	0.00	0.04	0.35	0.26	0.08	0.24	0.42	-0.01	0.19	-0.08	0.03
1962	0.12	0.16	0.17	0.02	0.36	-0.18	0.08	0.37	-0.43	0.12	-0.06	0.01
1963	0.09	0.07	0.16	0.07	0.04	0.22	0.35	0.33	0.14	0.16	-0.02	0.04
1964	0.03	0.03	0.28	0.31	-0.01	0.58	0.84	0.43	0.06	0.35	-0.10	0.15
1965	0.03	0.09	0.21	0.23	-0.05	0.41	0.89	0.45	0.29	0.15	0.31	0.24
1966	0.01	0.04	0.34	-0.26	0.36	0.58	0.70	0.06	-0.20	0.41	0.36	0.14
1967	0.24	0.24	0.40	0.15	0.14	0.49	0.51	0.73	-0.02	0.37	0.17	0.05
1968	-0.29	0.02	-0.05	0.23	0.02	0.38	0.22	0.57	0.35	0.28	-0.05	0.14
1969	0.12	-0.03	-0.07	0.18	0.03	0.41	0.72	0.36	-0.08	0.08	0.19	-0.09
1970	0.16	0.00	0.02	0.06	0.32	0.58	0.74	0.60	0.20	0.22	0.34	0.24
1971	0.22	0.17	0.46	0.51	0.41	0.59	0.60	-0.03	0.03	0.05	0.18	-0.13
1972	0.14	0.18	0.43	0.28	0.04	0.43	0.61	0.43	0.24	-0.13	0.10	0.16
1973	-0.12	0.04	0.14	0.04	0.34	0.26	0.24	0.58	-0.06	0.07	0.13	0.23
1974	0.14	0.19	0.32	0.24	0.37	0.57	0.63	0.28	-0.25	-0.03	0.14	0.06
1975	0.10	-0.04	0.18	0.23	-0.41	0.32	0.18	0.37	0.19	0.46	0.18	0.11
1976	0.23	0.38	0.36	0.09	0.11	0.42	0.36	0.54	-0.16	-0.15	0.17	0.11
1977	-0.06	0.17	0.20	0.16	0.09	0.44	0.64	0.35	0.51	0.36	0.22	0.29
1978	0.07	-0.04	0.18	0.40	0.20	0.43	0.83	0.21	0.33	0.29	-0.03	0.19
1979	-0.02	0.09	0.10	0.17	0.09	0.29	0.38	0.32	0.48	0.44	0.18	-0.01
1980	0.07	0.10	0.31	0.42	-0.20	0.68	0.93	0.79	-0.12	0.31	0.11	0.04
1981	0.18	0.03	0.12	0.14	0.08	0.17	0.62	0.49	0.34	-0.64	0.18	0.16
1982	0.13	0.09	0.18	0.24	-0.57	-0.07	0.49	0.58	0.37	0.29	0.05	-0.01
1983	0.04	0.03	0.07	0.25	0.05	0.15	0.62	0.64	0.64	0.09	0.14	0.06
1984	0.19	0.20	0.19	0.50	0.37	0.58	0.71	0.51	0.41	-0.25	0.06	-0.23
1985	0.05	-0.07	-0.12	0.15	0.27	0.12	0.58	0.66	0.38	-0.07	0.12	0.15

1986	0.28	0.10	0.32	0.17	-0.07	0.07	0.67	0.50	0.13	-0.16	-0.03	-0.03
1987	0.03	-0.20	0.20	0.40	-0.10	0.22	0.55	0.44	0.23	0.45	0.16	-0.24
1988	0.09	0.18	0.21	0.23	0.48	0.26	0.44	0.59	0.05	0.33	0.25	0.15
1989	0.08	-0.10	0.17	0.44	-0.37	-0.08	0.54	0.30	0.09	0.39	0.32	0.22
1990	0.04	-0.15	-0.16	-0.29	0.06	0.60	0.40	0.43	0.12	0.36	-0.01	0.07
1991	-0.09	0.24	0.33	0.41	0.27	0.30	0.73	0.41	0.23	0.20	0.25	-0.13
1992	-0.03	0.04	0.18	0.30	-0.09	-0.01	0.50	0.46	0.34	0.44	-0.03	0.03
1993	0.05	-0.05	0.12	0.23	0.19	0.37	1.02	0.73	0.34	0.19	0.28	0.02
1994	0.09	-0.06	0.26	0.17	0.04	0.74	0.59	0.80	0.35	-0.24	0.08	0.08
1995	0.01	0.01	0.07	0.25	-0.10	0.24	0.45	0.27	0.18	0.49	0.30	0.17
1996	0.18	0.32	0.22	0.43	0.60	0.34	0.55	0.12	-0.08	0.21	-0.31	0.19
1997	0.21	-0.19	0.34	0.01	0.04	0.25	0.58	0.38	0.49	0.23	0.19	-0.27
1998	-0.05	0.02	0.14	0.38	0.46	0.64	0.79	0.66	0.62	0.21	0.13	0.04
1999	-0.04	0.15	-0.12	0.24	0.06	0.20	0.63	0.68	0.53	0.25	0.29	0.23
2000	0.32	0.16	0.22	0.19	0.42	0.17	0.61	0.76	0.44	-0.18	-0.22	0.13
2001	-0.04	0.01	0.07	0.37	0.21	0.71	0.92	0.60	0.32	0.37	0.15	0.14
2002	0.16	0.16	0.12	0.08	0.28	0.27	0.17	0.67	0.40	-0.14	0.21	0.00
2003	0.19	0.09	0.29	0.42	0.21	-0.04	0.78	0.53	0.24	0.46	0.17	0.26
2004	0.08	-0.10	0.21	0.15	0.37	-0.09	0.26	0.33	0.48	0.04	-0.33	0.15
2005	0.09	0.05	0.27	0.47	0.24	0.48	0.42	-0.04	0.45	0.10	0.40	0.26
2006	0.34	0.17	0.23	0.36	0.29	0.64	0.81	0.69	0.32	0.09	0.22	0.06
2007	0.02	0.23	0.00	0.19	-0.20	-0.21	0.32	0.55	0.19	0.50	0.26	0.13
2008	0.23	0.19	0.13	0.31	0.26	0.51	0.73	0.32	0.24	0.23	0.31	0.24
2009	0.23	0.31	0.40	0.19	0.25	0.40	0.37	0.74	0.04	-0.07	0.29	0.03
2010	-0.04	0.03	0.23	0.07	0.24	0.43	0.17	0.68	0.07	0.36	0.38	0.20
2011	0.19	0.19	0.43	0.63	0.51	0.79	1.08	1.07	0.64	0.21	0.23	0.01
2012	0.09	0.10	0.22	0.25	0.19	0.38	0.59	0.55	0.30	0.22	0.17	0.10

Table A-9: Extended Inflows – Lake Nocona

-Values are in Acre-Feet per Month-

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1948	573	475	258	48	503	2,660	624	236	0	0	3	84
1949	495	634	344	57	3,053	3,179	16	200	1,064	953	0	94
1950	223	0	0	1,284	4,975	669	8,258	13,649	2,159	0	0	0
1951	0	1	416	194	2,401	977	149	0	470	16	0	0
1952	48	0	21	338	997	72	102	54	0	0	0	164
1953	0	0	935	169	373	0	1,432	730	0	8,036	214	59
1954	68	88	0	1,041	5,654	1,951	0	0	52	0	0	270
1955	310	444	254	676	3,532	5,916	98	47	8,109	2,315	0	0
1956	8	20	41	17	1,287	303	94	35	31	616	165	157
1957	0	333	569	5,478	17,532	3,478	130	0	6	927	4,580	0
1958	3	38	122	188	2,089	42	956	128	201	0	0	0
1959	0	0	9	3	348	2,283	367	9	220	2,670	19	646
1960	138	692	68	12	202	162	75	0	93	1,616	0	534
1961	64	200	535	57	564	570	222	0	764	49	485	109
1962	0	1	49	291	428	2,828	380	0	4,222	915	1,792	2,947
1963	0	0	236	484	268	642	0	61	65	87	263	0
1964	5	30	1	498	509	12	0	166	215	7	593	8
1965	0	5	1	0	1,584	1,166	1	307	69	41	0	0
1966	0	0	213	7,469	1,978	280	0	911	2,410	45	1	0
1967	0	0	0	7	841	3,151	62	0	49	0	0	0
1968	730	42	3,875	42	2,518	372	8	27	24	1	141	7
1969	0	347	3,331	1,289	3,840	23	0	0	110	1	0	627
1970	61	308	844	601	2,849	111	0	0	134	36	0	0
1971	0	0	0	0	0	0	0	532	713	249	0	1,228
1972	0	0	0	322	10,120	127	1	0	67	1,240	1,566	2
1973	901	256	34	2,874	33	2,628	3,532	1,130	255	253	2,719	61
1974	11	180	21	58	240	1	0	0	769	315	1,015	3
1975	36	1,950	332	358	5,827	1,607	589	33	79	0	5	8
1976	0	0	1	462	642	557	13	0	641	1,017	136	8
1977	803	788	4,302	778	214	6	24	448	2	0	0	0
1978	0	0	222	677	73	1,580	0	97	1	0	0	0
1979	16	2	1,136	126	1,107	134	0	0	0	0	0	0
1980	0	1	0	0	263	0	0	0	2,853	151	16	529
1981	0	219	1,203	423	1,995	1,122	0	0	420	25,631	70	16
1982	8	22	49	12	10,112	6,867	248	4	11	153	50	246
1983	54	224	318	845	235	333	4	0	0	968	1	0
1984	0	0	67	0	0	0	0	0	0	2,705	327	4,625
1985	3,551	1,106	8,533	1,361	358	6,392	30	2	0	2,511	14	170

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1986	8	6	4	250	1,966	2,039	2	0	1,748	278	1,358	925
1987	1,410	3,757	5,566	144	1,833	1,426	442	24	11	1	1	2,460
1988	14	24	26	189	11	94	2	0	25	4	2	1
1989	3	321	129	5	12,689	13,244	22	17	691	16	10	2
1990	307	781	7,752	19,218	12,514	1,615	249	118	138	3	137	3
1991	755	6	35	8	578	133	8	10	49	330	264	8,450
1992	2,453	1,486	821	118	10,032	14,197	861	16	37	3	254	824
1993	165	3,261	3,754	260	9,158	3,382	9	16	417	4	1	6
1994	3	67	92	261	4,669	116	9	292	252	171	2,258	575
1995	92	32	457	726	4,514	959	20	1,408	6	1	0	1
1996	2	3	95	15	2	0	0	1	32	8	410	47
1997	2	10,635	150	518	5,902	410	11	3	0	1	0	421
1998	399	110	7,992	100	22	6	0	0	0	0	0	0
1999	0	4	757	863	714	13	0	0	0	0	0	0
2000	0	0	0	1	467	12	6	0	0	145	2,759	1,205
2001	1,337	9,159	5,726	150	52	3	0	0	0	177	0	0
2002	0	0	1	981	0	1,514	15	0	0	40	1	92
2003	15	0	0	0	31	58	0	0	120	0	0	0
2004	0	119	275	2,005	30	93	237	40	0	47	3,311	124
2005	3,748	189	30	0	0	185	0	14	0	0	0	0
2006	0	0	68	2	1,426	0	0	0	17	1	73	445
2007	279	0	2,787	2,006	577	6,531	935	78	5	0	0	0
2008	0	0	1,315	115	16	0	0	0	67	0	0	0
2009	0	0	0	2,497	4,256	0	2	1	4	357	22	90
2010	830	1,524	1,501	2,349	8,409	11	0	0	90	0	0	0
2011	0	5	0	0	0	0	0	0	88	499	338	0
2012	1,293	18	2,417	3,708	0	0	0	0	45	5	0	0
2013	0	0	0	129	0	33	2	0	0	0	0	0

Table A-10: Extended Net Evaporation Rate – Lake Nocona

-Values are in Feet per Month-

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1948	0.04	-0.12	0.11	0.28	0.07	-0.11	0.19	0.42	0.44	0.18	0.17	0.08
1949	-0.04	-0.05	0.05	0.16	-0.38	0.22	0.68	0.33	-0.15	-0.11	0.17	-0.04
1950	-0.02	0.04	0.30	0.15	-0.11	0.11	-0.22	-0.17	-0.06	0.24	0.18	0.10
1951	0.09	0.01	0.21	0.18	0.11	-0.17	0.23	0.44	0.20	0.02	0.03	0.13
1952	0.09	0.11	0.09	0.01	0.04	0.46	0.38	0.68	0.49	0.38	-0.10	0.04
1953	0.18	0.15	0.17	0.25	0.41	0.78	0.17	0.26	0.37	-0.15	-0.03	0.07
1954	0.01	0.16	0.23	-0.06	-0.13	0.19	0.40	0.50	0.33	0.07	0.13	-0.02
1955	-0.02	0.01	0.09	0.40	0.15	0.21	0.63	0.60	0.06	0.31	0.22	0.09
1956	0.03	0.08	0.38	0.41	0.35	0.71	0.66	0.70	0.68	0.09	0.02	-0.05
1957	0.00	-0.04	0.04	-0.12	-0.13	0.28	0.63	0.52	0.16	0.04	-0.32	0.05
1958	-0.06	0.11	-0.04	0.15	0.22	0.37	0.32	0.50	0.34	0.22	0.11	0.06
1959	0.09	0.17	0.33	0.39	0.29	0.01	0.21	0.37	0.26	-0.11	0.18	-0.07
1960	-0.03	0.10	0.07	0.20	0.12	0.32	0.11	0.43	0.04	-0.09	0.20	-0.13
1961	0.04	0.03	0.00	0.26	0.14	0.16	0.24	0.27	-0.01	0.07	-0.10	0.01
1962	0.12	0.15	0.10	0.00	0.29	-0.18	-0.02	0.31	-0.28	0.12	-0.15	0.02
1963	0.08	0.10	0.11	0.07	0.03	0.24	0.24	0.30	0.14	0.16	0.04	0.00
1964	0.03	0.11	0.27	0.34	0.26	0.62	0.86	0.40	0.00	0.34	-0.18	0.13
1965	0.06	0.11	0.21	0.37	0.06	0.22	0.86	0.43	0.36	0.17	0.11	0.10
1966	0.03	0.06	0.34	0.14	0.48	0.66	0.64	0.00	0.07	0.31	0.22	0.08
1967	0.20	0.28	0.47	0.10	0.21	0.34	0.43	0.76	0.01	0.22	0.12	0.06
1968	-0.21	0.06	0.09	0.26	0.06	0.35	0.33	0.53	0.18	0.11	-0.02	0.11
1969	0.10	0.04	0.11	0.26	0.18	0.46	0.76	0.47	0.17	0.06	0.16	-0.05
1970	0.12	0.09	0.08	0.08	0.33	0.54	0.60	0.63	-0.12	0.06	0.22	0.19
1971	0.12	0.16	0.46	0.37	0.37	0.54	0.60	0.08	0.12	-0.01	0.14	-0.12
1972	0.15	0.21	0.50	0.26	0.31	0.60	0.71	0.45	0.25	-0.01	0.03	0.11
1973	-0.08	0.08	0.17	0.12	0.44	0.10	0.13	0.55	-0.11	0.08	-0.06	0.21
1974	0.13	0.24	0.35	0.21	0.49	0.42	0.61	0.24	-0.16	0.01	0.11	0.05
1975	0.11	0.03	0.14	0.28	0.01	0.30	0.31	0.32	0.15	0.40	0.24	0.06
1976	0.30	0.36	0.27	0.06	0.17	0.43	0.41	0.61	0.09	-0.05	0.18	0.08
1977	-0.03	0.18	0.25	0.31	0.34	0.58	0.68	0.36	0.43	0.28	0.19	0.25
1978	0.06	-0.02	0.22	0.38	0.15	0.43	0.88	0.42	0.38	0.33	-0.05	0.17
1979	-0.02	0.12	0.12	0.22	0.25	0.39	0.48	0.29	0.35	0.34	0.19	0.06
1980	0.08	0.18	0.39	0.37	0.11	0.63	0.90	0.90	0.24	0.26	0.10	0.11
1981	0.20	0.06	0.27	0.22	-0.06	0.38	0.59	0.48	0.18	-0.02	0.10	0.20
1982	0.12	0.13	0.23	0.28	-0.16	-0.01	0.37	0.55	0.34	0.11	0.03	0.02
1983	0.06	0.06	0.15	0.23	0.07	0.25	0.53	0.36	0.50	-0.11	0.10	0.08
1984	0.08	0.20	0.15	0.36	0.34	0.46	0.63	0.42	0.40	-0.15	0.08	-0.11
1985	0.06	0.03	0.04	0.21	0.26	0.14	0.61	0.80	0.32	0.03	0.16	0.08

1986	0.22	0.18	0.36	0.12	0.10	0.10	0.92	0.41	0.03	-0.04	-0.13	0.02
1987	0.01	-0.10	0.18	0.44	0.15	0.21	0.53	0.47	0.28	0.37	0.11	-0.17
1988	0.09	0.22	0.32	0.35	0.56	0.30	0.48	0.67	0.04	0.26	0.17	0.06
1989	0.07	0.10	0.20	0.53	0.13	-0.06	0.46	0.52	0.15	0.41	0.31	0.23
1990	0.09	0.08	0.00	0.09	0.32	0.71	0.48	0.48	0.19	0.33	-0.04	0.05
1991	-0.04	0.19	0.43	0.36	0.34	0.34	0.55	0.16	0.01	0.16	0.09	-0.20
1992	-0.07	0.17	0.25	0.28	0.11	0.09	0.43	0.42	0.20	0.35	-0.11	-0.05
1993	-0.01	0.00	0.19	0.36	0.11	0.35	0.83	0.58	0.15	0.10	0.14	0.01
1994	0.14	0.10	0.25	0.35	0.14	0.54	0.27	0.58	0.16	0.06	-0.10	-0.02
1995	0.06	0.23	0.15	0.30	0.04	0.28	0.51	0.41	0.16	0.49	0.28	0.08
1996	0.11	0.37	0.34	0.50	0.69	0.57	0.59	0.11	0.10	0.29	-0.15	0.20
1997	0.26	-0.06	0.29	0.08	0.22	0.15	0.63	0.51	0.45	0.06	0.14	-0.05
1998	-0.08	0.13	0.16	0.38	0.61	0.67	1.02	0.63	0.51	0.10	0.07	0.03
1999	-0.04	0.15	-0.12	0.24	0.06	0.20	0.63	0.68	0.53	0.25	0.29	0.23
2000	0.32	0.16	0.22	0.19	0.42	0.17	0.61	0.76	0.44	-0.18	-0.22	0.13
2001	-0.04	0.01	0.07	0.37	0.21	0.71	0.92	0.60	0.32	0.37	0.15	0.14
2002	0.16	0.16	0.12	0.08	0.28	0.27	0.17	0.67	0.40	-0.14	0.21	0.00
2003	0.19	0.09	0.29	0.42	0.21	-0.04	0.78	0.53	0.24	0.46	0.17	0.26
2004	0.08	-0.10	0.21	0.15	0.37	-0.09	0.26	0.33	0.48	0.04	-0.33	0.15
2005	0.09	0.05	0.27	0.47	0.24	0.48	0.42	-0.04	0.45	0.10	0.40	0.26
2006	0.34	0.17	0.23	0.36	0.29	0.64	0.81	0.69	0.32	0.09	0.22	0.06
2007	0.02	0.23	0.00	0.19	-0.20	-0.21	0.32	0.55	0.19	0.50	0.26	0.13
2008	0.23	0.19	0.13	0.31	0.26	0.51	0.73	0.32	0.24	0.23	0.31	0.24
2009	0.23	0.31	0.40	0.19	0.25	0.40	0.37	0.74	0.04	-0.07	0.29	0.03
2010	-0.04	0.03	0.23	0.07	0.24	0.43	0.17	0.68	0.07	0.36	0.38	0.20
2011	0.19	0.19	0.43	0.63	0.51	0.79	1.08	1.07	0.64	0.21	0.23	0.01
2012	0.09	0.10	0.22	0.25	0.19	0.38	0.59	0.55	0.30	0.22	0.17	0.10
2013	0.06	0.05	0.14	0.16	0.08	0.30	0.53	0.51	0.26	0.15	0.12	0.05

A.2 Sedimentation and Impacts to Reservoir Yields

As shown on Table A-11, there are areas with highly erodible soils in Region B that contribute to the accumulation of sediment, which can significantly impact reservoir storage capacities. Reservoirs with higher sedimentation rates include Lakes Kickapoo, Nocona and Arrowhead. The recent volumetric survey for Lake Kemp shows lower sediment accumulation than previously predicted. This has resulted in greater projected storage over the planning period.

Table A-11: Estimated Sedimentation Rates and Projected Capacities

Reservoir	Drainage Area (Sq mi)	Sediment Rate (af/yr/sq mi)	Year of Initial Capacity	Capacities (Ac-ft)			Source (sediment rate)
				Initial	2010	2070	
Lake Kemp	2086	1.02	1922[1]	(1)	221,929	126,790	TWDB, 2006
Lake Kickapoo	275	1.07	1946	106,000	86,345	69,644	TWDB, 2013
Lake Arrowhead	832	0.87	1966	262,100	230,359	189,262	TWDB 2013
Olney/Cooper	12.3	0.68	1935/1953	6,650	6,165	5,580	TBWE 1959
Lake Nocona	94	0.94	1961	25,400	21,819	19,112	TWDB, 2002

1. The capacity of Lake Kemp in 1922 was estimated 560,000 ac-ft at elevation 1153ft. There are multiple datum references used over time for estimates of reservoir volume. In 1973 the USACE estimated the volume of the lake at 268,000 ac-ft at the current conservation elevation of 1144 ft msl. The sediment rate shown considers the full record of data.

A.3 Reservoir Water Rights

Water rights for reservoirs located in Region B are summarized on Table A-12. Comparisons of rights to firm yields indicate that water rights for several of the reservoirs in Region B exceed firm yield. The current firm yield of Lake Kemp is about 30 percent of the total permitted diversion. The firm yields for Lakes Amon Carter and Wichita System are about half of the permitted diversions.

Table A-12: Summary of Reservoir Water Rights

Reservoir	Water Right No.	Priority Date	Holder	Water Right Amount (acre-feet/year)						2020 Yield[2] (ac-ft/yr)
				Mun	Ind	Irr	Mining	Rec	Total	
Kemp/ Diversion	5123	10/2/20	Wichita Co WID#2 Wichita Falls	25,150	40,000	120,000[1]	2,000	5,850	193,000[1]	57,677
Santa Rosa	5124	6/30/26	W.T. Waggoner Estate			3,075			3,075	3,075
Electra	5128 5128	3/29/49 2/25/74	City of Electra Emergency supply	600 800					600 800	454 0
Kickapoo	5144	6/21/44	Wichita Falls	40,000					40,000	
Arrowhead	5150	6/20/62	Wichita Falls	45,000					45,000	37,734
Olney/ Cooper	5146	3/26/53	City of Olney	1,260					1,260	780
N.F. Buffalo Creek	5131	9/19/62	City of Iowa Park	840					840	840
Iowa Park/ Lake Gordon	5132 5133	8/3/49 11/22/38	City of Iowa Park	500 300					800	555
Nocona	4879	10/9/58	North Montague Co. WSD	1,080		100		80	1,260	1,260
Amon Carter	3320	7/12/54	City of Bowie	3,500	1,300		200		5,000	2,014

Mun – Municipal Use Ind – Industrial Use Irr – Irrigation Use Rec – Recreational Use

1. Water right 5123 includes the ability to divert 16,660 acre-feet per year of the permitted 120,000 acre-feet per year directly from the river for irrigation. This portion of the right was evaluated as a run-of-the-river right and is also shown in Table A-13.
2. Yield reported is the firm yield as determined for this plan.

Source: Texas Commission on Environmental Quality, Water Rights Database, 2014.

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A.4 Run-of-the-River Supplies

Portions of three river basins are located in Region B. The Red River and its tributaries represent the largest river system, flowing across the central and northern areas of the region. The Brazos River flows through the southern portion of King and Baylor Counties, and the upper tributaries of the Trinity River lie in southwest Montague County.

The Red River forms the northern boundary of Region B and flows eastward along the Texas – Oklahoma border. Major tributaries within the region include the Pease River, Wichita River and Little Wichita River. High concentrations of total dissolved solids, sulfate and chloride are concerns for the upper reaches of these streams during low flow conditions. Naturally occurring salt springs, seeps and gypsum outcrops are found in the area westward of Wichita County to the High Plains Caprock Escarpment in the Panhandle Region Planning Area. As a result water from these rivers in Cottle, Foard, King, Hardeman and parts of Baylor and Wilbarger Counties is generally not used or is restricted to irrigation use only. The quality of the water gradually improves downstream toward the eastern portion of the region.

Table A-13 includes a list of the run-of-river water rights within Region B. The total available supplies from the run-of-the-river diversions are shown by use type, county and basin in Table A-14. These supplies were determined using the TCEQ Water Availability Models (WAM) Run 3 and were aggregated by county and use type. The available supply represents the minimum annual diversion over the historical record in the respective model. This is considered a reasonable approach to reliable supplies for these water rights given the monthly time-step of the WAM and the uncertainty of the diversions. Some of these rights include storage and may also be supplemented with other sources of water, such as groundwater. There is no direct connection between the aggregated water demand by county and an individual water right. Therefore, evaluating water reliability as if such direct relationship existed is not practical.

Table A-13: Summary of Run of the River Water Rights

Water Right	County	Permitted Amount (acre-feet/year)	Use Type	Owner
Red River				
5143	Clay	200	Irrigation	Joe J. Parker
Little Wichita River				
4268	Clay	3,600	Irrigation	A.L. Rhodes
5147	Archer	30	Irrigation	Joy Graham
5152	Clay	1,560	Municipal	City of Henrietta
5153	Clay	50	Irrigation	Clay County Country Club Inc.
5154	Clay	15	Irrigation	Johnnie H. Shaw
Wichita River				
4433	Wichita	300	Irrigation	Alvin & Nana Robertson
5123	Wichita	16,660	Irrigation	WCWID #2
5135	Clay	357	Irrigation	Eagle Farms, Inc.
5136	Clay	200	Irrigation	Joe L. Hale Estate
5138	Clay	55	Irrigation	M.E. McBride
5139	Clay	30	Irrigation	Bob Brown
5140	Clay	270	Industrial	Red River Feed Yard, Inc.
5530	Wichita	32	Irrigation	Joe L. Burton
Beaver Creek				
5125	Wilbarger	675	Irrigation	W.T. Waggoner Estate
5126	Wilbarger	60	Municipal	W.T. Waggoner Estate
5127	Wilbarger	85	Municipal, Mining	W.T. Waggoner Estate
5129	Wichita	404	Irrigation	Harry L. Mitchell
5393	Wichita	450	Irrigation	James Brockriede
5128[1]	Wilbarger	800	Municipal	City of Electra
Groesbeck Creek				
5225	Hardeman	96	Irrigation	Hunter Brothers
5226	Hardeman	60	Irrigation	FW Howard Jr.
5227	Hardeman	100	Irrigation	FW Howard Jr. & Wife
5228	Hardeman	63	Irrigation	BJ Howard & Wife
5231	Hardeman	41	Irrigation	Garland Welborn
Antelope Creek				
5130	Wichita	40	Irrigation	Hulen J. Cook Jr. Et Al
Big Mineral Creek				
5113	Wilbarger	150	Irrigation	James David Belew & Wife
Sherwood				
5238	Wilbarger	160	Irrigation	Joyce Virginia Chapman
Devils Creek				
5112	Hardeman	45	Irrigation	Texas Parks & Wildlife Dept.
Armand Bayou				
5230	Hardeman	16	Irrigation	AEP Texas North Company
Belknap				
4874	Clay	30	Irrigation	Herschel H. Studdard
4875	Montague	133	Irrigation	Clarice Benton Whiteside
Frog Creek				
5142	Clay	200	Irrigation	Joe J. Parker
Long Creek				
5109	Clay	200	Irrigation	A D Hanna
Mesquite Creek				
5146	Archer	35	Irrigation	City of Olney
Deep Draw				
5605	Montague	100	Irrigation	Jerry D. Nunneley
Pease Creek				
5111	Cottle	23	Irrigation	John E. Isbell Jr. & Wife

Table A-14: Run of the River WAM Availability by County and Use Type

Use Type	County	Basin	Available Supply (ac-ft/yr)
Irrigation	Archer	Red	7
Irrigation	Baylor	Red	0
Irrigation	Baylor	Brazos	17
Irrigation	Clay	Red	2,429
Irrigation	Cottle	Red	13
Irrigation	Hardeman	Red	148
Irrigation	Montague	Red	108
Irrigation	Wichita	Red	351
Irrigation	Wichita	Red	8,850
Irrigation	Wilbarger	Red	825
Municipal	Clay	Red	0
Municipal	Archer	Red	278
Municipal	Clay	Red	107
Municipal	Clay	Red	1,450
Municipal-	Wichita	Red	555
Municipal	Montague	Trinity	0
Municipal	Wilbarger	Red	115
Industrial	Clay	Red	127
Mining	Clay	Red	1
Mining	Montague	Red	0
Mining	Wilbarger	Red	30
Total Run of River			**15,411**

APPENDIX B

WUG SUMMARY TABLES

2016 FINAL PLAN

REGION B

DECEMBER 2015

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WUG SUMMARY TABLES
MULTIPLE COUNTY

Water User Group:	Wichita Valley WSC - Archer and Wichita Counties					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population - Archer	2,473	2,587	2,618	2,618	2,618	2,618
Population - Wichita	3,395	3,519	3,616	3,684	3,749	3,804
Population - Total (number of persons)	**5,868**	**6,106**	**6,234**	**6,302**	**6,367**	**6,422**
Water Demand - Archer (ac-ft/yr)	291	293	288	284	283	283
Water Demand - Wichita (ac-ft/yr)	400	399	398	399	405	411
Water Demand - Total (ac-ft/yr)	**691**	**692**	**686**	**683**	**688**	**694**
Current Supply - treated and raw - Wichita Falls (ac-ft/yr)	580	561	544	527	508	489
Current Supply - sales from Iowa Park (Wichita System) (ac-ft/yr)	346	335	324	314	303	292
Current Supply - sales from Archer City (Wichita System) (ac-ft/yr)	21	20	19	19	18	17
Total Current Supply	**947**	**916**	**888**	**859**	**829**	**799**
Supply - Archer County	411	400	383	369	352	336
Supply - Wichita County	536	516	504	491	477	462
Supply - Demand (ac-ft/yr)	256	224	202	176	141	105

Water User Group:	Dean Dale SUD - Clay and Wichita Counties					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population - Clay	2,262	2,333	2,333	2,333	2,333	2,333
Population - Wichita	1,121	1,161	1,193	1,216	1,237	1,256
Population - Total (number of persons)	**3,383**	**3,494**	**3,526**	**3,549**	**3,570**	**3,589**
Demand - Clay	172	167	160	157	157	157
Demand - Wichita	86	84	82	82	84	85
Water Demand (ac-ft/yr)	**258**	**251**	**242**	**239**	**241**	**242**
Current Supply - Contracts w/ Wichita Falls (ac-ft/yr)	237	229	222	215	207	200
Current Supply - Seymour Aquifer (ac-ft/yr)	0	0	0	0	0	0
Total Current Supply	**237**	**229**	**222**	**215**	**207**	**200**
Current Supply - Clay County	158	152	147	141	135	130
Current Supply - Wichita County	79	77	75	74	72	70
Supply - Demand (ac-ft/yr)	-21	-22	-20	-24	-34	-42

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WUG SUMMARY TABLES
MULTIPLE COUNTY

Water User Group:	**Windthorst WSC - Archer and Clay Counties**					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population - Archer	1,062	1,111	1,124	1,124	1,124	1,124
Population - Clay	233	240	240	240	240	240
Population - Total (number of persons)	**1,295**	**1,351**	**1,364**	**1,364**	**1,364**	**1,364**
Demand - Archer	317	327	327	325	324	324
Demand - Clay	70	71	70	70	70	70
Water Demand (ac-ft/yr)	**387**	**398**	**397**	**395**	**394**	**394**
Current Supply - Contracts w/ Wichita Falls (ac-ft/yr)	215	208	202	195	188	182
Total Current Supply	**215**	**208**	**202**	**195**	**188**	**182**
Current Supply - Archer County	176	171	166	161	155	149
Current Supply - Clay County	39	37	36	34	33	33
Supply - Demand (ac-ft/yr)	-172	-190	-195	-200	-206	-212

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WUG SUMMARY TABLES
ARCHER COUNTY

Water User Group:	Archer City - Archer					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population	1,834	1,834	1,834	1,834	1,834	1,834
Water Demand (ac-ft/yr)	280	271	264	260	259	259
Current Supply - contract w/ Wichita Falls (ac-ft/yr)	152	147	142	138	133	128
Current Supply - Archer City Lake (ac-ft/yr)	0	0	0	0	0	0
Supply - Demand (ac-ft/yr)	-128	-124	-122	-122	-126	-131
Required Safe Supply (ac-ft/yr)	336	325	317	312	311	311
Safe Supply Shortage (ac-ft/yr)	-184	-178	-175	-174	-178	-183

Water User Group:	County-Other - Archer					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	424	255	208	208	208	208
Water Demand (ac-ft/yr)	74	44	36	36	36	36
Current Supply - contracts w/ Wichita Falls (ac-ft/yr)	43	42	40	39	38	36
Current supply - Lake Megargel	0	0	0	0	0	0
Other Aquifer	135	135	135	135	135	135
Supply - Demand (ac-ft/yr)	104	133	139	138	137	135
Required Safe Supply (ac-ft/yr)	89	53	43	43	43	43
Safe Supply Shortage (ac-ft/yr)	**89**	**124**	**132**	**131**	**129**	**128**

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Water User Group:	Holliday - Archer					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	1,982	2,257	2,330	2,330	2,330	2,330
Water Demand (ac-ft/yr)	285	314	318	315	314	314
Current Supply - Wichita Falls (ac-ft/yr)	175	187	183	176	169	163
Supply - Demand (ac-ft/yr)	-110	-127	-135	-139	-145	-151
Required Safe Supply (ac-ft/yr)	342	377	382	378	377	377
Safe Supply Shortage (ac-ft/yr)	-167	-190	-198	-202	-208	-214

Water User Group:	Lakeside City - Archer					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	1,021	1,050	1,058	1,058	1,058	1,058
Water Demand (ac-ft/yr)	136	135	133	131	130	130
Current Supply - Wichita Falls (ac-ft/yr)	92	89	86	83	80	77
Supply - Demand (ac-ft/yr)	-44	-46	-47	-48	-50	-53
Required Safe Supply (ac-ft/yr)	163	162	160	157	156	156
Safe Supply Shortage (ac-ft/yr)	**-71**	-73	**-74**	**-74**	-76	-79

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Water User Group:	Scotland -Archer					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	613	751	788	788	788	788
Water Demand (ac-ft/yr)	216	261	271	271	270	270
Current Supply- Wichita Falls System (ac-ft/yr)	104	100	97	94	91	87
Supply - Demand (ac-ft/yr)	-112	-161	-174	-177	-179	-183
Required Safe Supply (ac-ft/yr)	259	313	325	325	324	324
Safe Supply Shortage (ac-ft/yr)	-156	-213	-228	-231	-233	-237

Water User Group:	Wichita Valley WSC - Archer					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	2,473	2,587	2,618	2,618	2,618	2,618
Water Demand (ac-ft/yr)	291	293	288	284	283	283
Current Supply- Wichita Falls System (Sales from Wichita Falls, Iowa Park, and Archer City) (ac-ft/yr)	411	400	383	369	352	336
Supply - Demand (ac-ft/yr)	120	107	95	85	69	53
Required Safe Supply (ac-ft/yr)	349	352	346	341	340	340
Safe Supply Shortage (ac-ft/yr)	61	48	38	28	12	-3

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WUG SUMMARY TABLES
ARCHER COUNTY

Water User Group:	Windthorst WSC - Archer					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	1,062	1,111	1,124	1,124	1,124	1,124
Water Demand (ac-ft/yr)	317	327	327	325	324	324
Current Supply - raw water - Wichita Falls (ac-ft/yr)	176	171	166	161	155	149
Supply - Demand (ac-ft/yr)	-141	-156	-161	-164	-169	-175
Required Safe Supply (ac-ft/yr)	380	392	392	390	389	389
Safe Supply Shortage (ac-ft/yr)	-204	-221	-226	-229	-234	-240

Water User Group:	Irrigation - Archer					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	1,214	1,178	1,142	1,106	1,106	1,106
Current Supply- Lake Kemp (ac-ft/yr)	719	643	568	495	429	363
Current Supply- Run-of-river	7	7	7	7	7	7
Supply - Demand (ac-ft/yr)	-489	-529	-568	-605	-671	-737

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ARCHER COUNTY

Water User Group:	Livestock - Archer					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	2,096	2,096	2,096	2,096	2,096	2,096
Current Supply stock ponds (ac-ft/yr)	1,800	1,800	1,800	1,800	1,800	1,800
Current Supply - Other Aquifer	300	300	300	300	300	300
Current Supply Lake Kemp/Diversion (Dundee Fish Hatchery)	489	442	396	349	303	256
Supply - Demand (ac-ft/yr)	493	446	400	353	307	260

Water User Group:	Manufacturing - Archer					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	1	1	1	1	1	1
Current Supply - Other Aquifer (ac-ft/yr)	1	1	1	1	1	1
Supply - Demand (ac-ft/yr)	0	0	0	0	0	0

Water User Group:	Mining - Archer					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	405	483	344	279	213	213
Current Supply - Other Aq (ac-ft/yr)	150	150	150	150	150	150
Supply - Demand (ac-ft/yr)	-255	-333	-194	-129	-63	-63

Water User Group:	County-Other - Baylor					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	986	986	986	986	986	986
Water Demand (ac-ft/yr)	131	126	122	122	121	121
Current Supply - Seymour Aquifer (ac-ft/yr)	150	150	150	150	150	150
Current Supply - Other Aquifer (ac-ft/yr)	45	45	45	45	45	45
Current Supply - Milllers Creek Lake - Sales from North Central Texas MWA (ac-ft/yr)	147	147	119	89	60	28
Supply - Demand (ac-ft/yr)	211	216	192	162	134	102
Required Safe Supply (ac-ft/yr)	157	151	146	146	145	145
Safe Supply Shortage (ac-ft/yr)	185	191	168	138	110	78

Water User Group:	Irrigation - Baylor					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	3,310	3,211	3,112	3,018	3,018	3,018
Current Supply - Run-of-river	17	17	17	17	17	17
Current Supply - Seymour Aquifer (ac-ft/yr)	2,905	2,882	2,882	2,882	2,882	2,882
Supply - Demand (ac-ft/yr)	-388	-312	-213	-119	-119	-119

Water User Group:	Livestock - Baylor					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	1,184	1,184	1,184	1,184	1,184	1,184
Current Supply Stock ponds (ac-ft/yr)	899	899	899	899	899	899
Current Supply - Seymour Aquifer	140	140	140	140	140	140
Current Supply - Other Aquifer	15	15	15	15	15	15
Supply - Demand (ac-ft/yr)	-130	-130	-130	-130	-130	-130

Water User Group:	Mining - Baylor					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	14	14	13	13	13	13
Current Supply - Seymour Aquifer (ac-ft/yr)	15	15	15	15	15	15
Supply - Demand (ac-ft/yr)	1	1	2	2	2	2

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WUG SUMMARY TABLES
BAYLOR COUNTY

Water User Group:	Seymour - Baylor					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	2,740	2,740	2,740	2,740	2,740	2,740
Water Demand (ac-ft/yr)	496	481	471	470	469	469
Current Supply - Seymour Aquifer (ac-ft/yr)	600	600	600	600	600	600
Supply - Demand (ac-ft/yr)	104	119	129	130	131	131
Required Safe Supply (ac-ft/yr)	595	577	565	564	563	563
Safe Supply Shortage (ac-ft/yr)	5	23	35	36	37	37

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WUG SUMMARY TABLES
CLAY COUNTY

Water User Group:	County-Other - Clay					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	4,688	4,835	4,835	4,835	4,835	4,835
Water Demand (ac-ft/yr)	577	574	557	548	547	547
Current Supply - Contracts w/ Wichita Falls (ac-ft/yr)	213	206	199	193	186	179
Current Supply - Seymour Aquifer (ac-ft/yr)	55	55	55	55	55	55
Current Supply - Other Aquifer (ac-ft/yr)	375	375	375	375	375	375
Supply - Demand (ac-ft/yr)	**66**	**62**	**72**	**75**	**69**	**62**
Required Safe Supply (ac-ft/yr)	692	689	668	658	656	656
Safe Supply Surplus/(Shortage) (ac-ft/yr)	**-50**	**-53**	**-39**	**-35**	**-40**	**-47**

Water User Group:	Dean Dale SUD - Clay					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	2,262	2,333	2,333	2,333	2,333	2,333
Water Demand (ac-ft/yr)	172	167	160	157	157	157
Current Supply - Contracts w/ Wichita Falls (ac-ft/yr)	158	152	147	141	135	130
Current Supply - Seymour Aquifer (ac-ft/yr)	0	0	0	0	0	0
Supply - Demand (ac-ft/yr)	-14	-15	-13	-16	-22	-27
Required Safe Supply (ac-ft/yr)	206	200	192	188	188	188
Safe Supply Surplus/(Shortage) (ac-ft/yr)	-48	-48	-45	-47	-53	-58

APPENDIX B
WUG SUMMARY TABLES
CLAY COUNTY

Water User Group:	Henrietta - Clay					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	3,259	3,361	3,361	3,361	3,361	3,361
Water Demand (ac-ft/yr)	652	657	645	638	637	637
Current Supply - Run-of-river (ac-ft/yr)	1,090	1,090	1,090	1,090	1,090	1,090
Supply - Demand (ac-ft/yr)	438	433	445	452	453	453
Required Safe Supply (ac-ft/yr)	782	788	774	766	764	764
Safe Supply Surplus/(Shortage) (ac-ft/yr)	307	301	316	324	325	325

Water User Group:	Irrigation - Clay					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population						
Water Demand (ac-ft/yr)	1,438	1,400	1,362	1,324	1,324	1,324
Current Supply - Lake Kemp (ac-ft/yr)	59	55	50	45	39	33
Current supply - Run-of-river	300	300	300	300	300	300
Current Supply - Seymour Aquifer (ac-ft/yr)	500	500	500	500	500	500
Current Supply - Other Aquifer (ac-ft/yr)	600	600	600	600	600	600
Supply - Demand (ac-ft/yr)	**21**	**55**	**88**	**121**	**115**	**109**

Water User Group:	Livestock - Clay					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population						
Water Demand (ac-ft/yr)	2,092	2,092	2,092	2,092	2,092	2,092
Current Supply Stock Ponds (ac-ft/yr)	1,872	1,872	1,872	1,872	1,872	1,872
Current Supply Other Aquifer - Red (ac-ft/yr)	200	200	200	200	200	200
Current Supply Seymour Aquifer (ac-ft/yr)	20	20	20	20	20	20
Supply - Demand (ac-ft/yr)	0	0	0	0	0	0

Water User Group:	Mining - Clay					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population						
Water Demand (ac-ft/yr)	613	786	584	471	357	357
Current Supply Red Run-of-River	1	1	1	1	1	1
Current Supply Other Aquifer	785	785	600	500	400	400
Current Supply Seymour Aquifer (ac-ft/yr)	0	0	0	0	0	0
Supply - Demand (ac-ft/yr)	173	0	17	30	44	44

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CLAY COUNTY

Water User Group:	Petrolia - Clay					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	712	734	734	734	734	734
Water Demand (ac-ft/yr)	68	67	64	64	63	63
Current Supply - Lake Petrolia (ac-ft/yr)	67	67	67	67	67	67
Current Supply - Seymour Aquifer (ac-ft/yr)	30	30	30	30	30	30
Supply - Demand (ac-ft/yr)	29	30	33	33	34	34
Required Safe Supply (ac-ft/yr)	82	80	77	77	76	76
Safe Supply Shortage (ac-ft/yr)	15	17	20	20	21	21

Water User Group:	Windthorst WSC - Clay					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	233	240	240	240	240	240
Water Demand (ac-ft/yr)	70	71	70	70	70	70
Current Supply - Sales Wichita Falls (ac-ft/yr)	39	37	36	34	33	33
Supply - Demand (ac-ft/yr)	-31	-34	-34	-36	-37	-37
Required Safe Supply (ac-ft/yr)	84	85	84	84	84	84
Safe Supply Surplus/(Shortage) (ac-ft/yr)	-45	-48	-48	-50	-51	-51

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WUG SUMMARY TABLES
COTTLE COUNTY

Water User Group:	County-Other - Cottle					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	328	328	328	328	328	328
Water Demand (ac-ft/yr)	46	44	43	43	43	43
Current Supply Other Aquifer (ac-ft/yr)	200	200	200	200	200	200
Supply - Demand (ac-ft/yr)	154	156	157	157	157	157
Required Safe Supply (ac-ft/yr)	55	53	52	52	52	52
Safe Supply Shortage (ac-ft/yr)	145	147	148	148	148	148

Water User Group:	Irrigation - Cottle					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population						
Water Demand (ac-ft/yr)	4,004	3,884	3,767	3,655	3,655	3,655
Current Supply Blaine Aquifer (ac-ft/yr)	2,400	2,400	2,400	2,400	2,400	2,400
Current Supply Other Aquifer (ac-ft/yr)	1,600	1,500	1,400	1,300	1,300	1,300
Current Supply Run of River (ac-ft/yr)	13	13	13	13	13	13
Supply - Demand (ac-ft/yr)	9	29	46	58	58	58

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WUG SUMMARY TABLES
COTTLE COUNTY

Water User Group:	Livestock - Cottle					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population						
Water Demand (ac-ft/yr)	544	544	544	544	544	544
Current Supply Blaine Aquifer (ac-ft/yr)	250	250	250	250	250	250
Current Supply Stock Ponds (ac-ft/yr)	294	294	294	294	294	294
Supply - Demand (ac-ft/yr)	0	0	0	0	0	0

Water User Group:	Mining - Cottle					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population						
Water Demand (ac-ft/yr)	41	41	38	34	31	31
Current Supply Blaine Aquifer (ac-ft/yr)	41	41	38	34	31	31
Supply - Demand (ac-ft/yr)	0	0	0	0	0	0

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WUG SUMMARY TABLES
COTTLE COUNTY

Water User Group:	Paducah - Cottle					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population	1,224	1,224	1,224	1,224	1,224	1,224
Water Demand (ac-ft/yr)	297	290	289	289	288	288
Current Supply - Blaine Aquifer (ac-ft/yr)	494	494	494	494	494	494
Supply - Demand (ac-ft/yr)	197	204	205	205	206	206
Required Safe Supply (ac-ft/yr)	356	348	347	347	346	346
Safe Supply Shortage (ac-ft/yr)	138	146	148	148	149	149

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WUG SUMMARY TABLES
FOARD COUNTY

Water User Group:	County-Other - Foard					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	403	406	406	406	406	406
Water Demand (ac-ft/yr)	75	73	72	72	72	72
Current Supply Greenbelt Reservoir (ac-ft/yr)	50	50	50	50	50	50
Current Supply Seymour Aquifer (ac-ft/yr)	35	35	35	35	35	35
Supply - Demand (ac-ft/yr)	10	12	13	13	13	13
Required Safe Supply (ac-ft/yr)	90	88	86	86	86	86
Safe Supply Shortage (ac-ft/yr)	-5	-3	-1	-1	-1	-1

Water User Group:	Crowell - Foard					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	986	995	995	995	995	995
Water Demand (ac-ft/yr)	138	134	132	131	131	131
Current Supply Greenbelt Reservoir (ac-ft/yr)	138	134	132	131	131	131
Supply - Demand (ac-ft/yr)	0	0	0	0	0	0
Required Safe Supply (ac-ft/yr)	166	161	158	157	157	157
Safe Supply Shortage (ac-ft/yr)	-28	-27	-26	-26	-26	-26

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WUG SUMMARY TABLES
FOARD COUNTY

Water User Group:	Irrigation - Foard					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	3,939	3,820	3,706	3,595	3,595	3,595
Current Supply Seymour Aquifer (ac-ft/yr)	4,511	4,511	4,511	4,511	4,511	4,511
Current Supply Blaine Aquifer (ac-ft/yr)	0	0	0	0	0	0
Supply - Demand (ac-ft/yr)	572	691	805	916	916	916

Water User Group:	Livestock - Foard					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	399	399	399	399	399	399
Current Supply Seymour Aquifer (ac-ft/yr)	8	8	8	8	8	8
Current Supply Blaine Aquifer (ac-ft/yr)	23	23	23	23	23	23
Current Supply Stock Ponds (ac-ft/yr)	368	368	368	368	368	368
Supply - Demand (ac-ft/yr)	0	0	0	0	0	0

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WUG SUMMARY TABLES
FOARD COUNTY

Water User Group:	Mining - Foard					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	12	12	12	12	11	11
Current Supply Other Aquifer (ac-ft/yr)	12	12	12	12	11	11
Supply - Demand (ac-ft/yr)	0	0	0	0	0	0

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WUG SUMMARY TABLES
HARDEMAN COUNTY

Water User Group:	Chillicothe - Hardeman					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	731	749	755	770	778	784
Water Demand (ac-ft/yr)	65	63	60	61	62	62
Current Supply Greenbelt Reservoir (ac-ft/yr)	65	63	60	61	62	62
Current Supply Seymour Aquifer (ac-ft/yr)	45	45	45	45	45	45
Supply - Demand (ac-ft/yr)	45	45	45	45	45	45
Required Safe Supply (ac-ft/yr)	78	76	72	73	74	74
Safe Supply Shortage (ac-ft/yr)	32	32	33	33	33	33

Water User Group:	County-Other - Hardeman					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	815	837	844	861	869	876
Water Demand (ac-ft/yr)	130	129	127	129	130	131
Current Supply Greenbelt Reservoir (ac-ft/yr)	60	60	60	60	60	60
Current Supply Seymour Aquifer (ac-ft/yr)	80	80	80	80	80	80
Supply - Demand (ac-ft/yr)	10	11	13	11	10	9
Required Safe Supply (ac-ft/yr)	156	155	152	155	156	157
Safe Supply Shortage (ac-ft/yr)	-16	-15	-12	-15	-16	-17

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WUG SUMMARY TABLES
HARDEMAN COUNTY

Water User Group:	Irrigation - Hardeman					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	7,939	7,701	7,470	7,246	7,246	7,246
Current Supply Blaine Aquifer (ac-ft/yr)	5,050	5,050	5,050	5,050	5,050	5,050
Current Supply Run-of-river	148	148	148	148	148	148
Current Supply Seymour Aquifer (ac-ft/yr)	250	250	250	250	250	250
Supply - Demand (ac-ft/yr)	-2,491	-2,253	-2,022	-1,798	-1,798	-1,798

Water User Group:	Livestock - Hardeman					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	631	631	631	631	631	631
Current Supply Seymour Aquifer (ac-ft/yr)	55	55	55	55	55	55
Current Supply Blaine Aquifer (ac-ft/yr)	136	136	136	136	136	136
Current Supply Other Aquifer (ac-ft/yr)	40	40	40	40	40	40
Current Supply Stock Ponds (ac-ft/yr)	400	400	400	400	400	400
Supply - Demand (ac-ft/yr)	0	0	0	0	0	0

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WUG SUMMARY TABLES
HARDEMAN COUNTY

Water User Group:	Manufacturing - Hardeman					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	276	294	313	332	332	332
Current Supply Greenbelt Reservoir (ac-ft/yr)	276	294	313	332	332	332
Supply - Demand (ac-ft/yr)	0	0	0	0	0	0
Required Safe Supply (ac-ft/yr)	331	353	376	398	398	398
Safe Supply Shortage (ac-ft/yr)	-55	-59	-63	-66	-66	-66

Water User Group:	Mining - Hardeman					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	17	17	18	18	18	18
Current Supply Blaine Aquifer (ac-ft/yr)	12	12	12	12	12	12
Current Supply - Other Local Supply (ac-ft/yr)	7	7	7	7	7	7
Supply - Demand (ac-ft/yr)	2	2	1	1	1	1

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WUG SUMMARY TABLES
HARDEMAN COUNTY

Water User Group:	Quanah - Hardeman					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	2,728	2,797	2,821	2,876	2,905	2,927
Water Demand (ac-ft/yr)	397	391	388	394	397	400
Current Supply Greenbelt Reservoir (ac-ft/yr)	397	391	388	394	397	400
Supply - Demand (ac-ft/yr)	0	0	0	0	0	0
Required Safe Supply (ac-ft/yr)	476	469	466	473	476	480
Safe Supply Shortage (ac-ft/yr)	-79	-78	-78	-79	-79	-80

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WUG SUMMARY TABLES
KING COUNTY

Water User Group:	County-Other - King					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	300	316	316	316	316	316
Water Demand (ac-ft/yr)	79	81	81	81	80	80
Current Supply Blaine Aquifer (ac-ft/yr)	190	190	190	190	190	190
Current Supply Other Aquifer - Dickens Co. (ac-ft/yr)	86	86	86	86	86	86
Current Supply Other Aquifer (ac-ft/yr)	4	4	4	4	4	4
Supply - Demand (ac-ft/yr)	201	199	199	199	200	200
Required Safe Supply (ac-ft/yr)	95	97	97	97	96	96
Safe Supply Shortage (ac-ft/yr)	185	183	183	183	184	184

Water User Group:	Irrigation - King					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	28	28	28	28	28	28
Current Supply Blaine Aquifer (ac-ft/yr)	28	28	28	28	28	28
Supply - Demand (ac-ft/yr)	0	0	0	0	0	0

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WUG SUMMARY TABLES
KING COUNTY

Water User Group:	**Livestock - King**					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	394	394	394	394	394	394
Current Supply Other Aquifer (ac-ft/yr)	130	130	130	130	130	130
Current Supply Blaine Aquifer (ac-ft/yr)	100	100	100	100	100	100
Current Supply Stock Ponds (ac-ft/yr)	164	164	164	164	164	164
Supply - Demand (ac-ft/yr)	0	0	0	0	0	0

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WUG SUMMARY TABLES
MONTAGUE COUNTY

Water User Group:	Bowie - Montague					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	5,427	5,626	5,716	5,817	5,881	5,928
Water Demand (ac-ft/yr)	927	935	929	934	942	949
Current Supply Amon Carter (ac-ft/yr)	1,235	1,168	1,102	1,035	969	968
Supply - Demand (ac-ft/yr)	308	233	173	101	27	19
Required Safe Supply (ac-ft/yr)	1,112	1,122	1,115	1,121	1,130	1,139
Safe Supply Shortage (ac-ft/yr)	122	46	-13	-86	-161	-171

Water User Group:	County-Other - Montague					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	10,840	11,238	11,418	11,618	11,747	11,842
Water Demand (ac-ft/yr)	1,312	1,312	1,297	1,299	1,309	1,320
Current Supply Amon Carter (ac-ft/yr)	131	131	130	130	131	132
Current Supply Trinity Aquifer (ac-ft/yr)	500	500	500	500	500	500
Current Supply Lake Nocona (ac-ft/yr)	52	52	52	52	52	53
Current Supply Other Aquifer (ac-ft/yr)	700	700	700	700	700	700
Supply - Demand (ac-ft/yr)	**72**	**72**	**85**	**83**	**74**	**65**
Required Safe Supply (ac-ft/yr)	1,574	1,574	1,556	1,559	1,571	1,584
Safe Supply Shortage (ac-ft/yr)	**-191**	**-191**	**-175**	**-177**	**-188**	**-199**

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WUG SUMMARY TABLES
MONTAGUE COUNTY

Water User Group:	Irrigation - Montague					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	872	872	872	872	872	872
Current Supply Trinity Aquifer (ac-ft/yr)	315	315	315	315	315	315
Current Supply Other Aquifer (ac-ft/yr)	350	350	350	350	350	350
Current Supply Lk Nocona (ac-ft/yr)	100	100	100	100	100	100
Current Supply Red Run-of-River Wtr Rt 5605 (ac-ft/yr)	108	108	108	108	108	108
Supply - Demand (ac-ft/yr)	1	1	1	1	1	1

Water User Group:	Livestock - Montague					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	1,591	1,591	1,591	1,591	1,591	1,591
Current Supply Trinity Aquifer (ac-ft/yr)	0	0	0	0	0	0
Current Supply Other Aquifer (ac-ft/yr)	50	50	50	50	50	50
Current Supply Stock ponds (ac-ft/yr)	1,665	1,665	1,665	1,665	1,665	1,665
Supply - Demand (ac-ft/yr)	124	124	124	124	124	124

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WUG SUMMARY TABLES
MONTAGUE COUNTY

Water User Group:	Manufacturing - Montague					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	5	6	8	10	10	10
Current Supply Lk Nocona (ac-ft/yr)	6	7	10	12	12	12
Supply - Demand (ac-ft/yr)	1	1	2	2	2	2
Required Safe Supply (ac-ft/yr)	6	7	10	12	12	12
Safe Supply Shortage (ac-ft/yr)	0	0	0	0	0	0

Water User Group:	Mining - Montague					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	3,639	2,577	1,606	691	777	777
Current Supply Other Aquifer (ac-ft/yr)	2,000	2,000	1,000	700	800	800
Current Supply Trinity Aquifer (ac-ft/yr)	0	0	0	0	0	0
Current supply Bowie Reuse	510	374	372	0	0	0
Current Supply Run-of-River (ac-ft/yr)	0	0	0	0	0	0
Current Supply - Direct Reuse (Sales from Bowie) (ac-ft/yr)	324	327	325	0	0	0
Supply - Demand (ac-ft/yr)	**-805**	**124**	**91**	**9**	**23**	**23**

Water User Group:	Nocona - Montague					
	2020	2030	2040	2050	2060	2070
Population (number of persons)	3,155	3,271	3,323	3,381	3,419	3,446
Water Demand (ac-ft/yr)	740	751	751	758	766	772
Current Supply Lake Nocona (ac-ft/yr)	1,102	1,101	1,098	1,096	1,096	1,095
Supply - Demand (ac-ft/yr)	362	350	347	338	330	323
Required Safe Supply (ac-ft/yr)	888	901	901	910	919	926
Safe Supply Shortage (ac-ft/yr)	214	200	197	186	176	169

Water User Group:	Saint Jo - Montague					
	2020	2030	2040	2050	2060	2070
Population (number of persons)	1,085	1,125	1,143	1,163	1,176	1,185
Water Demand (ac-ft/yr)	161	162	160	161	162	163
Current Supply Trinity Aquifer (ac-ft/yr)	211	211	211	211	211	211
Supply - Demand (ac-ft/yr)	50	49	51	50	49	48
Required Safe Supply (ac-ft/yr)	193	194	192	193	194	196
Safe Supply Shortage (ac-ft/yr)	18	17	19	18	17	15

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WICHITA COUNTY

Water User Group:	Burkburnett - Wichita					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	11,151	11,557	11,876	12,100	12,314	12,495
Water Demand (ac-ft/yr)	1,481	1,480	1,477	1,482	1,503	1,525
Current Supply Seymour Aquifer (ac-ft/yr)	989	989	989	989	989	989
Current Supply Wichita System (ac-ft/yr)	822	785	748	713	682	651
Supply - Demand (ac-ft/yr)	330	294	260	220	168	115
Required Safe Supply (ac-ft/yr)	1,777	1,776	1,772	1,778	1,804	1,830
Safe Supply Shortage (ac-ft/yr)	34	-2	-36	-77	-133	-190

Water User Group:	County-Other - Wichita					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	2,691	2,791	2,868	2,921	2,974	3,018
Water Demand (ac-ft/yr)	333	342	351	356	361	367
Current Supply Wichita System (ac-ft/yr)	144	139	135	130	126	121
Sales from Iowa Park to Horseshoe Bay	38	37	36	34	33	32
Current Supply Seymour Aquifer (ac-ft/yr)	100	100	100	100	100	100
Supply - Demand (ac-ft/yr)	-51	-66	-80	-92	-102	-114
Required Safe Supply (ac-ft/yr)	400	410	421	427	433	440
Safe Supply Shortage (ac-ft/yr)	-156	-172	-187	-197	-208	-219

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Water User Group:	Electra - Wichita					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	2,879	2,984	3,066	3,124	3,179	3,226
Water Demand (ac-ft/yr)	946	965	979	996	1,013	1,028
Current Supply Lk Electra (ac-ft/yr)	0	0	0	0	0	0
Current Supply Sales from Iowa Park (Wichita System) (ac-ft/yr)	411	397	384	371	357	344
Current Supply Seymour Aquifer (ac-ft/yr)	220	220	220	220	220	220
Supply - Demand (ac-ft/yr)	**-315**	**-348**	**-375**	**-405**	**-436**	**-464**
Required Safe Supply (ac-ft/yr)	1,135	1,158	1,175	1,195	1,216	1,234
Safe Supply Shortage (ac-ft/yr)	**-504**	**-541**	**-571**	**-604**	**-638**	**-670**

Water User Group:	Iowa Park - Wichita					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	6,555	6,794	6,981	7,113	7,238	7,345
Water Demand (ac-ft/yr)	893	893	891	894	907	921
Current Supply Lk Iowa Park/Lake Gordon (ac-ft/yr)	0	0	0	0	0	0
Current Supply NF Buffalo Crk (ac-ft/yr)	0	0	0	0	0	0
Current Supply Wichita System (ac-ft/yr)	469	444	417	396	382	369
Supply - Demand (ac-ft/yr)	-424	-449	-474	-498	-525	-552
Required Safe Supply (ac-ft/yr)	1,072	1,072	1,069	1,073	1,088	1,105
Safe Supply Shortage (ac-ft/yr)	-602	-628	-652	-677	-707	-736

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Water User Group:	Irrigation - Wichita					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population						
Water Demand (ac-ft/yr)	45,267	44,487	43,707	42,927	42,927	42,927
Current Supply Lk Kemp (ac-ft/yr)	26,247	23,759	21,271	18,780	16,282	13,788
Current Supply WR #5023(ROR) (ac-ft/yr)	0	0	0	0	0	0
Current Supply Run-of-river (ac-ft/yr)	351	351	351	351	351	351
Current Supply Seymour Aquifer (ac-ft/yr)	0	0	0	0	0	0
Current Supply Other Aquifer (ac-ft/yr)	600	600	600	600	600	600
Supply - Demand (ac-ft/yr)	**-18,069**	**-19,777**	**-21,485**	**-23,196**	**-25,694**	**-28,188**

Water User Group:	Livestock - Wichita					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	917	917	917	917	917	917
Current Supply Other Aquifer (ac-ft/yr)	40	40	40	40	40	40
Current Supply Stock Ponds (ac-ft/yr)	916	916	916	916	916	916
Supply - Demand (ac-ft/yr)	39	39	39	39	39	39

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WICHITA COUNTY

Water User Group:	Manufacturing - Wichita					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	2,743	2,874	3,036	3,162	3,162	3,162
Current Supply Wichita System (sales from Wichita Falls) (ac-ft/yr)	1,012	1,026	1,050	1,059	1,021	984
Current Supply Wichita System (sales from Burkburnett) (ac-ft/yr)	137	144	152	158	158	158
Current Supply Wichita System (sales from Iowa Park) (ac-ft/yr)	211	214	219	221	213	205
Current Supply Seymour Aquifer (ac-ft/yr)	129	129	129	129	129	129
Supply - Demand (ac-ft/yr)	-1,254	-1,361	-1,486	-1,595	-1,641	-1,685
Required Safe Supply (ac-ft/yr)	3,292	3,448	3,642	3,794	3,794	3,794
Safe Supply Shortage (ac-ft/yr)	-1,802	-1,935	-2,092	-2,227	-2,273	-2,317

Water User Group:	Mining - Wichita					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	62	61	55	49	44	44
Current Supply Seymour Aquifer (ac-ft/yr)	62	61	55	49	44	44
Current Supply Run-of-river (ac-ft/yr)	0	0	0	0	0	0
Supply - Demand (ac-ft/yr)	0	0	0	0	0	0

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WICHITA COUNTY

Water User Group:	Dean Dale SUD - Wichita					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	1,121	1,161	1,193	1,216	1,237	1,256
Water Demand (ac-ft/yr)	86	84	82	82	84	85
Current Supply - Wichita System (ac-ft/yr)	79	77	75	74	72	70
Supply - Demand (ac-ft/yr)	-7	-7	-7	-8	-12	-15
Required Safe Supply (ac-ft/yr)	103	101	98	98	101	102
Safe Supply Shortage (ac-ft/yr)	-24	-24	-23	-24	-29	-32

Water User Group:	Steam Electric Power - Wichita					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	360	360	360	360	360	360
Current Supply Wichita System (ac-ft/yr)	185	179	173	167	161	156
Supply - Demand (ac-ft/yr)	-175	-181	-187	-193	-199	-204

Water User Group:	Wichita Falls - Wichita					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	107,835	111,767	114,848	117,013	119,080	120,838
Water Demand (ac-ft/yr)	17,357	17,474	17,544	17,652	17,922	18,184
Current Supply Wichita System (ac-ft/yr)	6,428	6,555	6,677	6,817	7,015	7,207
Current Supply Lk Kemp (ac-ft/yr)	4,248	3,845	3,440	3,037	2,633	2,229
Supply - Demand (ac-ft/yr)	-6,681	-7,074	-7,427	-7,798	-8,274	-8,748
Required Safe Supply (ac-ft/yr)	20,828	20,969	21,053	21,182	21,506	21,821
Safe Supply Shortage (ac-ft/yr)	-10,153	-10,569	-10,936	-11,328	-11,859	-12,385

Water User Group:	Wichita Valley WSC - Wichita					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	3,395	3,519	3,616	3,684	3,749	3,804
Water Demand (ac-ft/yr)	400	399	398	399	405	411
Current Supply - Wichita System (Sales from Wichita Falls, Iowa Park and Archer City) (ac-ft/yr)	536	516	504	491	477	462
Supply - Demand (ac-ft/yr)	136	117	106	92	72	51
Required Safe Supply (ac-ft/yr)	480	479	478	479	486	493
Safe Supply Shortage (ac-ft/yr)	56	37	27	12	-9	-31

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WILBARGER COUNTY

Water User Group:	County-Other - Wilbarger					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	2,707	2,854	2,943	3,033	3,095	3,143
Water Demand (ac-ft/yr)	430	438	443	455	464	471
Current Supply Seymour Aquifer Sales from Vernon	280	285	281	273	276	277
Current Supply Seymour Aquifer	100	100	100	100	100	100
Current Supply Wichita System sales from Electra (ac-ft/yr)	20	20	20	20	20	20
Current Supply Red Run-of-River (ac-ft/yr)	115	115	115	115	115	115
Supply - Demand (ac-ft/yr)	85	82	73	53	47	41
Required Safe Supply (ac-ft/yr)	516	526	532	546	557	565
Safe Supply Shortage (ac-ft/yr)	-1	-6	-16	-38	-46	-53

Water User Group:	Irrigation - Wilbarger					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	31,603	30,655	29,736	28,843	28,843	28,843
Current Supply Seymour Aq (ac-ft/yr)	25,696	25,686	25,686	25,562	25,190	25,190
Current Supply Other Aq (ac-ft/yr)	4,000	3,800	3,600	3,400	3,200	3,000
Current Supply Run-of-river (ac-ft/yr)	825	825	825	825	825	825
Supply - Demand (ac-ft/yr)	-1,082	-344	375	944	372	172

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WILBARGER COUNTY

Water User Group:	Livestock - Wilbarger					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	913	913	913	913	913	913
Current Supply Seymour Aquifer (ac-ft/yr)	125	125	125	125	125	125
Current Supply Santa Rosa Lake (ac-ft/yr)	50	50	50	50	50	50
Current Supply Stock Ponds (ac-ft/yr)	738	738	738	738	738	738
Supply - Demand (ac-ft/yr)	0	0	0	0	0	0

Water User Group:	Manufacturing - Wilbarger					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	1,133	1,217	1,362	1,511	1,511	1,511
Current Supply Seymour Aquifer Sales from Vernon	1,133	1,217	1,330	1,396	1,380	1,368
Supply - Demand (ac-ft/yr)	0	0	-32	-115	-131	-143
Required Safe Supply (ac-ft/yr)	1,360	1,460	1,634	1,813	1,813	1,813
Safe Supply Shortage (ac-ft/yr)	**-227**	**-243**	**-304**	**-417**	**-433**	**-445**

Water User Group:	Mining - Wilbarger					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	20	20	19	19	18	18
Current Supply Other Aquifer (ac-ft/yr)	10	10	10	10	10	10
Current Supply Beaver Creek (ac-ft/yr)	30	30	30	30	30	30
Supply - Demand (ac-ft/yr)	20	20	21	21	22	22

Water User Group:	Steam Electric Power - Wilbarger					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)						
Water Demand (ac-ft/yr)	10,000	10,000	10,000	10,000	10,000	10,000
Current Supply Lk Kemp (ac-ft/yr)	8,886	8,041	7,197	6,352	5,508	4,663
Supply - Demand (ac-ft/yr)	-1,114	-1,959	**-2,803**	**-3,648**	**-4,492**	**-5,337**

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WILBARGER COUNTY

Water User Group:	Vernon - Wilbarger					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	11,758	12,398	12,785	13,175	13,447	13,653
Water Demand (ac-ft/yr)	1,883	1,923	1,934	1,982	2,018	2,049
Current Supply Seymour Aquifer (ac-ft/yr)	2,087	1,998	1,889	1,831	1,844	1,855
Supply - Demand (ac-ft/yr)	204	75	-45	-151	-174	-194
Required Safe Supply (ac-ft/yr)	2,260	2,308	2,321	2,378	2,422	2,459
Safe Supply Shortage (ac-ft/yr)	**-173**	**-310**	**-432**	**-547**	**-578**	**-604**

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WUG SUMMARY TABLES
YOUNG COUNTY

Water User Group:	Olney - Young					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	3,370	3,485	3,568	3,655	3,740	3,822
Water Demand (ac-ft/yr)	557	559	558	566	578	590
Current Supply Wichita System (ac-ft/yr)	288	278	270	261	252	243
Current Supply Lk Olney/Cooper (ac-ft/yr)	620	620	620	620	620	620
Supply - Demand (ac-ft/yr)	351	339	332	315	294	273
Required Safe Supply (ac-ft/yr)	668	671	670	679	694	708
Safe Supply Shortage (ac-ft/yr)	239	227	220	202	178	155

Water User Group:	County-Other - Young					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population (number of persons)	534	634	706	782	856	927
Water Demand (ac-ft/yr)	65	74	81	89	97	105
Current Supply - Other Aquifer (ac-ft/yr)	100	100	100	100	100	100
Supply - Demand (ac-ft/yr)	35	26	19	11	3	-5
Required Safe Supply (ac-ft/yr)	78	89	97	107	116	126
Safe Supply Shortage (ac-ft/yr)	22	11	3	-7	-16	-26

APPENDIX C

COST ESTIMATES

2016 FINAL PLAN

REGION B

DECEMBER 2015

APPENDIX C

COST ESTIMATES
2016 FINAL PLAN
REGION B

Region B Regional Water Planning Area Cost Estimates

As part of the 2011 Region B Regional Water Plan, cost estimates were developed for each of the recommended water management strategies in Region B. As appropriate, these cost estimates have been updated for the 2016 regional water plan. In accordance with the Texas Water Development Board guidance the costs for water management strategies are to be updated from second quarter 2008 dollars to September 2013 dollars. The methodology used to develop the 2016 costs is described in the following sections. Where updated unit costs were not available, the Engineering News Record (ENR) Index for construction was used to increase the costs from second quarter 2008 (September) costs to September 2013 costs. An increase of 111.6% from September 2008 to September 2013 was determined using the ENR Index method.

Introduction

1. The evaluation of water management strategies requires developing cost estimates. Guidance for cost estimates may be found in the TWDB's "First Amended General Guidelines for Regional Water Plan Development (2012-2017)", Section 5.1. Costs are to be reported in September 2013 dollars.

2. Standard unit costs for installed pipe, pump stations, standard treatment facilities, and well fields were developed and/or updated using the costing tool provided by the TWDB. The unit costs do not include engineering, contingency, financial and legal services, costs for land and rights-of-way, permits, environmental and archeological studies, or mitigation. The costs for these items are determined separately in the cost tables.

3. The information presented in this section is intended to be 'rule-of-thumb' guidance. Specific situations may call for alteration of the procedures and costs. Note that the costs in this memorandum provide a planning level estimate for comparison purposes.

4. It is important that when comparing alternatives that the cost estimates be similar and include similar items. If an existing reliable cost estimate is available for a project it should be used

where appropriate. All cost estimates must meet the requirements set forth in the TWDB's "First Amended General Guidelines for Regional Water Plan Development (2012-2017)".

5. The cost estimates have two components:
   - Initial Capital Costs: Including total construction cost of facilities, engineering and legal contingencies, environmental and archaeology studies and mitigation, land acquisition and surveying, and interest incurred during construction (4.0% annual interest rate less a 1.0% rate of return on investment of unspent funds).
   - Average Annual Costs: Including annual operation and maintenance costs, pumping energy costs, purchase of water and debt service.

TWDB does not require the consultant to determine life cycle or present value analysis. For most situations annual costs are sufficient for comparison purposes and a life-cycle analysis is not required.

ASSUMPTIONS FOR CAPITAL COSTS:

Conveyance Systems

The unit costs and factors shown in Tables C-1 through C-7 were developed directly from the TWDB costing tool. These costs are the basis of the capital costs developed for this plan. Standard pipeline costs used for these cost estimates are shown in Table C-1. Pump station costs are based on required Horsepower capacity and are listed in Table C-2. The power capacity is to be determined from the hydraulic analyses included in the TWDB costing tool (or detailed analysis if available). Pipelines and pump stations are to be sized for peak pumping capacity.

- Pump efficiency is assumed to be 70 percent.
- Peaking factor of 2 times the average demand is to be used for strategies when the water is pumped directly to a water treatment plant. (or historical peaking factor, if available)
- The target flow velocity in pipes is 5 fps and the Hazen-Williams Factor is assumed to be 120.

- Peaking factor of 1.2 to 1.5 is to be used if there are additional water sources and/or the water is transported to a terminal storage facility.
- Ground storage is to be provided at each booster pump station along the transmission line unless there is a more detailed design.
- Ground storage tanks should provide sufficient storage for 2.5 to 4 hours of pumping at peak capacity. Costs for ground storage are shown in Table C-3. Covered storage tanks are used for all strategies transporting treated water.

Water Treatment Plants

Water treatment plants are to be sized for peak day capacity (assume peaking factor of 2 if no specific data is available). Costs estimated include six different treatment levels of varying degree. These levels are groundwater chlorine disinfection, iron and manganese removal, simple filtration, construction of a new conventional treatment plant, expansion of a conventional treatment plant, brackish desalination, and seawater desalination. Costs are also based upon a TDS factor that will increase or decrease the cost of treatment accordingly. These costs are summarized in Table C-4. **All treatment plants are to be sized for finished water capacity**.

Direct Reuse

Direct reuse refers to the introduction of reclaimed water directly from a water reclamation plant to a distribution system. The following assumptions were made for direct potable and non-potable reuse strategies.

Direct Non-Potable Reuse

Non-potable reuse is the use of reclaimed water that is used directly for non-potable beneficial uses such as landscape irrigation. The TWDB costing tool currently does not have a direct non-potable reuse treatment plant improvements option, therefore the following assumptions were made.

- It was assumed that the cost of an iron and manganese removal plant would be an appropriate approximation of the improvements that would be needed at the Wastewater Treatment Plant. This cost was further refined by assuming that only upgrades to an existing facility would be required, and not construction of an entirely new plant.
- Approximately two miles of 6-inch pipeline was also included in the cost estimates for transport of the treated water to the destination. Since reuse is still relatively new, there is a lack of piping infrastructure for reuse water. It was also assumed that the pump station was included in the WWTP improvements.

Direct Potable Reuse

Direct potable reuse is the use of reclaimed water that is transported directly from a wastewater treatment plant to a drinking water system. The TWDB costing tool currently does not have a direct potable reuse treatment plant improvements option, therefore the following assumptions were made.

- Due to the high level of treatment that is required for direct potable reuse, the wastewater treatment plant improvements cost was assumed to be equivalent to 75% of a conventional treatment plant expansion plus brackish desalination treatment improvements. The 25% discount was given to Level 3 Treatment in order to alleviate any redundancy being assumed by the costing tool.

New Groundwater Wells

Cost estimates required for water management strategies that include additional wells or well fields were determined through the TWDB costing tool (unless a more detailed design was available). The associated costs are shown in Table C-5. The costing tool differentiated the wells based upon purpose. The categories were Public Supply, Irrigation, and ASR. These cost relationships are "rule-of-thumb" in nature and are only appropriate in the broad context of the cost evaluations for the RWP process.

The cost relationships assume construction methods required for public water supply wells, including carbon steel surface casing and pipe-based, stainless steel, and wire-wrap screen. The cost estimates assume that wells would be gravel-packed in the screen sections and the surface casing cemented to their total depth. Estimates include the cost of drilling, completion, well development, well testing, pump, motor, motor controls, column pipe, installation and mobilization. The cost relationships do not include engineering, contingency, financial and legal services, land costs, or permits. A more detailed cost analysis should be completed prior to developing a project.

The costs associated with conveyance systems for multi-well systems can vary widely based on the distance between wells, terrain characteristics, well production, and distance to the treatment facility. These costs should be estimated using standard engineering approaches and site-specific information. For planning purposes, these costs were estimated using the TWDB costing tool's assumptions for conveyance. It is important to note that conveyance costs were not included for point of use water user groups such as mining.

Other Costs

- Engineering, contingency, construction management, financial and legal costs are to be estimated at 30 percent of construction cost for pipelines and 35 percent of construction costs for pump stations, treatment facilities and reservoir projects. (This is in accordance with TWDB guidance.)
- Permitting and mitigation for transmission and treatment projects are to be estimated at $25,000 per mile. For reservoirs, mitigation and permitting costs are assumed equal to twice the land purchase cost, unless site specific data is available.
- Right-of-way (ROW) costs for transmission lines are estimated through costs provided by the Texas A&M University Real Estate Center (http://recenter.tamu.edu/data/rland/) which gives current land costs based on county. The ROW width is assumed to be 20 ft. If a small pipeline follows existing right-of-ways (such as highways), no additional right-of-way cost may be assumed. Large pipelines will require ROW costs regardless of routing.

Interest during construction is the total of interest accrued at the end of the construction period using a 4.0 percent annual interest rate on total borrowed funds, less a 1 percent rate of return on investment of unspent funds. This is calculated assuming that the total estimated project cost (excluding interest during construction) would be drawn down at a constant rate per month during the construction period. Factors were determined for different lengths of time for project construction. These factors were used in cost estimating and are presented in Table C-6.

ASSUMPTIONS FOR ANNUAL COSTS:

Annual costs are to be estimated using the following assumptions:

- Debt service for all transmission and treatment facilities is to be annualized over 20 years, but not longer than the life of the project. [Note: uniform amortization periods should be used when evaluating similar projects for an entity.]
- Annual interest rate for debt service is 5.5 percent.
- Water purchase costs are to be based on wholesale rates reported by the selling entity when possible. In lieu of known rates, a typical regional cost for treated water and raw water will be developed.
- Operation and Maintenance costs are to be calculated based on the construction cost of the capital improvement. Engineering, permitting, etc. should not be included as a basis for this calculation. However, a 20% allowance for construction contingencies should be included for all O&M calculations. Per the "First Amended General Guidelines for Regional Water Plan Development (2012-2017)", O&M should be calculated at:
    - 1 percent of the construction costs for pipelines
    - 1.5 percent for dams
    - 2.5 percent of the construction costs for pump stations
    - O&M Costs for the varying levels of water treatment plant improvements were developed by the TWDB and are shown in Table C-7. For Wichita Falls, the specific costs for treatment were developed based on actual unit

costs of \$0.85/1,000 gallons for conventional treatment and \$1.28 for advanced (RO) treatment.

- Pumping costs are to be estimated using an electricity rate of \$0.09 per Kilowatt Hour. If local data is available, this can be used.

Table C-1

Pipeline Costs

Diameter	Soil		Rock	
	Rural	Urban	Rural	Urban
(Inches)	($/Foot)	($/Foot)	($/Foot)	(Feet)
6	$18	$25	$22	$30
8	$28	$39	$34	$47
10	$31	$44	$38	$53
12	$35	$48	$41	$58
14	$46	$64	$55	$78
16	$57	$81	$68	$97
18	$68	$97	$83	$116
20	$81	$112	$96	$135
24	$103	$144	$123	$172
30	$137	$191	$164	$230
36	$170	$239	$204	$287
42	$204	$286	$246	$343
48	$239	$334	$286	$401
54	$273	$382	$327	$457
60	$306	$429	$368	$515
66	$358	$501	$430	$602
72	$419	$587	$504	$705
78	$490	$687	$589	$825
84	$574	$804	$689	$965
90	$672	$941	$806	$1,129
96	$772	$1,082	$927	$1,298
102	$865	$1,211	$1,038	$1,453
108	$952	$1,332	$1,142	$1,599
114	$1,047	$1,465	$1,256	$1,758
120	$1,152	$1,612	$1,382	$1,934
132	$1,324	$1,854	$1,589	$2,225
144	$1,523	$2,132	$1,828	$2,559

Table C-2
Pump Station Costs

Horsepower	Booster PS Cost ($-million)	Intake PS cost ($-millions)
0	$0.00	$0.00
5	$0.62	$0.67
10	$0.68	$0.72
20	$0.72	$0.77
25	$0.75	$0.82
50	$0.79	$1.03
100	$0.83	$1.55
200	$1.67	$2.06
300	$1.83	$2.58
400	$2.32	$3.09
500	$2.39	$3.61
600	$2.45	$4.12
700	$2.52	$4.64
800	$2.97	$5.15
900	$3.08	$5.67
1,000	$3.20	$6.18
2,000	$4.33	$8.66
3,000	$5.46	$10.00
4,000	$6.60	$11.34
5,000	$7.73	$12.37
6,000	$8.87	$13.40
7,000	$10.00	$14.43
8,000	$11.13	$15.46
9,000	$12.27	$16.49
10,000	$13.40	$17.52
20,000	$24.74	$28.86
30,000	$29.69	$38.13
40,000	$37.11	$48.44
50,000	$46.39	$57.72
60,000	$55.67	$66.99
70,000	$66.80	$77.30

Note:
1. Intake PS costs include intake and pump station.
2. Adjust pump station costs upward if the pump station is designed to move large quantities of water at a low head (i.e. low horsepower).
3. Assumed multiple pump setup for all pump stations.

Table C-3
Ground Storage Tanks

Tank Volume (MG)	With Roof ($)	Without Roof ($)
0.05	$178,301	$118,524
0.1	$192,730	$174,179
0.5	$412,257	$374,123
1	$698,776	$618,386
1.5	$967,774	$674,041
2	$1,236,772	$803,902
2.5	$1,339,836	$922,426
3	$1,442,900	$1,040,950
3.5	$1,649,029	$1,154,320
4	$1,855,158	$1,267,691
5	$2,061,286	$1,463,513
6	$2,370,479	$1,752,093
7	$2,782,736	$2,009,754
8	$3,194,994	$2,370,479
10	$3,997,864	$3,071,316
12	$4,997,331	$3,916,444
14	$6,021,017	$4,740,958

Note: Costs assume steel tanks smaller than 1 MG, concrete tanks 1 MG and larger.

Table C-4
Conventional Water Treatment Plant Costs

	Level 0	Level 1	Level 2	Level 3 (new)	Level 3 (exp)	Level 4	Level 5
	Chlorine Disinfection (GW)	Iron & Manganese Removal	Simple Filtration	Conventional Treatment	Conventional Treatment	Brackish Desalination	Seawater Desalination
Capacity (MGD)	Capital Cost ($)	Capital Cost ($)	Capital Cost ($)	Capital Cost ($)	Capital Cost ($)	Capital Cost ($)	Capital Cost ($)
0	0	0	0	0	0	0	0
0.1	17,948	224,345	1,030,643	1,373,739	1,373,739	916,221	2,202,644
1	69,098	900,371	3,607,251	4,844,022	4,844,022	3,664,883	14,738,196
10	440,703	3,747,009	19,066,897	32,980,578	18,551,575	24,777,648	98,615,306
50	2,203,515	10,882,523	72,145,015	135,606,271	66,991,800	94,233,468	372,343,747
75	3,305,272	15,701,003	105,469,141	199,327,155	106,502,260	131,935,273	520,364,186
100	4,407,030	19,236,530	138,793,267	261,974,046	129,095,574	167,517,457	659,848,640
150	6,610,545	29,438,241	205,441,519	385,074,680	193,640,235	234,539,403	922,162,931
200	8,814,060	33,898,368	272,089,771	506,100,496	238,822,748	297,793,331	1,169,350,182

Note: Plant is sized for finished peak day capacity.

Table C-5
Cost Elements for Water Wells

Public Supply Well Costs						
	Well Capacity (MGD)					
Well Depth (ft)	**100**	**175**	**350**	**700**	**1000**	**1800**
150	$124,138	$188,450	$321,561	$363,439	$453,177	$662,565
300	$167,510	$239,301	$382,882	$438,220	$541,419	$767,259
500	$216,867	$299,127	$454,672	$523,472	$644,618	$892,892
700	$261,736	$352,969	$518,984	$601,244	$737,347	$1,003,569
1000	$343,996	$451,681	$638,635	$743,330	$909,345	$1,209,967
1500	$481,594	$617,696	$836,059	$981,135	$1,193,515	$1,550,971
2000	$619,192	$782,216	$1,033,482	$1,218,941	$1,479,181	$1,893,471
Irrigation Well Costs						
150	$68,800	$106,190	$180,972	$207,893	$263,231	$379,891
300	$91,234	$136,103	$221,353	$261,736	$332,031	$463,646
500	$113,669	$170,502	$264,727	$320,065	$406,812	$560,863
700	$131,615	$195,928	$302,118	$369,422	$472,620	$644,618
1000	$171,998	$252,762	$379,891	$471,124	$602,740	$809,137
1500	$240,797	$349,979	$508,515	$640,130	$818,111	$1,081,342
2000	$308,100	$444,203	$637,139	$807,642	$1,034,978	$1,355,043
ASR Well Costs						
150	$137,598	$212,379	$369,422	$417,282	$520,480	$767,259
300	$180,972	$263,231	$430,742	$492,063	$608,723	$873,449
500	$230,327	$324,553	$502,532	$577,315	$713,417	$997,587
700	$276,692	$378,395	$568,341	$655,087	$804,651	$1,109,759
1000	$357,456	$477,107	$686,496	$797,173	$976,649	$1,314,662
1500	$496,550	$641,627	$883,919	$1,034,978	$1,260,819	$1,655,665
2000	$632,653	$806,146	$1,081,342	$1,272,783	$1,546,484	$1,998,165

Table C-6
Factors for Interest During Construction

Construction Period	Factor
6 months	0.0175
12 months	0.035
18 months	0.0525
24 months	0.07
36 months	0.105
48 month	0.14
60 months	0.175
72 months	0.21
84 months	0.245

Table C-7
Annual Water Treatment Plant O&M Costs

	Level 0	Level 1	Level 2	Level 3 (New)	Level (Exp)	Level 4	Level 5
Capacity (MGD)	**Chlorine Disinfection (GW)**	**Iron & Manganese Removal**	**Simple Filtration**	**Conventional Treatment**	**Conventional Treatment**	**Brackish Desalination**	**Seawater Desalination**
0	0	0	0	0	0	0	0
0.1	5,384	37,017	103,064	68,687	68,687	83,293	374,449
1	20,729	148,561	360,725	242,201	242,201	333,171	2,505,493
10	132,211	618,256	1,906,690	1,649,029	927,579	2,252,513	16,764,602
50	661,054	1,795,616	7,214,502	6,780,314	3,349,590	8,566,679	63,298,437
75	991,582	2,590,666	10,546,914	9,966,358	5,325,113	11,994,116	88,461,912
100	1,322,109	3,174,027	13,879,327	13,098,702	6,454,779	15,228,860	112,174,269
150	1,983,163	4,857,310	20,544,152	19,253,734	9,682,012	21,321,764	156,767,698
200	2,644,218	5,593,231	27,208,977	25,305,025	11,941,137	27,072,121	198,789,531

2016 Region B Water Plan
Wichita WCID #2
Chloride Control Project

Supply (Ac-ft)	6,538				
Supply (MGD)	5.8				
Construction Cost:				**Total**	
Corps Estimate of Construction Cost Remaining					$59,371,000
TOTAL CONSTRUCTION COST					$59,371,000
Annual Costs:	**Quantity**	**Unit**	**Unit Price**	**Total**	
Debt Service (20 yrs. @ 5.5%)					$4,970,000
Operation and Maintenance					$1,484,000
Total Annual Costs:					**$6,454,000**
During Amortization					
Water Cost ($ per ac-ft)					**$987**
Water Cost ($ per 1,000 gallons)					**$3.03**
After Amortization					
Water Cost ($ per ac-ft)					**$227**
Water Cost ($ per 1,000 gallons)					**$0.70**

2016 Region B Water Plan
Wichita Falls
Water Conservation

Supply (Ac-ft)	4,484
Supply (MGD)	4

Construction Cost:	**Quantity**	**Unit**	**Unit Price**	**Total**
6" Pipeline Replacement	10,000	LF	$25	$250,000
12" Pipeline Replacement	10,000	LF	$48	$480,000
18" Pipeline Replacement	10,000	LF	$97	$970,000
24" Pipeline Replacement	2,000	LF	$144	$290,000
30" Pipeline Replacement	2,000	LF	$192	$380,000
36" Pipeline Replacement	2,000	LF	$239	$480,000
42" Pipeline Replacement	1,000	LF	$287	$290,000
42" Pipeline Replacement (Lake Kickapoo)	100,000	LF	$246	$24,640,000
48" Pipeline Replacement	1,000	LF	$335	$340,000
Total Construction Costs:				**$28,120,000**

Other Project Cost:	**Quantity**	**Unit**	**Unit Price**	**Total**
Engineering and Contingencies (30% for pipeline)			30%	$8,436,000
Engineering and Contingencies (35% for other items)			35%	$0
Landscape Ordinance				$50,000
Water Waste Ordinance				$50,000
Total Other Project Costs:				**$8,536,000**
Total Capital Cost:				**$36,656,000**

Annual Costs:	**Quantity**	**Unit**	**Unit Price**	**Total**
Debt Service (20 yrs. @ 5.5%)				$3,067,000
Operation and Maintenance				$337,000
Leak Detection and Repair Personnel				$100,000
Education Program				$100,000
Enforcement				$50,000
Total Annual Costs:				**$3,654,000**

During Amortization	
Water Cost ($ per ac-ft)	**$815**
Water Cost ($ per 1,000 gallons)	**$2.50**

After Amortization	
Water Cost ($ per ac-ft)	**$131**
Water Cost ($ per 1,000 gallons)	**$0.40**

2016 Region B Water Plan
Wichita Falls
Indirect Reuse to Lake Arrowhead

Supply (Ac-ft)	11,210			
Supply (MGD)	10			
Construction Cost:	**Quantity**	**Unit**	**Unit Price**	**Total**
32" Water Line*	66,000	LF	$148	$9,770,000
36" Water Line*	13,200	LF	$171	$2,260,000
RRWWTP-Pump Station Improvements*	1	EA	$17,000,000	$17,000,000
Road Crossings	3,000	LF	$290	$870,000
* Cost provided by City, includes contingencies				
Total Construction Costs:				**$29,900,000**
Other Project Cost:	**Quantity**	**Unit**	**Unit Price**	**Total**
Additional Construction Contingencies*				$1,000,000
Engineering, Legal & Financial @ 10%			10%	$2,990,000
Land, Easements and Conflicts	76	AC	$1,500	$110,000
Environmental Studies, Mitigation & Permitting	13	MI	$25,000	$310,000
Interest During Construction (2 Years)				$2,090,000
Total Other Project Costs:				**$6,500,000**
Total Capital Cost:				**$36,400,000**
Annual Costs:	**Quantity**	**Unit**	**Unit Price**	**Total**
Debt Service (20 yrs. @ 5.5%)				$3,050,000
Operation and Maintenance				$680,000
Power Costs	2,777,800	kwh	$0.09	$250,000
Water Treatment Costs	3,650,000	1,000 gallons	$0.85	$3,100,000
Total Annual Costs:				**$7,080,000**
During Amortization				
Water Cost ($ per ac-ft)				**$632**
Water Cost ($ per 1,000 gallons)				**$1.94**
After Amortization				
Water Cost ($ per ac-ft)				**$360**
Water Cost ($ per 1,000 gallons)				**$1.10**

2016 Region B Water Plan
Wichita Falls
Lake Ringgold

Supply (Ac-ft)	18,600			
Supply (MGD)	16.6			
Construction Cost:	**Quantity**	**Unit**	**Unit Price**	**Total**
Ringgold Reservoir & Dam	1	LS	$69,430,000	$69,430,000
48" Raw Water Line	156,800	LF	$239	$37,480,000
Road Crossings	20,000	LF	$710	$14,200,000
43 MGD Pump Station with Intake Structure	1	EA	$12,426,000	$12,430,000
Total Construction Costs:				**$133,540,000**
Other Project Cost:	**Quantity**	**Unit**	**Unit Price**	**Total**
Engineering and Contingencies (30% for pipeline)			30%	$11,240,000
Engineering and Contingencies (35% for other items)			35%	$33,620,000
Land and Easements	17,460	Acre	$2,200	$38,410,000
Conflicts	1	LS	$8,310,000	$8,310,000
Environmental Studies, Mitigation & Permitting	1	LS	$82,020,000	$82,020,000
Interest During Construction (5 Years)				$23,370,000
Total Other Project Costs:				**$196,970,000**
Total Capital Cost:				**$330,510,000**
Annual Costs:	**Quantity**	**Unit**	**Unit Price**	**Total**
Debt Service (40 yrs. @ 5.5%)				$20,600,000
Operation and Maintenance				$3,330,000
Power Costs	7,891,878	kwh	$0.09	$710,000
Water Treatment Costs	6,056,200	1,000 gallons	$0.85	$5,150,000
Total Annual Costs:				**$29,790,000**
During Amortization				
Water Cost ($ per ac-ft)				**$1,602**
Water Cost ($ per 1,000 gallons)				**$4.92**
After Amortization				
Water Cost ($ per ac-ft)				**$494**
Water Cost ($ per 1,000 gallons)				**$1.52**

2016 Region B Water Plan

Wichita Falls

Local Seymour Aquifer

Supply (Ac-ft)	2,242			
Supply (MGD)	2			
Construction Cost:	**Quantity**	**Unit**	**Unit Price**	**Total**
Water Supply Wells	50	EA	$85,000	$4,250,000
Well Field Collection System	50	EA		$1,000,000
24" Treated Water Line	2,323	LF	$103	$240,000
Pump Station	1	EA	$1,666,000	$1,670,000
Storage Tank with Roof	1	EA	$247,612	$250,000
2 MGD RO Treatment Plant	1	EA	$6,380,000	$6,380,000
Road Crossings	500	LF	$200	$100,000
Total Construction Costs:				**$13,890,000**
Other Project Cost:	**Quantity**	**Unit**	**Unit Price**	**Total**
Engineering and Contingencies (30% for pipeline)			30%	$370,000
Engineering and Contingencies (35% for other items)			35%	$4,430,000
Land, Easements and Conflicts	3	AC	$1,500	$4,000
Environmental Studies, Mitigation & Permitting	0.4	MI	$25,000	$10,000
Interest During Construction (2 Years)				$970,000
Total Other Project Costs:				**$5,784,000**
Total Capital Cost:				**$19,674,000**
Annual Costs:	**Quantity**	**Unit**	**Unit Price**	**Total**
Debt Service (20 yrs. @ 5.5%)				$1,650,000
Operation and Maintenance				$390,000
Power Costs	2,777,800	kwh	$0.09	$250,000
Purchase Water Costs ($0.50/Kgal)	730,000	Kgal	$0.50	$370,000
Water Treatment Costs	730,000	Kgal	$1.28	$930,000
Total Annual Costs:				**$3,590,000**
During Amortization				
Water Cost ($ per ac-ft)				**$1,601**
Water Cost ($ per 1,000 gallons)				**$4.91**
After Amortization				
Water Cost ($ per ac-ft)				**$865**
Water Cost ($ per 1,000 gallons)				**$2.66**

2016 Region B Water Plan
Wichita Falls
Wichita River Diversion

Supply (Ac-ft)	2,242			
Supply (MGD)	2			
Construction Cost:	**Quantity**	**Unit**	**Unit Price**	**Total**
18" Water line	16,000	LF	$97	$1,550,000
Intake Pump Station	1	EA	$2,489,000	$2,490,000
Channel Dam	1	EA	$3,840,000	$3,840,000
Total Construction Costs:				**$7,880,000**
Other Project Cost:	**Quantity**	**Unit**	**Unit Price**	**Total**
Engineering and Contingencies (30% for pipeline)			30%	$470,000
Engineering and Contingencies (35% for other items)			35%	$2,220,000
Land, Easements and Conflicts	18	AC	$1,500	$30,000
Environmental Studies, Mitigation & Permitting	3	MI	$25,000	$80,000
Interest During Construction (2 Years)				$550,000
Total Other Project Costs:				**$3,350,000**
Total Capital Cost:				**$11,230,000**
Annual Costs:	**Quantity**	**Unit**	**Unit Price**	**Total**
Debt Service (20 yrs. @ 5.5%)				$940,000
Operation and Maintenance				$210,000
Power Costs	685,518	kwh	$0.09	$60,000
Water Treatment Costs	730,000	Kgal	$0.85	$620,000
Total Annual Costs:				**$1,830,000**
During Amortization				
Water Cost ($ per ac-ft)				**$816**
Water Cost ($ per 1,000 gallons)				**$2.50**
After Amortization				
Water Cost ($ per ac-ft)				**$397**
Water Cost ($ per 1,000 gallons)				**$1.22**

2016 Region B Water Plan
City of Vernon
Water Conservation (Replace Transmission Line)

Supply (Ac-Ft)	313 AF/Y			
Supply (MGD)	0.28			
Construction Cost:	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission System				
21" Pipeline - Transmission Line Replacement	63,360	LF	$92	$5,829,000
Pump Station	0	LS	$774,571	$0
Subtotal for Transmission				**$5,829,000**
TOTAL CONSTRUCTION COST				**$5,829,000**
Engineering and Contingencies (30% for pipelines)				$1,749,000
Permitting and Mitigation	1	MI	$25,000	$25,000
Interest During Construction (6 Months)				$204,000
TOTAL CAPITAL COST				**$7,807,000**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$653,000
Operation and Maintenance				$70,000
Total Annual Cost				**$723,000**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$2,310**
Water Cost ($ per 1,000 gallons)				**$7.09**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$224**
Water Cost ($ per 1,000 gallons)				**$0.69**

2016 Region B Water Plan
City of Vernon
Additional Seymour Aquifer

Supply (Ac-Ft)	600	AF/Y		
Supply (MGD)	0.5			

Construction Cost:	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (35 GPM)	22	EA	$85,000	$1,870,000
Well Field Collection Pipeline(s)	22	EA	$20,000	$440,000
Storage Tank	1	EA	$179,000	$179,000
Water Treatment Plant (Ion Exchange)	1	EA	$1,560,000	$1,560,000
Subtotal for Wellfield and Treatment				**$4,049,000**
Transmission System				
12" Pipeline - Transmission Main	52,800	LF	$38	$2,006,000
Pump Station	1	LS	$774,571	$775,000
Subtotal for Transmission				**$2,781,000**
TOTAL CONSTRUCTION COST				**$6,830,000**
Engineering and Contingencies (30% for pipelines)				$734,000
Engineering and Contingencies (35% for well field)				$1,534,000
Easement - Rural	24	AC	$1,719	$42,000
Permitting and Mitigation	10	MI	$25,000	$250,000
Groundwater Rights/ Purchase	600	AC-FT	$500	$300,000
Interest During Construction (6 Months)				$120,000
TOTAL CAPITAL COST				**$9,810,000**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$821,000
Electricity				$10,000
Water Treatment				$137,000
Operation and Maintenance				$108,000
Total Annual Cost				**$1,076,000**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$1,793**
Water Cost ($ per 1,000 gallons)				**$5.50**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$425**
Water Cost ($ per 1,000 gallons)				**$1.30**

2016 Region B Water Plan
City of Vernon
Direct Reuse - Manufacturing

Supply (Ac-Ft)	400 AF/Y			
Supply (MGD)	0.4			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
6" Pipeline to Manufacturing	13,200	LF	$20	$264,000
0.6 MGD Pre-Treatment WTP	1	EA	$2,476,000	$2,476,000
0.6 MGD RO Plant	1	EA	$2,591,000	$2,591,000
Pump Station at WWTP	1	EA	$702,558	$703,000
6" RO Discharge Line	2,640	LF	$20	$53,000
TOTAL CONSTRUCTION COST				**$6,087,000**
Engineering and Contingencies (30% for pipelines)				$95,000
Engineering and Contingencies (35% other)				$2,020,000
Easement - Rural	7	AC	$1,719	$13,000
Permitting and Mitigation	3	MI	$25,000	$175,000
Interest During Construction (6 Months)				$110,000
TOTAL CAPITAL COST				**$8,500,000**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$711,000
Electricity				$8,000
Water Treatment				$195,000
Operation and Maintenance				$177,000
Total Annual Cost				**$1,091,000**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$2,728**
Water Cost ($ per 1,000 gallons)				**$8.37**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$950**
Water Cost ($ per 1,000 gallons)				**$2.92**

2016 Region B Water Plan
Steam Electric Power - Wilbarger County
Alternative Cooling Technology

Supply (Ac-Ft)	5,337 AF/Y					
Supply (MGD)	4.8					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Steam-Electric Needs (acft)	1,114	1,959	2,803	3,648	4,492	5,337
Equivalent Needs (GWh)	0	0	0	0	0	0
MW Capacity Needed (MW)	0	0	0	0	0	0
Incremental Capacity Installed (MW)	400	0	0	400	0	0
Cumulative Capacity Installed (MW)	400	400	400	800	800	800
Incremental Cost of ACT (million $)	$44.87	$0.00	$0.00	$44.87	$0.00	$0.00
Total Capital Cost (million $)	$44.87	$44.87	$44.87	$89.74	$89.74	$89.74
Debt Service (million $)	$3.75	$3.75	$0.00	$3.75	$3.75	$0.00
Operation & Maintenane (million $)	$1.12	$1.12	$1.12	$2.24	$2.24	$2.24
Total Annual Cost (million $)	$4.87	$4.87	$1.12	$5.99	$5.99	$2.24
Amount of Water Saved (acft/yr)	1,114	1,959	2,803	3,648	4,492	5,337
Annual Cost of Water ($ per acft)	$4,372	$2,486	$400	$1,642	$1,333	$420
Annual Cost of Water ($ per 1,000 gallons)	$13.42	$7.63	$1.23	$5.04	$4.09	$1.29

APPENDIX D

STRATEGY EVALUATION AND QUANTIFIED ENVIRONMENTAL IMPACT MATRIX

2016 FINAL PLAN

REGION B

DECEMBER 2015

APPENDIX D

STRATEGY EVALUATION AND QUANTIFIED ENVIRONMENTAL IMPACT MATRIX
2016 FINAL PLAN
REGION B

In accordance with TWDB rules and guidelines, the Region B Water Planning Group has adopted a standard procedure for ranking potential water management strategies. This procedure classifies the strategies using the TWDB's standard categories developed for regional water planning.

The strategies are ranked based upon the following categories;

- Quantity
- Reliability
- Cost
- Environmental Factors
- Agricultural Resources/Rural Areas
- Other Natural Resources
- Key Water Quality Parameters
- Third Party Social & Economic Factors

Each category is quantitatively assessed and assigned a ranking from 1 to 5. With the exception of the Environmental Factors category, Table D-1 shows the correlation between the category and the ranking. The Environmental Factors score is taken directly from the Environmental Matrix where the potential environmental considerations are evaluated in more detail.

Table D-1
Evaluation Matrix Category Ranking Correlation

Rank	Quantity	Cost per Ac-Ft	Reliability	Remaining Strategy Impacts
1	Meets 0-25% Shortage	>$5,000	Low	High
2	Meets 25-50% Shortage	$1,000-$5,000	Low to Medium	Medium
3	Meets 50-75% of Shortage	$500-$1,000	Medium	Low
4	Meets 75-100% of Shortage	$0-$500	Medium to High	None
5	Exceeds Shortage	No Cost	High	Positive Impact

Environmental Matrix

The Environmental Matrix is used to determine the score of the 'Environmental Factors' category on the Evaluation Matrix.

The Environmental Matrix takes into consideration the following categories;

- Total Acres Impacted
- Total Wetland Acres Impacted
- Environmental Water Needs
- Habitat
- Threatened and Endangered Species
- Cultural Resources
- Bays & Estuaries
- Environmental Water Quality

Each category is quantitatively assessed and assigned a ranking from 1 to 5. The Overall Environmental Impacts column averages all of the rankings assigned to the strategy. This value is also illustrated in the Evaluation Matrix as the Environmental Factors rank. Table D-2 shows the correlation between the rank assigned within each category.

Table D-2
Environmental Matrix Category Ranking Correlation

Rank	Acres Impacted	Threatened and Endangered Species	Agricultural Impacts	All Remaining Categories
1	Greater than 500 Acres and/or Wetlands	Greater than 20	Greater than 2,000 acres	High Impact
2	100-500 Acres	Between 15-20	Between 50 and 2,000 acres	Medium Impact
3	50-100 Acres	Between 10-15 or 'varies'	Between 6 and 50 acres	Low Impact
4	0-50 Acres	Between 5-10	Between 0 and 5 acres	No Impact or n/a
5	None	Between 0-5 (or n/a)	Provides water to agriculture or rural	Positive

Acres Impacted

Acres Impacted refers to the total amount of area that will be impacted due to the implementation of a strategy.

The following conservative assumptions were made (unless more detailed information was available);

- Each well will impact approximately 1 acre of land
- The acres impacted for pipelines is equivalent to the right of way easements required
- Reservoirs will impact an area equal to their surface area
- A conventional water treatment plant will impact 5 acres
- Conservation and Precipitation Enhancement strategies will have no impact on acres

Wetland Acres

Wetland Acres refers to how many acres that are classified as wetlands are impacted by implementation of the strategy. The only strategy that had a quantified impact on surrounding wetlands was the Lake Ringgold strategy. The total acreage was determined using the National Wetlands Inventory located at http://www.fws.gov/wetlands/Data/Mapper.html, as prepared for the Lake Ringgold Feasibility Study in October 2013. The Wichita River strategy will impact Waters of the U.S., but the studies necessary to determine the quantified impacts have not been conducted.

Environmental Water Needs

Environmental Water Needs refers to how the strategy will impact the area's overall environmental water needs. Water is vital to the environmental health of a region, and so it is important to take into account how strategies will impact the amount of water that will be available to the environment.

The following conservative assumptions were made (unless more detailed information was available);

- The majority of the strategies will have a low impact on environmental water needs
- Reuse will also have a medium impact if the effluent was previously used for irrigation or discharged back into the water system. This will decrease the overall amount of water that is available to the environment by diverting the effluent and using it for another purpose
- Precipitation Enhancement will have a positive impact because both of these strategies increase the amount of water available to the environment.

Habitat

Habitat refers to how the strategy will impact the habitat of the local area. The more area that is impacted due to the implementation of the strategy, the more the area's habitat will be disrupted.

The following conservative assumptions were made (unless more detailed information was available);

- Strategies with less than 100 acres impacted will have a low impact
- Strategies above 100 acres impacted will have a medium impact

Threatened and Endangered Species

Threatened and endangered species refers to how the strategy will impact those species in the area once implemented.

The following conservative assumptions were made (unless more detailed information was available);

- Only applicable to strategies implementing infrastructure
- Rankings were based on the amount of threatened and endangered species located within the county. This amount was found using the Texas Parks and Wildlife Database located at http://tpwd.texas.gov/gis/rtest/ and the U.S. Fish and Wildlife Service Database located at http://www.fws.gov/endangered/ .
- This ranking only includes threatened and endangered species as defined in the TWDB guidelines and does not include species without official protection such as those proposed for listing or species that are considered rare or otherwise of special concern.

Agricultural Resources

Impacts to Agricultural Resources is quantified based on the permanent impacts to water supplies to irrigation users or direct impacts to irrigated acreage. Projects with only temporary impacts, such as pipeline projects, would be classified as low impacts. Specific assumptions include:

- If the location of the strategy is known and data is available, actual impacts to agricultural lands will be used. An example of this was Lake Ringgold.

- If a strategy is located in a rural area of a county with significant irrigation use (>10,000 irrigated acres), it is assumed that the strategy could potentially impact agricultural lands. Since most projects will avoid direct impacts to agricultural lands, the quantity of impacts is estimated to be no more than 10% of the total area for the strategy.
- If a strategy impacts more than 2,000 acres of agricultural land, the impacts are classified as “high”. If a strategy impacts between 5 and 50 acres of agricultural lands, the impacts are classified as “low”. If the strategy impacts less than 5 acres, it was assumed to negligible.
- If a strategy will reduce the available water to an irrigation user (by county) by the greater of 10% current irrigation use or 5,000 ac-ft/yr, the strategy is determined to have “high” impacts. If a strategy will reduce the available water to an irrigation user (by county) by 1% of current irrigation use or 500 ac-ft/yr, the strategy is determined to have “low” impacts.
- If the entity already holds water rights for the strategy, the impacts would be “none”.
- If the strategy does not impact any agricultural or rural user, “none” is selected.
- For strategies that provide water to agricultural and rural users, the strategy is rated as “positive impacts.”

Cultural Resources

Cultural Resources refers to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people. Locations, buildings and features with scientific, cultural or historic value are considered to be cultural resources.

The following conservative assumptions were made (unless more detailed information was available);

- Only applicable to strategies implementing infrastructure
- All applicable strategies will have a low impact on cultural resources

Bays and Estuaries

Region B is located too far away from and bays or estuaries to have a quantifiable impact. Therefore this category was assumed to be non-applicable for every strategy.

Environmental Water Quality

Environmental Water Quality refers to the impact that the implementation of the strategy will have on the area's water quality. Generally most strategies will have a neutral to low impact on water quality and are ranked as "3" as documented in Table D-2. Similarly, strategies with no impacts are assigned a "4" and those with a positive impact are assigned a "5".

Strategy Evaluation Matrix

Entity	County Used	Strategy	Quantity (Ac-Ft/Yr)	Maximum Safe Need	Percentage of Max Need Met	Quantity Score	Reliability	Cost ($/Ac-Ft)	Cost Score	Impacts of Strategy on: Environmental Factors	Agricultural Resources/ Rural Areas	Other Natural Resources	Key Water Quality Parameters	Third Party Social & Economic Factors	Overall Score (5-45)	Implementation Issues	Comments
Archer City	Archer	Conservation	32	184	17%	1	3	$729	3	4	5	5	3	5	29		
Holliday	Archer	Conservation	39	214	18%	1	3	$562	3	4	5	5	3	5	29		
Lakeside City	Archer	Conservation	15	79	19%	1	3	$549	3	4	5	5	3	5	29		
Scotland	Archer	Conservation	28	237	12%	1	3	$554	3	4	5	5	3	5	29		
Archer City	Archer	Voluntary Transfer	20	184	11%	1	5	$114	4	4	3	4	3	4	28		
Scotland	Archer	Voluntary Transfer	123	237	52%	3	5	$1,629	2	4	3	4	3	4	28		
Windthorst WSC	Archer	Voluntary Transfer	54	291	19%	1	5	$114	4	4	3	4	3	4	28		
Irrigation	Archer	Conservation	121	737	16%	1	3	$0	5	4	5	5	3	5	31		
Mining	Archer	Conservation	121	333	36%	3	3	$0	5	4	5	5	3	5	33		
Windthorst WSC	Archer, Clay	Conservation	34	291	12%	1	3	$564	3	4	5	5	3	5	29		
County Other	Baylor	Conservation	14	0	101%	5	3	$736	3	4	5	5	3	5	33		
Irrigation	Baylor	Conservation	331	388	85%	4	3	$0	5	4	5	5	3	5	34		
Mining	Baylor	Conservation	4	0	100%	4	3	$0	5	4	5	5	3	5	34		
County Other	Clay	Conservation	60	53	113%	5	3	$768	3	4	5	5	3	5	33		
Dean Dale SUD	Clay	Conservation	7	90	8%	1	3	$802	3	4	5	5	3	5	29		
County Other	Clay	Voluntary Transfer	53	53	100%	4	5	$1,140	2	4	3	4	3	4	29		
Irrigation	Clay	Conservation	144	0	100%	4	3	$0	5	4	5	5	3	5	34		
Mining	Clay	Conservation	197	0	100%	4	3	$0	5	4	5	5	3	5	34		
Irrigation	Cottle	Conservation	400	0	100%	4	3	$0	5	4	5	5	3	5	34		
Mining	Cottle	Conservation	10	0	100%	4	3	$0	5	4	5	5	3	5	34		
County Other	Foard	Conservation	8	5	160%	5	3	$883	3	4	5	5	3	5	33		
Crowell	Foard	Conservation	16	28	57%	3	3	$729	3	4	5	5	3	5	31		
County Other	Foard	Voluntary Transfer	5	5	100%	4	5	$1,140	2	4	3	4	3	4	29		
Crowell	Foard	Voluntary Transfer	28	0	101%	5	5	$1,140	2	4	3	4	3	4	30		
Irrigation	Foard	Conservation	394	0	100%	4	3	$0	5	4	5	5	3	5	34		
Mining	Foard	Conservation	3	0	100%	4	3	$0	5	4	5	5	3	5	34		
County Other	Hardeman	Conservation	13	17	76%	4	3	$697	3	4	5	5	3	5	32		
Quanah	Hardeman	Conservation	48	80	60%	3	3	$655	3	4	5	5	3	5	31		
County Other	Hardeman	Voluntary Transfer	16	17	94%	4	5	$1,140	2	4	3	4	3	4	29		
Quanah	Hardeman	Voluntary Transfer	79	80	99%	4	5	$1,140	2	4	3	4	3	4	29		
Manufacturing	Hardeman	Voluntary Transfer	66	66	100%	4	5	$1,140	2	4	3	4	3	4	29		
Irrigation	Hardeman	Conservation	794	2,491	32%	3	3	$0	5	4	5	5	3	5	33		
Mining	Hardeman	Conservation	5	0	100%	4	3	$0	5	4	5	5	3	5	34		
Irrigation	King	Conservation	3	0	100%	4	3	$0	5	4	5	5	3	5	34		
Mining	King	Conservation	95	0	100%	4	3	$0	5	4	5	5	3	5	34		
Bowie	Montague	Conservation	81	171	47%	3	3	$608	3	4	5	5	3	5	31		
County Other	Montague	Conservation	144	199	72%	3	3	$782	3	4	5	5	3	5	31		
County Other	Montague	Voluntary Transfer	199	0	101%	5	5	$1,423	2	4	3	4	3	4	30		
Irrigation	Montague	Conservation	87	0	100%	4	3	$0	5	4	5	5	3	5	34		
Mining	Montague	Conservation	910	805	113%	5	3	$0	5	4	5	5	3	5	35		
Burkburnett	Wichita	Conservation	305	190	161%	5	3	$770	3	4	5	5	3	5	33		
County Other	Wichita	Conservation	36	219	16%	1	3	$799	3	4	5	5	3	5	29		
Electra	Wichita	Conservation	105	670	16%	1	3	$631	3	4	5	5	3	5	29		
Iowa Park	Wichita	Conservation	91	736	12%	1	3	$625	3	4	5	5	3	5	29		
Wichita Falls	Wichita	Conservation	2,242	19,124	12%	1	3	$311	4	4	5	5	3	5	30		
Wichita Valley WSC	Wichita	Conservation	24	34	71%	3	3	$660	3	4	5	5	3	5	31		
Wichita Falls	Wichita	Reuse	11,210	19,124	59%	3	5	$632	3	4	3	3	3	3	27		
Wichita Falls	Wichita	Precipitation Enhancement	1,000	19,124	5%	1	4	$0	5	4	5	5	4	5	33		
Wichita Falls	Wichita	New Surface Water	2,242	19,124	12%	1	3	$816	3	4	2	2	3	3	21		
County Other	Wichita	Voluntary Transfer	60	219	27%	3	5	$1,629	2	3	3	4	3	4	27		
Electra	Wichita	Voluntary Transfer	193	670	29%	3	5	$1,629	2	4	3	4	3	4	28		
Irrigation	Wichita	Conservation	4,527	28,188	16%	1	3	$0	5	3	5	5	3	5	30		
Mining	Wichita	Conservation	16	0	100%	4	3	$0	5	4	5	5	3	5	34		
Wichita County WID2	Wichita	Red River Chloride	0	13,034	0%	0	4	$0	5	4	5	5	5	5	33		
Wichita Falls	Wichita	New Groundwater	2,242	19,124	12%	1	3	$1,601	2	3	3	2	3	5	22		
Wichita Falls	Wichita	Reservoir	18,600	19,124	97%	4	4	$1,602	2	3	1	3	3	3	23		
Wichita County WID2	Wichita, Archer, Clay	Irrigation Conservation	13,034	13,034	100%	4	4	$49	4	4	5	5	3	5	34		
County Other	Wilbarger	Conservation	45	53	85%	4	3	$789	3	4	5	5	3	5	32		
Vernon	Wilbarger	Conservation	202	1,139	18%	1	3	$201	4	4	5	5	3	5	30		
Vernon	Wilbarger	Reuse	400	1,139	35%	3	5	$2,728	2	4	3	3	3	3	26		
Vernon	Wilbarger	New Groundwater	600	1,139	53%	3	3	$1,567	2	4	3	3	3	5	26		
County Other	Wilbarger	Voluntary Transfer	53	53	100%	4	5	$0	5	4	3	4	3	4	32		
Irrigation	Wilbarger	Conservation	3,160	1,682	188%	5	3	$0	5	3	5	5	3	5	34		
Mining	Wilbarger	Conservation	5	0	100%	4	3	$0	5	4	5	5	3	5	34		
Steam Electric Power	Wilbarger	Alternative Cooling	5,337	5,337	100%	4	3	$4,372	2	4	5	5	3	5	31		
County Other	Young	Conservation	5	0	101%	5	3	$832	3	4	5	5	3	5	33		
County Other	Young	Voluntary Transfer	21	0	101%	5	5	$1,140	2	4	3	4	3	4	30		
Mining	Young	Conservation	0	0	100%	4	3	$0	5	4	5	5	3	5	34		

Environmental Quantification Matrix

			Environmental Factors															Agricultural Resource Impacts		
Entity	County	Strategy	Acres Impacted	Wetland Acres	Acres Impacted Score	Envir Water Needs	Envir Water Needs Score	Habitat	Habitat Score	Threatened and Endangered Species	Threat and Endanger Species Score	Cultural Resources	Cultural Resources Score	Bays & Estuaries	Bays & Estuaries Score	Envir Water Quality	Overall Environmental Impacts	Temp Ag Acres Impacted	Permanent Ag Acres Impacted	Agricultural Resources Score
Archer City	Archer	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Archer City	Archer	Voluntary Transfer	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Holliday	Archer	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Irrigation	Archer	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	5
Lakeside City	Archer	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Mining	Archer	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Scotland	Archer	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Scotland	Archer	Voluntary Transfer	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Windthorst WSC	Archer	Voluntary Transfer	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Windthorst WSC	Archer, Clay	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
County Other	Baylor	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Irrigation	Baylor	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	5
Mining	Baylor	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
County Other	Clay	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
County Other	Clay	Voluntary Transfer	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Dean Dale SUD	Clay	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Irrigation	Clay	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	5
Mining	Clay	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Irrigation	Cottle	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	5
Mining	Cottle	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
County Other	Foard	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
County Other	Foard	Voluntary Transfer	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Crowell	Foard	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Crowell	Foard	Voluntary Transfer	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Irrigation	Foard	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	5
Mining	Foard	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
County Other	Hardeman	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
County Other	Hardeman	Voluntary Transfer	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Irrigation	Hardeman	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	5
Manufacturing	Hardeman	Voluntary Transfer	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Quanah	Hardeman	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Quanah	Hardeman	Voluntary Transfer	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Mining	Hardeman	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Irrigation	King	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	5
Mining	King	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Bowie	Montague	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
County Other	Montague	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
County Other	Montague	Voluntary Transfer	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Irrigation	Montague	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	5
Mining	Montague	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Burkburnett	Wichita	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
County Other	Wichita	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
County Other	Wichita	Voluntary Transfer	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Electra	Wichita	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Electra	Wichita	Voluntary Transfer	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Iowa Park	Wichita	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Irrigation	Wichita	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	5
Wichita County WID2	Wichita	Red River Chloride	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	5	4	0	0	5
Wichita Falls	Wichita	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Wichita Falls	Wichita	Reuse	76	n/a	3	Medium	2	Low	3	9	4	Low	3	None	5	3	3	8	8	4
Wichita Falls	Wichita	Precipitation Enhancement	0	n/a	5	Positive	5	Low	3	n/a	5	n/a	4	None	5	4	4	0	0	5

Region B
Appendix D
Environmental Quantification Matrix

Entity	County	Strategy	Environmental Factors															Agricultural Resource Impacts		
			Acres Impacted	Wetland Acres	Acres Impacted Score	Envir Water Needs	Envir Water Needs Score	Habitat	Habitat Score	Threatened and Endangered Species	Threat and Endanger Species Score	Cultural Resources	Cultural Resources Score	Bays & Estuaries	Bays & Estuaries Score	Envir Water Quality	Overall Environmental Impacts	Temp Ag Acres Impacted	Permanent Ag Acres Impacted	Agricultural Resources Score
Wichita Falls	Wichita	New Surface Water	18	<10	4	Medium	2	Low	3	9	4	Low	3	None	5	3	3	2	2	4
Mining	Wichita	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Wichita Valley WSC	Wichita	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Wichita Falls	Wichita	New Groundwater	53	n/a	3	Low	3	Low	3	9	4	Low	3	None	5	3	3	5	5	4
Wichita Falls	Wichita	Reservoir	17,460	910	1	Medium	2	High	1	9	4	Low	3	None	5	3	3	0	667	2
Wichita County WID2	Wichita, Archer, Clay	Irrigation Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
County Other	Wilbarger	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
County Other	Wilbarger	Voluntary Transfer	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Irrigation	Wilbarger	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	5
Steam Electric Power	Wilbarger	Alternative Cooling	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Vernon	Wilbarger	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Vernon	Wilbarger	Reuse	7	n/a	4	Medium	2	Low	3	9	4	Low	3	None	5	3	3	1	1	4
Mining	Wilbarger	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Vernon	Wilbarger	New Groundwater	34	n/a	4	Low	3	Low	3	9	4	Low	3	None	5	3	4	3	3	4
County Other	Young	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
County Other	Young	Voluntary Transfer	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4
Mining	Young	Conservation	0	n/a	5	Low	3	Low	3	n/a	5	n/a	4	None	5	3	4	0	0	4

APPENDIX E

ECONOMIC IMPACT ANALYSIS

2016 FINAL PLAN

REGION B

DECEMBER 2015

Socioeconomic Impacts of Projected Water Shortages for the Region B Regional Water Planning Area

Prepared in Support of the 2016 Region B Regional Water Plan

Texas Water Development Board

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Executive Summary

Evaluating the social and economic impacts of not meeting identified water needs is a required part of the regional water planning process. The Texas Water Development Board (TWDB) estimates those impacts for regional water planning groups, and summarizes the impacts in the state water plan. The analysis presented is for the Region B Regional Water Planning Group.

Based on projected water demands and existing water supplies, the Region B planning group identified water needs (potential shortages) that would occur within its region under a repeat of the drought of record for six water use categories. The TWDB then estimated the socioeconomic impacts of those needs—if they are not met—for each water use category and as an aggregate for the region.

The analysis was performed using an economic modeling software package, IMPLAN (Impact for Planning Analysis), as well as other economic analysis techniques, and represents a snapshot of socioeconomic impacts that may occur during a single year during a drought of record within each of the planning decades. For each water use category, the evaluation focused on estimating income losses and job losses. The income losses represent an approximation of gross domestic product (GDP) that would be foregone if water needs are not met.

The analysis also provides estimates of financial transfer impacts, which include tax losses (state, local, and utility tax collections); water trucking costs; and utility revenue losses. In addition, social impacts were estimated, encompassing lost consumer surplus (a welfare economics measure of consumer wellbeing); as well as population and school enrollment losses.

It is estimated that not meeting the identified water needs in Region B would result in an annually combined lost income impact of approximately $644 million in 2020, decreasing to $370 million in 2070 (Table ES-1). In 2020, the region would lose approximately 4,800 jobs, and by 2070 job losses would decrease to approximately 3,870.

All impact estimates are in year 2013 dollars and were calculated using a variety of data sources and tools including the use of a region-specific IMPLAN model, data from the TWDB annual water use estimates, the U.S. Census Bureau, Texas Agricultural Statistics Service, and Texas Municipal League.

Table ES-1: Region B Socioeconomic Impact Summary

Regional Economic Impacts	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$644	$356	$352	$338	$332	$370
Job losses	4,812	3,633	3,785	3,817	3,750	3,870
Financial Transfer Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Tax losses on production and imports ($ millions)*	$96	$39	$33	$24	$17	$18
Water trucking costs ($ millions)*	-	-	-	-	-	-
Utility revenue losses ($ millions)*	$19	$21	$22	$23	$24	$26
Utility tax revenue losses ($ millions)*	$0	$0	$0	$0	$0	$0
Social Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Consumer surplus losses ($ millions)*	$4	$5	$6	$7	$8	$10
Population losses	883	667	695	701	689	711
School enrollment losses	163	123	129	130	127	132

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

1 Introduction

Water shortages during a repeat of the drought of record would likely curtail or eliminate certain economic activity in businesses and industries that rely heavily on water. Insufficient water supplies could not only have an immediate and real impact on existing businesses and industry, but they could also adversely and chronically affect economic development in Texas. From a social perspective, water supply reliability is critical as well. Shortages could disrupt activity in homes, schools and government and could adversely affect public health and safety. For these reasons, it is important to evaluate and understand how water supply shortages during drought could impact communities throughout the state.

Administrative rules (31 Texas Administrative Code §357.33 (c)) require that regional water planning groups evaluate the social and economic impacts of not meeting water needs as part of the regional water planning process, and rules direct the TWDB staff to provide technical assistance upon request. Staff of the TWDB's Water Use, Projections, & Planning Division designed and conducted this analysis in support of the Region B Regional Water Planning Group.

This document summarizes the results of the analysis and discusses the methodology used to generate the results. Section 1 summarizes the water needs calculation performed by the TWDB based on the regional water planning groups' data. Section 2 describes the methodology for the impact assessment and discusses approaches and assumptions specific to each water use category (i.e., irrigation, livestock, mining, steam-electric, municipal and manufacturing). Section 3 presents the results for each water use category with results summarized for the region as a whole. Appendix A presents details on the socioeconomic impacts by county.

1.1 Identified Regional Water Needs (Potential Shortages)

As part of the regional water planning process, the TWDB adopted water demand projections for each water user group (WUG) with input from the planning groups. WUGs are composed of cities, utilities, combined rural areas (designated as county-other), and the county-wide water use of irrigation, livestock, manufacturing, mining and steam-electric power. The demands are then compared to the existing water supplies of each WUG to determine potential shortages, or needs, by decade. Existing water supplies are legally and physically accessible for immediate use in the event of drought. Projected water demands and existing supplies are compared to identify either a surplus or a need for each WUG.

Table 1-1 summarizes the region's identified water needs in the event of a repeat of the drought of record. Demand management, such as conservation, or the development of new infrastructure to increase supplies are water management strategies that may be recommended by the planning group to meet those needs. This analysis assumes that no strategies are implemented, and that the identified needs correspond to future water shortages. Note that projected water needs generally increase over time, primarily due to anticipated population and economic growth. To provide a general sense of proportion, total projected needs as an overall percentage of total demand by water use category are presented in aggregate in Table 1-1. Projected needs for individual water user groups within the aggregate vary greatly, and may reach 100% for a given WUG and water use category. Detailed water needs by WUG and county appear in Chapter 4 of the 2016 Region B Regional Water Plan.

Table 1-1 Regional Water Needs Summary by Water Use Category

Water Use Category		2020	2030	2040	2050	2060	2070
Irrigation	Water Needs (acre-feet per year)	22,756	23,513	24,654	26,146	28,710	31,270
	% of the category's total water demand	23%	24%	26%	28%	31%	34%
Livestock	Water Needs (acre-feet per year)	845	844	844	844	844	859
	% of the category's total water demand	8%	8%	8%	8%	8%	8%
Manufacturing	Water Needs (acre-feet per year)	1,254	1,361	1,518	1,710	1,771	1,829
	% of the category's total water demand	30%	31%	32%	34%	35%	36%
Mining	Water Needs (acre-feet per year)	1,575	605	491	143	75	75
	% of the category's total water demand	30%	14%	16%	8%	4%	4%
Municipal	Water Needs (acre-feet per year)	8,150	8,706	9,196	9,764	10,371	10,970
	% of the category's total water demand	25%	27%	28%	30%	31%	32%
Steam electric power	Water Needs (acre-feet per year)	1,289	2,140	2,990	3,841	4,691	5,541
	% of the category's total water demand	12%	21%	29%	37%	45%	53%
Total water needs		**35,869**	**37,169**	**39,693**	**42,448**	**46,462**	**50,544**

2 Economic Impact Assessment Methodology Summary

This portion of the report provides a summary of the methodology used to estimate the potential economic impacts of future water shortages. The general approach employed in the analysis was to obtain estimates for income and job losses on the smallest geographic level that the available data would support, tie those values to their accompanying historic water use estimate (volume), and thereby determine a maximum impact per acre-foot of shortage for each of the socioeconomic measures. The calculations of economic impacts were based on the overall composition of the economy using many underlying economic "sectors." Sectors in this analysis refer to one or more of the 440 specific production sectors of the economy designated within IMPLAN (Impact for Planning Analysis), the economic impact modeling software used for this assessment. Economic impacts within this report are estimated for approximately 310 of those sectors, with the focus on the more water intense production sectors. The economic impacts for a single water use category consist of an aggregation of impacts to multiple related economic sectors.

2.1 Impact Assessment Measures

A required component of the regional and state water plans is to estimate the potential economic impacts of shortages due to a drought of record. Consistent with previous water plans, several key variables were estimated and are described in Table 2-1.

Table 2-1 Socioeconomic Impact Analysis Measures

Regional Economic Impacts	Description
Income losses - value added	The value of output less the value of intermediate consumption; it is a measure of the contribution to GDP made by an individual producer, industry, sector, or group of sectors within a year. For a shortage, value added is a measure of the income losses to the region, county, or WUG and includes the direct, indirect and induced monetary impacts on the region.
Income losses - electrical power purchase costs	Proxy for income loss in the form of additional costs of power as a result of impacts of water shortages.
Job losses	Number of part-time and full-time jobs lost due to the shortage.
Financial Transfer Impacts	**Description**
Tax losses on production and imports	Sales and excise taxes (not collected due to the shortage), customs duties, property taxes, motor vehicle licenses, severance taxes, other taxes, and special assessments less subsidies.
Water trucking costs	Estimate for shipping potable water.
Utility revenue losses	Foregone utility income due to not selling as much water.
Utility tax revenue losses	Foregone miscellaneous gross receipts tax collections.
Social Impacts	**Description**
Consumer surplus losses	A welfare measure of the lost value to consumers accompanying less water use.
Population losses	Population losses accompanying job losses.
School enrollment losses	School enrollment losses (K-12) accompanying job losses.

2.1.1 Regional Economic Impacts

Two key measures were included within the regional economic impacts classification: income losses and job losses. Income losses presented consist of the sum of value added losses and additional purchase costs of electrical power. Job losses are also presented as a primary economic impact measure.

Income Losses - Value Added Losses

Value added is the value of total output less the value of the intermediate inputs also used in production of the final product. Value added is similar to Gross Domestic Product (GDP), a familiar measure of the productivity of an economy. The loss of value added due to water shortages was estimated by input-output analysis using the IMPLAN software package, and includes the direct, indirect, and induced monetary impacts on the region.

Income Losses - Electric Power Purchase Costs

The electrical power grid and market within the state is a complex interconnected system. The industry response to water shortages, and the resulting impact on the region, are not easily modeled using traditional input/output impact analysis and the IMPLAN model. Adverse impacts on the region will occur, and were represented in this analysis by the additional costs associated with power purchases from other generating plants within the region or state. Consequently, the analysis employed additional power purchase costs as a proxy for the value added impacts for that water use category, and these are included as a portion of the overall income impact for completeness.

For the purpose of this analysis, it was assumed that power companies with insufficient water will be forced to purchase power on the electrical market at a projected higher rate of 5.60 cents per kilowatt hour. This rate is based upon the average day-ahead market purchase price of electricity in Texas from the recent drought period in 2011.

Job Losses

The number of jobs lost due to the economic impact was estimated using IMPLAN output associated with the water use categories noted in Table 1-1. Because of the difficulty in predicting outcomes and a lack of relevant data, job loss estimates were not calculated for the steam-electric power production or for certain municipal water use categories.

2.1.2 Financial Transfer Impacts

Several of the impact measures estimated within the analysis are presented as supplemental information, providing additional detail concerning potential impacts on a sub-portion of the economy or government. Measures included in this category include lost tax collections (on production and imports), trucking costs for imported water, declines in utility revenues, and declines in utility tax revenue collected by the state. Many of these measures are not solely adverse, with some having both positive and negative impacts. For example, cities and residents would suffer if forced to pay large costs for trucking in potable water. Trucking firms, conversely, would benefit from the transaction. Additional detail for each of these measures follows.

Tax Losses on Production and Imports

Reduced production of goods and services accompanying water shortages adversely impacts the collection of taxes by state and local government. The regional IMPLAN model was used to estimate reduced tax collections associated with the reduced output in the economy.

Water Trucking Costs

In instances where water shortages for a municipal water user group were estimated to be 80 percent or more of water demands, it was assumed that water would be trucked in to support basic consumption and sanitation needs. For water shortages of 80 percent or greater, a fixed cost of $20,000 per acre-foot of water was calculated and presented as an economic cost. This water trucking cost was applied for both the residential and non-residential portions of municipal water needs and only impacted a small number of WUGs statewide.

Utility Revenue Losses

Lost utility income was calculated as the price of water service multiplied by the quantity of water not sold during a drought shortage. Such estimates resulted from city-specific pricing data for both water and wastewater. These water rates were applied to the potential water shortage to determine estimates of lost utility revenue as water providers sold less water during the drought due to restricted supplies.

Utility Tax Losses

Foregone utility tax losses included estimates of uncollected miscellaneous gross receipts taxes. Reduced water sales reduce the amount of utility tax that would be collected by the State of Texas for water and wastewater service sales.

2.1.3 Social Impacts

Consumer Surplus Losses of Municipal Water Users

Consumer surplus loss is a measure of impact to the wellbeing of municipal water users when their water use is restricted. Consumer surplus is the difference between how much a consumer is willing and able to pay for the commodity (i.e., water) and how much they actually have to pay. The difference is a benefit to the consumer’s wellbeing since they do not have to pay as much for the commodity as they would be willing to pay. However, consumer’s access to that water may be limited, and the associated consumer surplus loss is an estimate of the equivalent monetary value of the negative impact to the consumer’s wellbeing, for example, associated with a diminished quality of their landscape (i.e., outdoor use). Lost consumer surplus estimates for reduced outdoor and indoor use, as well as residential and commercial/institutional demands, were included in this analysis. Consumer surplus is an attempt to measure effects on wellbeing by monetizing those effects; therefore, these values should not be added to the other monetary impacts estimated in the analysis.

Lost consumer surplus estimates varied widely by location and type. For a 50 percent shortage, the estimated statewide consumer surplus values ranged from $55 to $2,500 per household (residential use), and from $270 to $17,400 per firm (non-residential).

Population and School Enrollment Losses

Population losses due to water shortages, as well as the related loss of school enrollment, were based upon the job loss estimates and upon a recent study of job layoffs and the resulting adjustment of the labor market, including the change in population.[1] The study utilized Bureau of Labor Statistics data regarding layoffs between 1996 and 2013, as well as Internal Revenue Service data regarding migration, to model an estimate of the change in the population as the result of a job layoff event. Layoffs impact both out-migration, as well as in-migration into an area, both of which can negatively affect the population of an area. In addition, the study found that a majority of those who did move following a layoff moved to another labor market rather than an adjacent county. Based on this study, a simplified ratio of job and net population losses was calculated for the state as a whole: for every 100 jobs lost, 18 people were assumed to move out of the area. School enrollment losses were estimated as a proportion of the population lost.

2.2 Analysis Context

The context of the economic impact analysis involves situations where there are physical shortages of surface or groundwater due to drought of record conditions. Anticipated shortages may be nonexistent in earlier decades of the planning horizon, yet population growth or greater industrial, agricultural or other sector demands in later decades may result in greater overall demand, exceeding the existing supplies. Estimated socioeconomic impacts measure what would happen if water user groups experience water shortages for a period of one year. Actual socioeconomic impacts would likely become larger as drought of record conditions persist for periods greater than a single year.

2.2.1 IMPLAN Model and Data

Input-Output analysis using the IMPLAN (Impact for Planning Analysis) software package was the primary means of estimating value added, jobs, and taxes. This analysis employed county and regional level models to determine key impacts. IMPLAN is an economic impact model, originally developed by the U.S. Forestry Service in the 1970's to model economic activity at varying geographic levels. The model is currently maintained by the Minnesota IMPLAN Group (MIG Inc.) which collects and sells county and state specific data and software. The year 2011 version of IMPLAN, employing data for all 254 Texas counties, was used to provide estimates of value added, jobs, and taxes on production for the economic sectors associated with the water user groups examined in the study. IMPLAN uses 440 sector-specific Industry Codes, and those that rely on water as a primary input were assigned to their relevant planning water user categories (manufacturing, mining, irrigation, etc.). Estimates of value added for a water use category were obtained by summing value added estimates across the relevant IMPLAN sectors

[1] Foote, Andrew, Grosz, Michel, Stevens, Ann. "Locate Your Nearest Exit: Mass Layoffs and Local Labor Market Response." University of California, Davis. April 2015. http://paa2015.princeton.edu/uploads/150194

associated with that water use category. Similar calculations were performed for the job and tax losses on production and import impact estimates.

Note that the value added estimates, as well as the job and tax estimates from IMPLAN, include three components:

- *Direct effects* representing the initial change in the industry analyzed;
- *Indirect effects* that are changes in inter-industry transactions as supplying industries respond to reduced demands from the directly affected industries; and,
- *Induced effects* that reflect changes in local spending that result from reduced household income among employees in the directly and indirectly affected industry sectors.

2.2.2 Elasticity of Economic Impacts

The economic impact of a water need is based on the relative size of the water need to the water demand for each water user group (Figure 2-1). Smaller water shortages, for example, less than 5 percent, were anticipated to result in no initial negative economic impact because water users are assumed to have a certain amount of flexibility in dealing with small shortages. As a water shortage deepens, however, such flexibility lessens and results in actual and increasing economic losses, eventually reaching a representative maximum impact estimate per unit volume of water. To account for such ability to adjust, an elasticity adjustment function was used in estimating impacts for several of the measures. Figure 2-1 illustrates the general relationship for the adjustment functions. Negative impacts are assumed to begin accruing when the shortage percentage reaches the lower bound b1 (10 percent in Figure 2-1), with impacts then increasing linearly up to the 100 percent impact level (per unit volume) once the upper bound for adjustment reaches the b2 level shortage (50 percent in Figure 2-1 example).

Initially, the combined total value of the three value added components (direct, indirect, and induced) was calculated and then converted into a per acre-foot economic value based on historical TWDB water use estimates within each particular water use category. As an example, if the total, annual value added for livestock in the region was $2 million and the reported annual volume of water used in that industry was 10,000 acre-feet, the estimated economic value per acre-foot of water shortage would be $200 per acre-foot. Negative economic impacts of shortages were then estimated using this value as the maximum impact estimate ($200 per acre-foot in the example) applied to the anticipated shortage volume in acre-feet and adjusted by the economic impact elasticity function. This adjustment varied with the severity as percentage of water demand of the anticipated shortage. If one employed the sample elasticity function shown in Figure 2-1, a 30% shortage in the water use category would imply an economic impact estimate of 50% of the original $200 per acre-foot impact value (i.e., $100 per acre-foot).

Such adjustments were not required in estimating consumer surplus, nor for the estimates of utility revenue losses or utility tax losses. Estimates of lost consumer surplus relied on city-specific demand curves with the specific lost consumer surplus estimate calculated based on the relative percentage of the city's water shortage. Estimated changes in population as well as changes in school enrollment were indirectly related to the elasticity of job losses.

Assumed values for the bounds b1 and b2 varied with water use category under examination and are presented in Table 2-2.

Figure 2-1 Example Economic Impact Elasticity Function (as applied to a single water user's shortage)

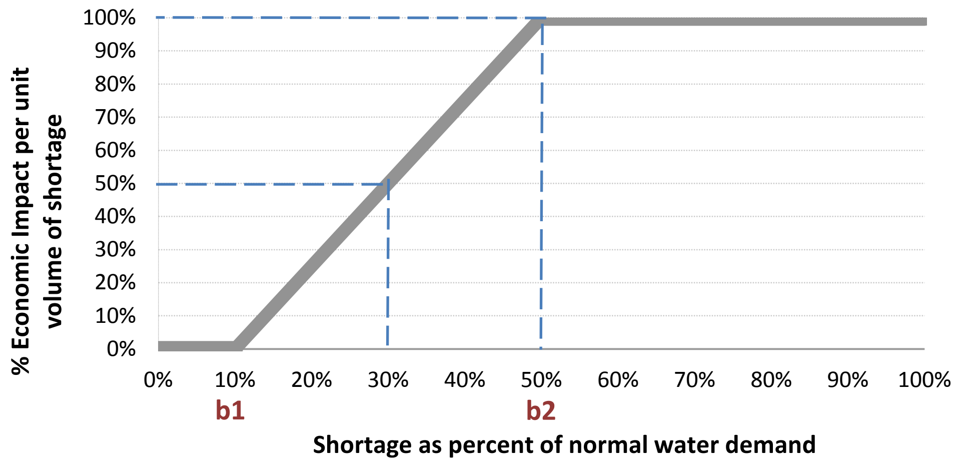

Table 2-2 Economic Impact Elasticity Function Lower and Upper Bounds

Water use category	Lower Bound (b1)	Upper Bound (b2)
Irrigation	5%	50%
Livestock	5%	10%
Manufacturing	10%	50%
Mining	10%	50%
Municipal (non-residential water intensive)	50%	80%
Steam-electric power	20%	70%

2.3 Analysis Assumptions and Limitations

Modeling of complex systems requires making assumptions and accepting limitations. This is particularly true when attempting to estimate a wide variety of economic impacts over a large geographic area and into future decades. Some of the key assumptions and limitations of the methodology include:

1. The foundation for estimating socioeconomic impacts of water shortages resulting from a drought are the water needs (potential shortages) that were identified as part of the regional water planning process. These needs have some uncertainty associated with them, but serve as a reasonable basis for evaluating potential economic impacts of a drought of record event.

2. All estimated socioeconomic impacts are snapshot estimates of impacts for years in which water needs were identified (i.e., 2020, 2030, 2040, 2050, 2060, and 2070). The estimates are independent and distinct "what if" scenarios for each particular year, and water shortages are assumed to be temporary events resulting from severe drought conditions. The evaluation assumed that no recommended water management strategies are implemented. In other words, growth occurs, future shocks are imposed on an economy at 10-year intervals, and the resulting impacts are estimated. Note that the estimates presented were not cumulative (i.e., summing up expected impacts from today up to the decade noted), but were simply an estimate of the magnitude of annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated supplies and demands for that same decade.

3. Input-output models such as IMPLAN rely on a static profile of the structure of the economy as it appears today. This presumes that the relative contributions of all sectors of the economy would remain the same, regardless of changes in technology, supplies of limited resources, and other structural changes to the economy that may occur into the future. This was a significant assumption and simplification considering the 50-year time period examined in this analysis. To presume an alternative future economic makeup, however, would entail positing many other major assumptions that would very likely generate as much or more error.

4. This analysis is not a cost-benefit analysis. That approach to evaluating the economic feasibility of a specific policy or project employs discounting future benefits and costs to their present value dollars using some assumed discount rate. The methodology employed in this effort to estimate the economic impacts of future water shortages did not use any discounting procedures to weigh future costs differently through time.

5. Monetary figures are reported in constant year 2013 dollars.

6. Impacts are annual estimates. The estimated economic model does not reflect the full extent of impacts that might occur as a result of persistent water shortages occurring over an extended duration. The drought of record in most regions of Texas lasted several years.

7. Value added estimates are the primary estimate of the economic impacts within this report. One may be tempted to add consumer surplus impacts to obtain an estimate of total adverse economic impacts to the region, but the consumer surplus measure represents the change to the wellbeing of households (and other water users), not an actual change in the flow of dollars through the economy. The two categories (value added and consumer surplus) are both valid impacts but should not be summed.

8. The value added, jobs, and taxes on production and import impacts include the direct, indirect and induced effects described in Section 2.2.1. Population and school enrollment losses also indirectly include such effects as they are based on the associated losses in employment. The remaining measures (consumer surplus, utility revenue, utility taxes, additional electrical power purchase costs, and potable water trucking costs), however, do not include any induced or indirect effects.

9. The majority of impacts estimated in this analysis may be considered smaller than those that might occur under drought of record conditions. Input-output models such as IMPLAN only capture "backward linkages" on suppliers (including households that supply labor to directly affected industries). While this is a common limitation in these types of economic impact modeling efforts, it is important to note that "forward linkages" on the industries that use the outputs of the directly affected industries can also be very important. A good example is impacts on livestock operators. Livestock producers tend to suffer substantially during droughts, not because there is not enough water for their stock, but because reductions in available pasture and higher prices for purchased hay have significant economic effects on their operations. Food processors could be in a similar situation if they cannot get the grains or other inputs that they need. These effects are not captured in IMPLAN, which is one reason why the impact estimates are likely conservative.

10. The methodology did not capture "spillover" effects between regions – or the secondary impacts that occur outside of the region where the water shortage is projected to occur.

11. The model did not reflect dynamic economic responses to water shortages as they might occur, nor does the model reflect economic impacts associated with a recovery from a drought of record including:
    a. The likely significant economic rebound to the landscaping industry immediately following a drought;
    b. The cost and years to rebuild liquidated livestock herds (a major capital item in that industry);
    c. Direct impacts on recreational sectors (i.e., stranded docks and reduced tourism); or,
    d. Impacts of negative publicity on Texas' ability to attract population and business in the event that it was not able to provide adequate water supplies for the existing economy.

12. Estimates for job losses and the associated population and school enrollment changes may exceed what would actually occur. In practice, firms may be hesitant to lay off employees, even in difficult economic times. Estimates of population and school enrollment changes are based on regional evaluations and therefore do not accurately reflect what might occur on a statewide basis.

13. The results must be interpreted carefully. It is the general and relative magnitudes of impacts as well as the changes of these impacts over time that should be the focus rather than the absolute numbers. Analyses of this type are much better at predicting relative percent differences brought about by a shock to a complex system (i.e., a water shortage) than the precise size of an impact. To illustrate, assuming that the estimated economic impacts of a drought of record on the manufacturing and mining water user categories are $2 and $1 million, respectively, one should be more confident that the economic impacts on manufacturing are twice as large as those on mining and that these impacts will likely be in the millions of dollars. But one should have less confidence that the actual total economic impact experienced would be $3 million.

3 Analysis Results

This section presents a breakdown of the results of the regional analysis for Region B. Projected economic impacts for six water use categories (irrigation, livestock. municipal, manufacturing, mining, and steam-electric power) are also reported by decade.

Overview of the Regional Economy

Table 3-1 presents the 2011 economic baseline as represented by the IMPLAN model and adjusted to 2013 dollars for Region B. In year 2011, Region B generated about $9.8 billion in gross state product associated with 111,000 jobs based on the 2011 IMPLAN data. These values represent an approximation of the current regional economy for a reference point.

Table 3-1 Region B Economy

Income($ millions)*	Jobs	Taxes on production and imports ($ millions)
$9,842	**110,830**	**$982**

***Year 2013 dollars based on 2011 IMPLAN model value added estimates for the region.**

The remainder of Section 3 presents estimates of potential economic impacts for each water use category that could reasonably be expected in the event of water shortages associated with a drought of record and if no recommended water management strategies were implemented.

3.1 Impacts for Irrigation Water Shortages

Seven of the 11 counties in the region are projected to experience water shortages in the irrigation water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 3-2. Note that tax collection impacts were not estimated for this water use category. IMPLAN data indicates a negative tax impact (i.e., increased tax collections) for the associated production sectors, primarily due to past subsidies from the federal government. Two factors led to excluding any reported tax impacts: 1) Federal support (subsidies) has lessened greatly since the year 2011 IMPLAN data was collected, and 2) It was not considered realistic to report increasing tax revenue collections for a drought of record.

Table 3-2 Impacts of Water Shortages on Irrigation Sector in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$3	$3	$4	$4	$5	$5
Job losses	54	64	74	80	88	96

***** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.2 Impacts for Livestock Water Shortages

Four of the 11 counties in the region are projected to experience water shortages in the livestock water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 3-3. Note that tax impacts are not reported for this water use category for similar reasons that apply to the irrigated agriculture water use category described above.

Table 3-3 Impacts of Water Shortages on Livestock Sector in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$20	$20	$20	$20	$20	$20
Jobs losses	588	587	587	587	587	587

***** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.3 Impacts for Municipal Water Shortages

Five of the 11 counties in the region are projected to experience water shortages in the municipal water use category for one or more decades within the planning horizon. Impact estimates were made for the two subtypes of use within municipal use: residential, and non-residential. The latter includes commercial and institutional users. Consumer surplus measures were made for both residential and non-residential demands. In addition, available data for the non-residential, water-intensive portion of municipal demand allowed use of IMPLAN and TWDB Water Use Survey data to estimate income loss, jobs, and taxes. Trucking cost estimates, calculated for shortages exceeding 80 percent, assumed a fixed cost of $20,000 per acre-foot to transport water for municipal use. The estimated impacts to this water use category appear in Table 3-4.

Table 3-4 Impacts of Water Shortages on Municipal Water Users in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses[1] ($ millions)*	$0	$2	$3	$4	$6	$7
Job losses[1]	4	35	62	87	114	145
Tax losses on production and imports[1] ($ millions)*	$0	$0	$0	$0	$1	$1
Consumer surplus losses ($ millions)*	$4	$5	$6	$7	$8	$10
Trucking costs ($ millions)*	-	-	-	-	-	-
Utility revenue losses ($ millions)*	$19	$21	$22	$23	$24	$26
Utility tax revenue losses ($ millions)*	$0	$0	$0	$0	$0	$0

1 Estimates apply to the water-intensive portion of non-residential municipal water use.
**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.4 Impacts of Manufacturing Water Shortages

Manufacturing water shortages in the region are projected to occur in 2 of the 11 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 3-5.

Table 3-5 Impacts of Water Shortages on Manufacturing in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$157	$178	$203	$223	$230	$236
Job losses	1,964	2,230	2,538	2,798	2,877	2,958
Tax losses on production and Imports ($ millions)*	$9	$10	$12	$13	$13	$14

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.5 Impacts of Mining Water Shortages

Mining water shortages in the region are projected to occur in 4 of the 11 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use type appear in Table 3-6.

Table 3-6 Impacts of Water Shortages on Mining in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$462	$150	$110	$55	$18	$18
Job losses	2,201	717	523	264	84	84
Tax losses on production and Imports ($ millions)*	$87	$28	$21	$10	$3	$3

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000***

3.6 Impacts of Steam-Electric Water Shortages

Steam-electric water shortages in the region are projected to occur in 2 of the 11 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 3-7.

Note that estimated economic impacts to steam-electric water users:

- Are reflected as an income loss proxy in the form of the estimated additional purchasing costs for power from the electrical grid that could not be generated due to a shortage;
- Do not include estimates of impacts on jobs. Because of the unique conditions of power generators during drought conditions and lack of relevant data, it was assumed that the industry would retain, perhaps relocating or repurposing, their existing staff in order to manage their ongoing operations through a severe drought.
- Does not presume a decline in tax collections. Associated tax collections, in fact, would likely increase under drought conditions since, historically, the demand for electricity increases during times of drought, thereby increasing taxes collected on the additional sales of power.

Table 3-7 Impacts of Water Shortages on Steam-Electric Power in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income Losses ($ millions)*	$2	$2	$13	$30	$54	$84

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a***

zero ($0) indicate income losses less than $500,000.

3.7 Regional Social Impacts

Projected changes in population, based upon several factors (household size, population, and job loss estimates), as well as the accompanying change in school enrollment, were also estimated and are summarized in Table 3-8.

Table 3-8 Region-wide Social Impacts of Water Shortages in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Consumer surplus losses ($ millions)*	$4	$5	$6	$7	$8	$10
Population losses	883	667	695	701	689	711
School enrollment losses	163	123	129	130	127	132

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

Appendix A - County Level Summary of Estimated Economic Impacts for Region B

County level summary of estimated economic impacts of not meeting identified water needs by water use category and decade (in 2013 dollars, rounded). Values presented only for counties with projected economic impacts for at least one decade.

**** Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000***

		Income losses (Million $)*						Job losses						Consumer Surplus (Million $)*					
County	Water Use Category	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
ARCHER	IRRIGATION	$0	$0	$0	$0	$0	$0	2	2	2	3	3	3	-	-	-	-	-	-
ARCHER	MINING	$113	$148	$87	$54	$16	$16	541	706	414	257	76	76	-	-	-	-	-	-
ARCHER	MUNICIPAL	$0	$2	$2	$2	$3	$3	4	33	44	50	59	70	$0	$1	$1	$1	$1	$1
ARCHER Total		**$114**	**$150**	**$89**	**$56**	**$19**	**$20**	**546**	**742**	**460**	**309**	**138**	**150**	**$0**	**$1**	**$1**	**$1**	**$1**	**$1**
BAYLOR	IRRIGATION	$0	$0	$0	$0	$0	$0	-	-	-	-	-	-	-	-	-	-	-	-
BAYLOR	LIVESTOCK	$15	$15	$15	$15	$15	$15	436	435	435	435	435	435	-	-	-	-	-	-
BAYLOR	MINING	$1	$2	$2	$2	$2	$2	7	10	8	8	8	8	-	-	-	-	-	-
BAYLOR Total		**$16**	**$17**	**$16**	**$16**	**$16**	**$16**	**443**	**446**	**443**	**443**	**443**	**443**	**-**	**-**	**-**	**-**	**-**	**-**
CLAY	IRRIGATION	$0	$0	$0	$0	$0	$0	-	-	-	-	-	-	-	-	-	-	-	-
CLAY	MUNICIPAL	-	-	-	$0	$0	$0	-	-	-	-	2	3	$0	$0	$0	$0	$0	$0
CLAY Total		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**-**	**-**	**-**	**-**	**2**	**3**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
HARDEMAN	IRRIGATION	$0	$0	$0	$0	$0	$0	8	7	6	5	5	5	-	-	-	-	-	-
HARDEMAN Total		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**8**	**7**	**6**	**5**	**5**	**5**	**-**	**-**	**-**	**-**	**-**	**-**
MONTAGUE	IRRIGATION	$0	$0	$0	$0	$0	$0	-	-	-	-	-	-	-	-	-	-	-	-
MONTAGUE	LIVESTOCK	$5	$5	$5	$5	$5	$5	152	152	152	152	152	152	-	-	-	-	-	-
MONTAGUE	MINING	$347	-	$21	-	-	-	1,654	-	101	-	-	-	-	-	-	-	-	-
MONTAGUE Total		**$352**	**$5**	**$27**	**$5**	**$5**	**$5**	**1,806**	**152**	**253**	**152**	**152**	**152**	**-**	**-**	**-**	**-**	**-**	**-**
WICHITA	IRRIGATION	$2	$3	$4	$4	$5	$5	44	54	66	72	80	88	-	-	-	-	-	-
WICHITA	MANUFACTURING	$157	$178	$203	$223	$230	$236	1,964	2,230	2,538	2,798	2,877	2,958	-	-	-	-	-	-
WICHITA	MUNICIPAL	-	$0	$1	$2	$3	$4	-	2	18	37	54	72	$3	$4	$5	$6	$8	$9
WICHITA	STEAM-ELECTRIC POWER	$2	$2	$3	$3	$3	$3	-	-	-	-	-	-	-	-	-	-	-	-
WICHITA Total		**$162**	**$184**	**$210**	**$232**	**$240**	**$248**	**2,008**	**2,285**	**2,622**	**2,907**	**3,011**	**3,118**	**$3**	**$4**	**$5**	**$6**	**$8**	**$9**
WILBARGER	MUNICIPAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	$0	$0	$0	$0
WILBARGER	STEAM-ELECTRIC POWER	-	-	$10	$27	$51	$80	-	-	-	-	-	-	-	-	-	-	-	-
WILBARGER Total		**-**	**-**	**$10**	**$27**	**$51**	**$80**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**$0**	**$0**	**$0**	**$0**

		Income losses (Million $)*						Job losses						Consumer Surplus (Million $)*					
County	Water Use Category	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
YOUNG	MUNICIPAL	-	-	-	-	-	-	-	-	-	-	-	-	$0	$0	$0	$0	$0	$0
YOUNG Total		-	-	-	-	-	-	-	-	-	-	-	-	$0	$0	$0	$0	$0	$0
Regional Total		$644	$356	$352	$338	$332	$370	4,812	3,633	3,785	3,817	3,750	3,870	$4	$5	$6	$7	$8	$10

APPENDIX F

CONSISTENCY MATRIX

2016 FINAL PLAN

REGION B

DECEMBER 2015

APPENDIX F
CONSISTENCY MATRIX
Title 31 Texas Administrative Code Chapters 357 and 358 Regulations Pertaining to the 2016 Plan

Regulatory Citation	Summary of Requirement	2016 Plan Compliance (Yes/No)	Location(s) in the Regional Plan and/or Other Commentary
31 TAC §357.11			
(d)(1)-(12)	RWPGs shall maintain at least one representative of the following interest categories as voting members: public, counties, municipalities, industries, agricultural interests, environmental interests, small businesses, electric generating utilities, river authorities, water districts, water utilities, and groundwater management areas.	Yes	The Executive Summary and Chapter 10 provide a list of current voting members of the RWPG and the interests they represent.
(e)(1)-(5)	Non-voting members will receive the same meeting notifications and information as voting members. Non voting members are to include: staff members from the Board, from Texas Parks and Wildlife, from the Texas Department of Agriculture, and from each adjacent RWPG; persons to represent entities which are located in another RWPA but which diverts, supplies, or receives 1,000 acre-feet a year or more in , to, or from the RWPA.	Yes	The Executive Summary provides a list of current non-voting members of the RWPG.
31 TAC §357.12			
(b)	A RWPG shall hold a public meeting to determine the process for identifying potentially feasible water management strategies. Input from the public meeting will be documented. All possible water management strategies that are potentially feasible for meeting needs in the region will be listed.	Yes	The process used to identify potentially feasible WMSs was addressed in two regularly scheduled meetings of the RWPG. Appendix D lists all potentially feasible WMSs identified.
31 TAC §357.20			
	Development of RWPs shall be guided by the principles stated in Title 31 §358.3 (relating to Guidance Principles).	Yes	See 31 TAC §358.3 below.
31 TAC §357.21			
(b)	Public notice requirements for regular RWPG meetings and meetings where the following were considered: amendments to the RWP scope or budget, process for identification of potentially feasible water management strategies, member addition or replacement, and adoption of water plans.	Yes	Public notice requirements were met and are addressed in Chapter 10.
(c)	Public notice requirements for meetings where the following items were considered: population projection and water demand projection revisions, substitution of alternative water management strategies, and minor amendments to the RWPs.	Yes	Public notice requirements were met and are addressed in Chapter 10.
(d)	Public notice requirements for holding a preplanning public meeting to obtain public input on development of the next RWP; major amendments to RWPs; holding hearings for IPPs; and requesting research and planning funds from the Board.	Yes	Public notice requirements were met and are addressed in Chapter 10.

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Regulatory Citation	Summary of Requirement	2016 Plan Compliance (Yes/No)	Location(s) in the Regional Plan and/or Other Commentary
31 TAC §357.22			
(a)	RWPGs shall consider existing local, regional, and state water planning efforts, including water plans, information and relevant local, regional, state and federal programs and goals when developing the regional water plan. RWPGs must also consider:	Yes	Relevant State and federal programs and goals are addressed primarily in Chapter 1. As appropriate, water plans of specific WUGs have been considered in the evaluation of WMSs in Chapter 5. Coordination with Regions A, C, G, and O (all adjacent to Region B) has occurred and planning efforts of these regions considered.
(a)(1)	water conservation plans;	Yes	Chapter 5 addresses water conservation efforts in the region and summarizes water conservation plans reviewed.
(a)(2)	drought management and drought contingency plans;	Yes	Chapter 7 addresses drought management and drought contingency within the region and summarizes drought management and drought contingency plans reviewed.
(a)(3)	information compiled by the Board from water loss audits performed by retail public utilities;	Yes	Chapter 5 describes information on water loss audits.
(a)(4)	publicly available plans for major agricultural, municipal, manufacturing and commercial water users;	Yes	Publicly available plans for major agricultural, municipal, manufacturing, and commercial water users were not identified. However, the demand projections for each use category were reviewed at several meetings as documented in Chapter 10.
(a)(5)	local and regional water management plans;	Yes	Chapter 1 summarizes local and regional water management plans identified in the RWPA. Information from the Wichita Falls water plan is considered in Chapter 5.
(a)(6)	water availability requirements;	Yes	Water availability is addressed primarily in Chapter 3.
(a)(7)	the Texas Clean Rivers Program;	Yes	Chapter 6 references the Texas Clean Rivers program. Where relevant, water quality data from the program were used.

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Regulatory Citation	Summary of Requirement	2016 Plan Compliance (Yes/No)	Location(s) in the Regional Plan and/or Other Commentary
(a)(8)	the U.S. Clean Water Act;	Yes	Chapter 6 references the CWA; the CWA is a cornerstone of the water planning process and central to the planning process for the 2016 Plan.
(a)(9)	water management plans;	Yes	See above.
(a)(10)	other planning goals including regionalization of water and wastewater services where appropriate;	Yes	Regionalization of water and wastewater services has been considered where appropriate. Chapter 5 includes WMSs that may address regionalization.
(a)(11)	approved groundwater conservation district management plans and other plans submitted	Yes	Groundwater Conservation Districts have been included, where appropriate, in Chapters 1, 3, 5, and 7.
(a)(12)	approved groundwater regulatory plans; and	Yes	See above.
(a)(13)	any other information available from existing local or regional water planning studies.	Yes	See above.
(b)	The following sections from Title 31 should have a separate chapter in the RWP devoted to their contents: §§357.30, 357.31, 357.32, 357.33, 357.42, 357.43, 357.44, 357.45, 357.50, 357.34, 357.35, 357.40, and 357.41	Yes	The 2016 Plan contains chapters as required by the rules and TWDB Guidance.
31 TAC §357.30			
	The description of the RWP area must include a description of the following 12 criteria:		
(1)	social and economic aspects of a region such as information on current population, economic activity and economic sectors heavily dependent on water resources;	Yes	Chapter 1 describes the social and economic aspects of the region relative to water resources.
(2)	current water use and major water demand centers;	Yes	Chapters 1 and 2 include current water use and major water demand centers.
(3)	current groundwater, surface water, and reuse supplies including major springs that are important for water supply or protection of natural resources;	Yes	Chapter 1 generally describes groundwater, surface water, reuse, and springs. Chapter 3 includes more specific information on groundwater, surface water, and reuse sources that are, or may be, used for water supply.

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Regulatory Citation	Summary of Requirement	2016 Plan Compliance (Yes/No)	Location(s) in the Regional Plan and/or Other Commentary
(4)	wholesale water providers;	Yes	Chapter 1 identifies the region's WWPs. Chapters 2 and 3 describe WWP demands and supply. Chapter 5 addresses WMSs for each WWP in the region.
(5)	agricultural and natural resources;	Yes	Chapter 1 provides a description of the agricultural and natural resources of the region; Chapter 6 describes protection of these resources.
(6)	identified water quality problems;	Yes	Chapters 1 and 3 provide a discussion of water quality problems that may be relevant to regional water planning. To the extent possible, water quality issues are considered in the evaluation of WMSs in Chapter 5.
(7)	identified threats to agricultural and natural resources due to water quantity problems or water quality problems related to water supply;	Yes	Chapters 1 and 6 describe threats to agricultural and natural resources due to water quantity or quality issues.
(8)	summary of existing local and regional water plans;	Yes	Chapter 1 contains descriptions of relevant existing local and regional water plans.
(9)	the identified historic drought(s) of record within the planning area;	Yes	Chapters 1 and 7 contain a discussion of historic droughts of record within the RWPA.
(10)	current preparations for drought within the RWPA;	Yes	Chapters 1 and 7 describe current preparations for drought within the region.
(11)	information compiled by the Board from water loss audits performed by retail public utilities; and	Yes	Chapters 5 summarizes water loss audits compiled by the TWDB.
(12)	an identification of each threat to agricultural and natural resources and a discussion of how that threat will be addressed or affected by the water management strategies evaluated in the plan.	Yes	Chapters 1 and 6 describe threats to agricultural and natural resources due to water quantity or quality issues. Chapter 5 provides a discussion of how WMSs address threats.

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Regulatory Citation	Summary of Requirement	2016 Plan Compliance (Yes/No)	Location(s) in the Regional Plan and/or Other Commentary
31 TAC §357.31			
(a); (f)	RWPs shall present projected population and WUG water demands for each planning decade.	Yes	Chapter 2 provides projections of population and WUG water demands for the period 2020-2070.
(b)	RWPs shall present projected water demands associated with WWPs by category of water use, including municipal, manufacturing, irrigation, steam electric power generation, mining, and livestock for each county or portion of a county in the RWPA.	Yes	Chapter 2 provides projections of WWP water demands for all categories of water use. Appendix G contains a summary of WWP demands by category, county, and basin.
(c)	RWPs shall report the current contractual obligations of WUG and WWPs to supply water in addition to any demands projected for the WUG or WWP.	Yes	Chapter 2 reports current contractual obligations of WUGs and WWPs.
(d)	Municipal demands shall be adjusted to reflect water savings due to plumbing fixture requirements identified in the Texas Health and Safety Code, Chapter 372.	Yes	Municipal demands, addressed in Chapter 2, include water savings due to plumbing fixture requirements. Chapters 5, 9, and 11 include further discussion of water conservation measures.
(e)(1)-(2)	RWPs are to use population and water demands developed by the EA for the next water plan or use population and water demands revisions (only if requested).	Yes	Population projections and municipal water demands developed by the EA were used in development of the RWP; projections are presented in Chapter 2.
31 TAC §357.32			
(a)(1)-(2)	RWPGs shall evaluate the source water availability and existing water supplies that are legally available to WUGs and wholesale water providers during drought conditions.	Yes	Water availability, addressed in Chapter 3, includes water legally available to WUGs and WWPs during drought conditions.
(b); (c); (d)	RWPG evaluations shall consider surface water (firm yield unless otherwise requested) and groundwater (modeled, Board-issued) data from the state water plan, existing water rights, contracts and option agreements relating to water rights, other planning and water supply studies, and analysis of water supplies existing in and available to the RWPA during drought of record conditions.	Yes	The availability of water addressed in Chapter 3 included consideration of the requirements of this section. WMS evaluations in Chapter 5 used Chapter 3 availability.
(e)-(f)	RWPGs shall evaluate the existing water supplies for each WUG and WWP; existing contractual agreements should be taken into account.	Yes	Contractual agreements were taken into account as appropriate in the development of existing water supplies presented in Chapter 3.

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Regulatory Citation	Summary of Requirement	2016 Plan Compliance (Yes/No)	Location(s) in the Regional Plan and/or Other Commentary
31 TAC §357.33			
(a); (b); (d)	RWPs shall include, for each planning decade, comparisons of existing water supplies and projected water demands to determine whether WUGs will experience water surpluses or needs for additional supplies. Results will be reported for WUGs and for WWPs by use categories described in §357.31 (b)	Yes	Chapter 4 provides a comparison of water demands to supplies to determine surplus or needs for each WUG and WWP. WUG results are reported in Appendix B.
(c)	Social and economic impacts of water shortages will be evaluated.	See Comment	A socioeconomic impact analysis prepared by the TWDB is presented in Appendix E and summarized in Chapter 6.
(e)	RWPGs shall perform a secondary water needs analysis (calculating water needs remaining after all conservation and direct reuse strategies are implemented) for all WUGs and WWPs for which conservation water management strategies or direct reuse water management strategies are recommended.	See Comment	Secondary water needs analyses were performed for WUGs and WWPS for which conservation WMSs were recommended. The needs analysis considering water conservation is presented in Chapter 5.
31 TAC §357.34			
(a) & (b)	RWPGs shall identify and evaluate potentially feasible water management strategies for all WUGs and WWPs with identified water needs. The strategies shall meet new water supply obligations necessary to implement recommended water management strategies of WWPs and WUGs. RWPGs shall plan for water supply during Drought of Record conditions. In developing RWPs, RWPGs shall provide WMSs to be used during a drought of record.	Yes	Chapter 5 provides an identification and evaluation of potentially feasible WMSs for WUGs and WWPs.
(c)	Potentially feasible WMSs may include expanded use of existing supplies; new supply development; conservation and drought management measures; reuse; interbasin transfers of surface water; emergency transfers of surface water.	Yes	Chapter 5 describes the types of WMSs used in the 2016 Plan.
(d)(1)	Evaluations of potentially feasible water management strategies shall use the Commission's most current Water Availability Model and shall include the following analyses:	Yes	Chapter 3 describes the use of the WAM in the 2016 Plan. Strategies evaluated in Chapter 5 utilize available water supplies identified in Chapter 3.
(d)(2)	An equitable comparison between and consistent evaluation and application of all water management strategies the RWPGs determine to be potentially feasible for each water supply need	Yes	Chapter 5 contains WMS evaluations.
(d)(3)(A)-(C)&(d)(5)	A quantitative reporting of: the net quantity, reliability, and cost of water delivered and treated for the end user's requirements during drought of record conditions; all applicable environmental factors; and impacts to natural and agricultural resources (including threats).	Yes	Chapter 5 contains WMS evaluations.

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Regulatory Citation	Summary of Requirement	2016 Plan Compliance (Yes/No)	Location(s) in the Regional Plan and/or Other Commentary
(d)(4); (d)(7)	A discussion of this RWP's impact on other water resources of the state and on local third-party social and environmental impacts.	Yes	Chapters 5 and 6 contain discussion of impacts on other water resources of the state and on local third-party social and environmental impacts.
(d)(8)	A description of the major impacts of recommended water management strategies on key parameters of water quality, comparing current conditions to recommended strategies.	Yes	Chapters 1, 3, and 6 address issues of key parameters of water quality. Where appropriate, water quality is considered in the evaluations of WMSs in Chapter 5.
(d)(9)	Consideration of water pipelines and other facilities that are currently used for water conveyance.	Yes	Chapter 5 includes consideration of conveyance for WMSs.
(f)(1); (f)(2)(A)-(D)	Conservation, Drought Management Measures, and Drought Contingency Plans shall be considered by RWPGs when developing the regional plans. Water conservation practices shall be included for each WUG beyond minimum requirements. Any interbasin water transfers will also include a water conservation strategy. Any water loss audits shall be addressed.	Yes	Chapters 5 and 7 contain most of the required information regarding conservation and drought management measures for each WUG.
(g)	RWPs shall include a subchapter consolidating the RWPG's recommendations regarding water conservation.	Yes	Summaries of the RWPG's recommendations regarding water conservation are included in Chapter 5.
31 TAC §357.35			
(a);(b);(c);(f)	RWPGs shall recommend water management strategies to be used during a drought of record. Potentially feasible water management strategies shall be specific, cost effective, environmentally sensitive, and consistent with the long-term protection of the state's water, agricultural, and natural resources. Strategies shall protect existing water rights, water contracts, and option agreements.	Yes	Chapter 5 contains a list of potentially feasible WMSs identified. Chapter 5 evaluations were performed using a drought of record as a basis for the 2016 Plan.
(d)	Water management strategies shall meet all water needs for drought conditions, except when no water management strategy is feasible or when a political subdivision that provides water explicitly does not participate.	Yes	Chapter 5 WMSs were designed to meet water needs for drought conditions.
(g)(1)	RWPGs shall report recommended water management strategies and the associated results of all the potentially feasible water management strategy evaluations by WUG and WWP.	Yes	Chapter 5 and associated appendices report results by WUG and WWP.

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Regulatory Citation	Summary of Requirement	2016 Plan Compliance (Yes/No)	Location(s) in the Regional Plan and/or Other Commentary
(g)(2)	Calculated supply factors for each WUG and WWP, by entity and planning decade, shall be calculated based on the sum of the total existing water supplies, plus all water supplies from recommended water management strategies; divided by total projected water demand.	Yes	Supply factors are presented in Appendix G.
(g)(3)	Fully evaluated Alternative Water Management Strategies included in the adopted RWP shall be presented together in one place in the RWP.	Yes	Chapter 5 presents a summary of Alternative WMSs evaluated.
31 TAC §357.40			
(a)	RWPs shall include a quantitative description of the socioeconomic impacts of not meeting the identified water needs.	Yes	Appendix E contains a socioeconomic impact analysis prepared by the TWDB.
(b)(1)-(6)	RWPs shall include a description of the impacts of the RWP regarding agricultural resources, other water resources of the state, threats to agricultural and natural resources, third-party social and economic impacts resulting from voluntary water redistributions, water quality, and effects on navigation.	Yes	Chapter 6 contains discussion of impacts on other water resources of the state and on local third-party social and environmental impacts.
(c)	RWPs shall include a summary of the identified water needs that remain unmet by the RWP.	Yes	Chapters 5 and 6 include a summary of unmet needs.
31 TAC §357.41			
	RWPGs shall describe how RWPs are consistent with the long-term protection of the state's water resources, agricultural resources, and natural resources.	Yes	Chapter 6 provides a demonstration of how the 2016 Plan is consistent with the long-term protection of the state's water resources, agricultural resources, and natural resources
31 TAC §357.42			
(a)	RWPs shall consolidate and present information on current and planned preparations for, and responses to, drought conditions in the region including drought of record conditions based on the following subsections:	See following sections	
(b);(c)	RWPGs shall conduct an overall assessment of current preparations for drought and develop drought response recommendations for groundwater and surface water sources.	Yes	Chapter 7 describes current preparations for drought within the region.
(d);(e)	RWPGs will collect (in a closed meeting) and submit (separately to the EA) information on existing major water infrastructure facilities that may be used for interconnections in event of an emergency shortage of water and will provide descriptions of local drought contingency plans that involve making emergency connections.	Yes	Chapter 7 describes emergency interconnections. Information related to existing interconnections is considered confidential and was not presented in the 2016 Plan.

APPENDIX F
CONSISTENCY MATRIX
Title 31 Texas Administrative Code Chapters 357 and 358 Regulations Pertaining to the 2016 Plan

Regulatory Citation	Summary of Requirement	2016 Plan Compliance (Yes/No)	Location(s) in the Regional Plan and/or Other Commentary
(g)	The RWPGs shall evaluate, for all applicable municipal WUGs, potential emergency responses to local drought conditions or loss of existing water supplies, including identification of potential alternative water sources that may be considered for temporary emergency use.	Yes	Chapter 7 describes potential emergency responses to drought within the region.
(h)	RWPGs shall consider any relevant recommendations from the Drought Preparedness Council.	Yes	Relevant recommendations from the Drought Preparedness Council have been considered in Chapter 7.
(i); (i)(1)-(4)	RWPGs shall make drought preparation and response recommendations regarding local drought contingency plans; current drought management preparations, including drought response triggers and responses to drought conditions; and The Drought Preparedness Council and the State Drought Preparedness Plan.	Yes	Chapter 7 contains recommendations regarding local drought contingency plans and preparations.
(j)	The RWPGs shall develop region-specific model drought contingency plans.	Yes	Chapter 7 references model drought contingency plans with reference to the Region B web site where the modle plans can be obtained.
31 TAC §357.43			
(a); (d)	The RWPs shall contain any regulatory, administrative, or legislative recommendations developed by the RWPGs, including those that the RWPG believes are needed and desirable to facilitate the orderly development, management, and conservation of water resources and prepare for and respond to drought conditions.	Yes	Chapter 8 includes relevant regulatory, administrative, and legislative recommendations of the RWPG.
(b); (c)	If "Ecologically Unique River and Stream Segments" and "Unique Sites for Reservoir Construction" are designated by the RWPGs, the RWP should include relevant descriptions, value, and other relevant criteria, as described in this section.	Yes	Chapter 8 addresses ecologically unique river and stream segments and unique sites for reservoir construction.
31 TAC §357.44			
	RWPGs shall assess and quantitatively report on how individual local governments, regional authorities, and other political subdivisions in their RWPA propose to finance recommended water management strategies.	See Comment	The TWDB will provide an infrastructure financing report to the RWPG after submittal of the IPP. Chapter 9 and an associated Appendix will summarize the proposed financing.

APPENDIX F
CONSISTENCY MATRIX
Title 31 Texas Administrative Code Chapters 357 and 358 Regulations Pertaining to the 2016 Plan

Regulatory Citation	Summary of Requirement	2016 Plan Compliance (Yes/No)	Location(s) in the Regional Plan and/or Other Commentary
31 TAC §357.45			
(a)	RWPGs shall describe the level of implementation of previously recommended water management strategies, recommended in the previous RWP, including conservation and drought management water management strategies; and the implementation of projects that have affected progress in meeting the state's future water needs.	See Comment	The TWDB will provide an Implementation Survey to the RWPG after submittal of the IPP. Chapter 11 will summarize survey results reporting implementation of the 2011 Plan WMSs.
(b)(1)-(4)	RWPGs shall provide a brief summary of how the RWP differs from the previously adopted RWP with regards to: water demand projections; drought of record and hydrologic and modeling assumptions used in planning for the region; groundwater and surface water availability, existing water supplies, and identified water needs for WUGs and WWPs; and recommended and alternative water management strategies.	Yes	Chapter 11 provides a summary of how the 2016 Plan and the 2011 Plan differ.
31 TAC §357.50			
(a)	The RWPGs shall submit their adopted RWPs to the Board every five years on a date to be disseminated by the EA.	Yes	The 2016 Plan has been adopted in accordance with a schedule provided by the EA.
(b)	Prior to the adoption of the RWP, the RWPGs shall submit concurrently to the EA and the public an IPP. The IPP shall be distributed in accordance with Title 31 §357.21(d)(5).	Yes	The 2016 IPP was submitted to the TWDB as required.
(d)(1)-(3)	When adopting a RWP the RWPGs shall solicit, and consider properly submitted written comments from the EA and from any federal or Texas state agency; and properly submitted written or oral comments from the public.	Yes	The RWPG considered comments from the EA, federal and state agencies, and the public that were submitted in response to the IPP in finalizing the 2016 Plan.
(e)(1)(A)-(C)	When submitted, RWP shall include: a technical report, an executive summary, and summaries of and responses to all comments (written and oral).	Yes	The 2016 Plan includes: a technical report, executive summary, and summaries of and responses to all IPP comments (written and oral).

APPENDIX F
CONSISTENCY MATRIX
Title 31 Texas Administrative Code Chapters 357 and 358 Regulations Pertaining to the 2016 Plan

Regulatory Citation	Summary of Requirement	2016 Plan Compliance (Yes/No)	Location(s) in the Regional Plan and/or Other Commentary
31 TAC §358.3			
(2)	The regional water plans and state water plan shall serve as water supply plans under drought of record conditions.	Yes	The supply availability and existing water supplies evaluated in Chapter 3 assume drought of record conditions. Chapters 3 and 7 describe this evaluation.
(4)	Regional water plans shall provide for the orderly development, management, and conservation of water resources and preparation for and response to drought conditions so that sufficient water will be available at a reasonable cost to satisfy a reasonable projected use of water to ensure public health, safety, and welfare; further economic development; and protect the agricultural and natural resources of the regional water planning area.	Yes	Chapter 5 presents WMS evaluations developed in response to projected demands and potential drought conditions.
(5)	Regional water plans shall include identification of those policies and action that may be needed to meet Texas' water supply needs and prepare for and respond to drought conditions.	Yes	Chapters 5 and 7 identify policies and actions that may be required to meet water supply needs and to prepare for and respond to drought conditions.
(6)	RWPG decision-making shall be open to and accountable to the public with decisions based on accurate, objective and reliable information with full dissemination of planning results except for those matters made confidential by law.	Yes	Chapter 10 summarizes public notice requirements and provides examples of how these requirements were met during the planning cycle.
(7)	The RWPG shall establish terms of participation in its water planning efforts that shall be equitable and shall not unduly hinder participation.	Yes	Chapter 10 summarizes how participation was encouraged as a part of water planning efforts in the RWPA.
(27)	RWPGs shall conduct their planning to achieve efficient use of existing water supplies, explore opportunities for and the benefits of developing regional water supply facilities or providing regional management of water facilities, coordinate the actions of local and regional water resource management agencies, provide substantial involvement by the public in the decision-making process, and provide full dissemination of planning results.	Yes	Chapter 3 discusses the evaluations of existing water supplies, Chapter 1 summarizes local and regional plans considered in the planning process, and Chapter 10 summarizes public involvement in the region.
(28)	RWPGs must consider existing regional water planning efforts when developing their plans.	Yes	Chapter 1 summarizes existing regional water plans that were considered in development of the 2016 Plan.

APPENDIX G

DATA REPORTS

2016 FINAL PLAN

REGION B

DECEMBER 2015

APPENDIX G

DB17 REPORTS
2016 FINAL PLAN
REGION B

As required by regional water planning rules and guidelines, the data used in developing the regional water plans must be reported by water user, source, county and basin. These data are incorporated into the state water planning database, hence forward called "DB17".

Data tables are developed by water user group (WUG), wholesale water provider (WWP), and water source. Unfortunately, not all of the data easily fits into the structure of DB17. Specifically, groundwater sources are not constrained by political boundaries (county and regional lines), nor by river basin divides. However, this water source is represented as such.

Water supplies must be identified by source. This includes source type (surface water, groundwater, reuse, aquifer storage and recovery or precipitation enhancement), location (reservoir, county, basin), and river basin. Water users that utilize multiple sources of water must account for the quantity and end user of each source. This structure is very difficult to represent systems that blend multiple sources of water prior to distribution. It also poses challenges to accurately represent conjunctive use strategies that use different volumes of water from each source, pending annual availability. Generally, for conjunctive use operations, the decadal averages are represented in DB17.

The following data tables represent, to the best of the consultant's ability, the essence of the regional water plan. For some water user groups, the entity sells water to other users. These sales are included in the projected water needs for the water users in the regional plan. This relationship between seller and customer are represented in DB17, but may not be reflected in the following data reports. As a result, there may be differences in projected water needs between the regional water plan chapter tables and the data reports.

Also, the report tables were developed for each user group as a whole, regardless of county or basin splits. The splitting of these data by counties and basin can result in rounding differences between the report tables and following data tables. Differences of less than 10 on a county basis are considered consistent with the regional water plan report.

While the DB17 data adequately represents the regional water plan within the constraints of the data structure, it is highly recommended that the user of this data refer to the written plan for clarification and description of the water needs and water management strategies.

Source Availability

REGION B

GROUNDWATER	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
BLAINE AQUIFER	COTTLE	RED	FRESH	4,469	4,469	4,469	4,469	4,469	4,469
BLAINE AQUIFER	FOARD	RED	FRESH	23	23	23	23	23	23
BLAINE AQUIFER	HARDEMAN	RED	FRESH	5,198	5,198	5,198	5,198	5,198	5,198
BLAINE AQUIFER	KING	BRAZOS	FRESH	6,977	6,977	6,977	6,977	6,977	6,977
BLAINE AQUIFER	KING	RED	FRESH	3,863	3,863	3,863	3,863	3,863	3,863
OTHER AQUIFER	ARCHER	BRAZOS	FRESH	33	33	33	33	33	33
OTHER AQUIFER	ARCHER	RED	FRESH	523	523	523	523	523	523
OTHER AQUIFER	ARCHER	TRINITY	FRESH	69	69	69	69	69	69
OTHER AQUIFER	CLAY	RED	FRESH	1,625	1,631	1,654	1,670	1,680	1,680
OTHER AQUIFER	CLAY	TRINITY	FRESH	375	369	346	330	320	320
OTHER AQUIFER	COTTLE	RED	FRESH	1,800	1,800	1,800	1,800	1,800	1,800
OTHER AQUIFER	KING	BRAZOS	FRESH	195	195	195	195	195	195
OTHER AQUIFER	MONTAGUE	TRINITY	FRESH	1,720	1,720	1,720	1,720	1,720	1,720
OTHER AQUIFER | ALLUVIUM	KING	RED	FRESH	455	455	455	455	455	455
OTHER AQUIFER | ALLUVIUM	MONTAGUE	RED	FRESH	2,280	2,280	2,280	2,280	2,280	2,280
OTHER AQUIFER | ALLUVIUM	WICHITA	RED	FRESH	840	840	840	840	840	840
OTHER AQUIFER | ALLUVIUM	WILBARGER	RED	FRESH	4,600	4,600	4,600	4,600	4,600	4,600
OTHER AQUIFER | COUNTY-OTHER, LIVESTOCK	BAYLOR	BRAZOS	FRESH	25	25	25	25	25	25
OTHER AQUIFER | COUNTY-OTHER, LIVESTOCK	BAYLOR	RED	FRESH	35	35	35	35	35	35
OTHER AQUIFER | LIVESTOCK	HARDEMAN	RED	FRESH	50	50	50	50	50	50
OTHER AQUIFER | MINING	FOARD	RED	FRESH	200	200	200	200	200	200
SEYMOUR AQUIFER	ARCHER	RED	FRESH	35	35	35	35	35	35
SEYMOUR AQUIFER	BAYLOR	BRAZOS	FRESH	3,168	3,168	3,168	3,168	3,168	3,168
SEYMOUR AQUIFER	BAYLOR	RED	FRESH	642	619	619	619	619	619
SEYMOUR AQUIFER	CLAY	RED	FRESH	787	787	787	787	787	787
SEYMOUR AQUIFER	FOARD	RED	FRESH	4,906	4,691	4,662	4,662	4,691	4,691
SEYMOUR AQUIFER	HARDEMAN	RED	FRESH	430	430	431	431	431	431
SEYMOUR AQUIFER	WICHITA	RED	FRESH	2,295	2,295	2,288	2,291	2,291	2,291
SEYMOUR AQUIFER	WILBARGER	RED	FRESH	29,421	29,421	29,421	29,297	28,925	28,925
TRINITY AQUIFER	MONTAGUE	RED	FRESH	129	129	129	129	129	129
TRINITY AQUIFER	MONTAGUE	TRINITY	FRESH	2,545	2,545	2,545	2,545	2,545	2,545
GROUNDWATER TOTAL SOURCE AVAILABILITY				**79,713**	**79,475**	**79,440**	**79,319**	**78,976**	**78,976**

Source Availability

REGION B

REUSE	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
DIRECT REUSE | CITY OF BOWIE	MONTAGUE	TRINITY	FRESH	324	327	325	0	0	0
REUSE TOTAL SOURCE AVAILABILITY				**324**	**327**	**325**	**0**	**0**	**0**

REGION B

SURFACE WATER	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
AMON G. CARTER LAKE/RESERVOIR	RESERVOIR	TRINITY	FRESH	1,366	1,299	1,232	1,165	1,100	1,100
BRAZOS LIVESTOCK LOCAL SUPPLY	ARCHER	BRAZOS	FRESH	122	122	122	122	122	122
BRAZOS LIVESTOCK LOCAL SUPPLY	BAYLOR	BRAZOS	FRESH	800	799	799	799	799	799
BRAZOS LIVESTOCK LOCAL SUPPLY	KING	BRAZOS	FRESH	257	257	257	257	257	257
BRAZOS LIVESTOCK LOCAL SUPPLY	YOUNG	BRAZOS	FRESH	301	301	301	301	301	301
BRAZOS RUN-OF-RIVER	BAYLOR	BRAZOS	FRESH	17	17	17	17	17	17
ELECTRA CITY LAKE/RESERVOIR	RESERVOIR	RED	FRESH	0	0	0	0	0	0
FARMERS CREEK/NOCONA LAKE/RESERVOIR	RESERVOIR	RED	FRESH	1,260	1,260	1,260	1,260	1,260	1,260
KEMP-DIVERSION LAKE/RESERVOIR SYSTEM	RESERVOIR	RED	FRESH	42,875	38,800	34,725	30,650	26,575	22,500
LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	RESERVOIR	RED	FRESH	13,241	13,241	13,241	13,241	13,241	13,241
NORTH FORK BUFFALO CREEK LAKE/RESERVOIR	RESERVOIR	RED	FRESH	0	0	0	0	0	0
OLNEY-COOPER LAKE/RESERVOIR SYSTEM	RESERVOIR	RED	FRESH	620	620	620	620	620	620
RED LIVESTOCK LOCAL SUPPLY	ARCHER	RED	FRESH	2,049	2,049	2,049	2,049	2,049	2,049
RED LIVESTOCK LOCAL SUPPLY	BAYLOR	RED	FRESH	99	100	100	100	100	100
RED LIVESTOCK LOCAL SUPPLY	CLAY	RED	FRESH	1,784	1,784	1,784	1,784	1,784	1,784
RED LIVESTOCK LOCAL SUPPLY	COTTLE	RED	FRESH	449	449	449	449	449	449
RED LIVESTOCK LOCAL SUPPLY	FOARD	RED	FRESH	368	368	368	368	368	368
RED LIVESTOCK LOCAL SUPPLY	HARDEMAN	RED	FRESH	400	400	400	400	400	400
RED LIVESTOCK LOCAL SUPPLY	KING	RED	FRESH	437	437	437	437	437	437
RED LIVESTOCK LOCAL SUPPLY	MONTAGUE	RED	FRESH	1,165	1,165	1,165	1,165	1,165	1,165
RED LIVESTOCK LOCAL SUPPLY	WICHITA	RED	FRESH	916	916	916	916	916	916
RED LIVESTOCK LOCAL SUPPLY	WILBARGER	RED	FRESH	1,617	1,617	1,617	1,617	1,617	1,617
RED OTHER LOCAL SUPPLY	HARDEMAN	RED	FRESH	7	7	7	7	7	7
RED RUN-OF-RIVER	ARCHER	RED	FRESH	285	285	285	285	285	285

Source Availability

REGION B									
				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SURFACE WATER	**COUNTY**	**BASIN**	**SALINITY**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
RED RUN-OF-RIVER	CLAY	RED	FRESH	4,114	4,114	4,114	4,114	4,114	4,114
RED RUN-OF-RIVER	COTTLE	RED	FRESH	13	13	13	13	13	13
RED RUN-OF-RIVER	HARDEMAN	RED	FRESH	148	148	148	148	148	148
RED RUN-OF-RIVER	MONTAGUE	RED	FRESH	108	108	108	108	108	108
RED RUN-OF-RIVER	WILBARGER	RED	FRESH	970	970	970	970	970	970
RED RUN-OF-RIVER | COMBINED IRRIGATION	WICHITA	RED	FRESH	351	351	351	351	351	351
RED RUN-OF-RIVER | MUNICIPAL-IOWA PARK (LAKE GORDON)	WICHITA	RED	FRESH	555	555	555	555	555	555
RED RUN-OF-RIVER | WCWID #2	WICHITA	RED	FRESH	8,850	8,850	8,850	8,850	8,850	8,850
SANTA ROSA LAKE/RESERVOIR	RESERVOIR	RED	FRESH	50	50	50	50	50	50
TRINITY LIVESTOCK LOCAL SUPPLY	ARCHER	TRINITY	FRESH	268	268	268	268	268	268
TRINITY LIVESTOCK LOCAL SUPPLY	CLAY	TRINITY	FRESH	198	198	198	198	198	198
TRINITY LIVESTOCK LOCAL SUPPLY	MONTAGUE	TRINITY	FRESH	500	500	500	500	500	500
TRINITY LIVESTOCK LOCAL SUPPLY	YOUNG	TRINITY	FRESH	20	20	20	20	20	20
SURFACE WATER TOTAL SOURCE AVAILABILITY				**86,580**	**82,438**	**78,296**	**74,154**	**70,014**	**65,939**
REGION B TOTAL SOURCE AVAILABILITY				**166,617**	**162,240**	**158,061**	**153,473**	**148,990**	**144,915**

Source Water Balance (Availability- WUG Supply)

REGION B									
				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
GROUNDWATER	**COUNTY**	**BASIN**	**SALINITY**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
BLAINE AQUIFER	COTTLE	RED	FRESH	1,284	1,284	1,287	1,291	1,294	1,294
BLAINE AQUIFER	FOARD	RED	FRESH	0	0	0	0	0	0
BLAINE AQUIFER	HARDEMAN	RED	FRESH	0	0	0	0	0	0
BLAINE AQUIFER	KING	BRAZOS	FRESH	6,659	6,659	6,659	6,659	6,659	6,659
BLAINE AQUIFER	KING	RED	FRESH	3,863	3,863	3,863	3,863	3,863	3,863
OTHER AQUIFER	ARCHER	BRAZOS	FRESH	0	0	1	2	4	4
OTHER AQUIFER	ARCHER	RED	FRESH	31	31	31	31	31	16
OTHER AQUIFER	ARCHER	TRINITY	FRESH	7	7	7	7	7	22
OTHER AQUIFER	CLAY	RED	FRESH	40	40	225	325	425	425
OTHER AQUIFER	CLAY	TRINITY	FRESH	0	0	0	0	0	0
OTHER AQUIFER	COTTLE	RED	FRESH	0	100	200	300	300	300
OTHER AQUIFER	KING	BRAZOS	FRESH	41	56	68	80	89	89
OTHER AQUIFER	MONTAGUE	TRINITY	FRESH	387	387	817	946	903	903
OTHER AQUIFER | ALLUVIUM	KING	RED	FRESH	94	128	158	184	207	207
OTHER AQUIFER | ALLUVIUM	MONTAGUE	RED	FRESH	513	513	1,083	1,254	1,197	1,197
OTHER AQUIFER | ALLUVIUM	WICHITA	RED	FRESH	200	200	200	200	200	200
OTHER AQUIFER | ALLUVIUM	WILBARGER	RED	FRESH	590	790	990	1,190	1,390	1,590
OTHER AQUIFER | COUNTY-OTHER, LIVESTOCK	BAYLOR	BRAZOS	FRESH	0	0	0	0	0	0
OTHER AQUIFER | COUNTY-OTHER, LIVESTOCK	BAYLOR	RED	FRESH	0	0	0	0	0	0
OTHER AQUIFER | LIVESTOCK	HARDEMAN	RED	FRESH	3	3	3	3	3	3
OTHER AQUIFER | MINING	FOARD	RED	FRESH	188	188	188	188	189	189
SEYMOUR AQUIFER	ARCHER	RED	FRESH	35	35	35	35	35	35
SEYMOUR AQUIFER	BAYLOR	BRAZOS	FRESH	0	0	0	0	0	0
SEYMOUR AQUIFER	BAYLOR	RED	FRESH	0	0	0	0	0	0
SEYMOUR AQUIFER	CLAY	RED	FRESH	182	182	182	182	182	182
SEYMOUR AQUIFER	FOARD	RED	FRESH	352	137	108	108	137	137
SEYMOUR AQUIFER	HARDEMAN	RED	FRESH	0	0	1	1	1	1
SEYMOUR AQUIFER	WICHITA	RED	FRESH	795	796	795	804	809	809
SEYMOUR AQUIFER	WILBARGER	RED	FRESH	0	10	10	10	10	10
TRINITY AQUIFER	MONTAGUE	RED	FRESH	129	129	129	129	129	129
TRINITY AQUIFER	MONTAGUE	TRINITY	FRESH	1,519	1,519	1,519	1,519	1,519	1,519
GROUNDWATER TOTAL SOURCE WATER BALANCE				**16,912**	**17,057**	**18,559**	**19,311**	**19,583**	**19,783**

Source Water Balance (Availability- WUG Supply)

REGION B

REUSE	COUNTY	BASIN	SALINITY	SOURCE WATER BALANCE (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
DIRECT REUSE | CITY OF BOWIE	MONTAGUE	TRINITY	FRESH	0	0	0	0	0	0
REUSE TOTAL SOURCE WATER BALANCE				**0**	**0**	**0**	**0**	**0**	**0**

REGION B

SURFACE WATER	COUNTY	BASIN	SALINITY	SOURCE WATER BALANCE (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
AMON G. CARTER LAKE/RESERVOIR	RESERVOIR	TRINITY	FRESH	0	0	0	0	0	0
BRAZOS LIVESTOCK LOCAL SUPPLY	ARCHER	BRAZOS	FRESH	32	32	32	32	32	32
BRAZOS LIVESTOCK LOCAL SUPPLY	BAYLOR	BRAZOS	FRESH	0	0	0	0	0	0
BRAZOS LIVESTOCK LOCAL SUPPLY	KING	BRAZOS	FRESH	196	196	196	196	196	196
BRAZOS LIVESTOCK LOCAL SUPPLY	YOUNG	BRAZOS	FRESH	301	301	301	301	301	301
BRAZOS RUN-OF-RIVER	BAYLOR	BRAZOS	FRESH	0	0	0	0	0	0
ELECTRA CITY LAKE/RESERVOIR	RESERVOIR	RED	FRESH	0	0	0	0	0	0
FARMERS CREEK/NOCONA LAKE/RESERVOIR	RESERVOIR	RED	FRESH	0	0	0	0	0	0
KEMP-DIVERSION LAKE/RESERVOIR SYSTEM	RESERVOIR	RED	FRESH	2,227	2,015	1,803	1,592	1,381	1,168
LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	RESERVOIR	RED	FRESH	900	900	900	900	900	900
NORTH FORK BUFFALO CREEK LAKE/RESERVOIR	RESERVOIR	RED	FRESH	0	0	0	0	0	0
OLNEY-COOPER LAKE/RESERVOIR SYSTEM	RESERVOIR	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	ARCHER	RED	FRESH	537	537	537	537	537	537
RED LIVESTOCK LOCAL SUPPLY	BAYLOR	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	CLAY	RED	FRESH	99	99	99	99	99	99
RED LIVESTOCK LOCAL SUPPLY	COTTLE	RED	FRESH	155	155	155	155	155	155
RED LIVESTOCK LOCAL SUPPLY	FOARD	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	HARDEMAN	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	KING	RED	FRESH	334	334	334	334	334	334
RED LIVESTOCK LOCAL SUPPLY	MONTAGUE	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	WICHITA	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	WILBARGER	RED	FRESH	879	879	879	879	879	879
RED OTHER LOCAL SUPPLY	HARDEMAN	RED	FRESH	7	7	7	7	7	7
RED RUN-OF-RIVER	ARCHER	RED	FRESH	278	278	278	278	278	278

Source Water Balance (Availability- WUG Supply)

REGION B

SURFACE WATER	COUNTY	BASIN	SALINITY	SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
				2020	2030	2040	2050	2060	2070
RED RUN-OF-RIVER	CLAY	RED	FRESH	2,656	2,656	2,656	2,656	2,656	2,656
RED RUN-OF-RIVER	COTTLE	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	HARDEMAN	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	MONTAGUE	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	WILBARGER	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER | COMBINED IRRIGATION	WICHITA	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER | MUNICIPAL-IOWA PARK (LAKE GORDON)	WICHITA	RED	FRESH	555	555	555	555	555	555
RED RUN-OF-RIVER | WCWID #2	WICHITA	RED	FRESH	8,850	8,850	8,850	8,850	8,850	8,850
SANTA ROSA LAKE/RESERVOIR	RESERVOIR	RED	FRESH	0	0	0	0	0	0
TRINITY LIVESTOCK LOCAL SUPPLY	ARCHER	TRINITY	FRESH	70	70	70	70	70	70
TRINITY LIVESTOCK LOCAL SUPPLY	CLAY	TRINITY	FRESH	11	11	11	11	11	11
TRINITY LIVESTOCK LOCAL SUPPLY	MONTAGUE	TRINITY	FRESH	0	0	0	0	0	0
TRINITY LIVESTOCK LOCAL SUPPLY	YOUNG	TRINITY	FRESH	20	20	20	20	20	20
SURFACE WATER TOTAL SOURCE WATER BALANCE				**18,107**	**17,895**	**17,683**	**17,472**	**17,261**	**17,048**
REGION B TOTAL SOURCE WATER BALANCE				**35,019**	**34,952**	**36,242**	**36,783**	**36,844**	**36,831**

Water User Group (WUG) Population

REGION B	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
ARCHER COUNTY						
BRAZOS BASIN						
COUNTY-OTHER	58	61	61	61	61	61
BRAZOS BASIN TOTAL POPULATION	**58**	**61**	**61**	**61**	**61**	**61**
RED BASIN						
ARCHER CITY	1,834	1,834	1,834	1,834	1,834	1,834
HOLLIDAY	1,982	2,257	2,330	2,330	2,330	2,330
LAKESIDE CITY	1,021	1,050	1,058	1,058	1,058	1,058
SCOTLAND	613	751	788	788	788	788
WICHITA VALLEY WSC	2,473	2,587	2,618	2,618	2,618	2,618
WINDTHORST WSC	1,062	1,111	1,124	1,124	1,124	1,124
COUNTY-OTHER	296	121	73	73	73	73
RED BASIN TOTAL POPULATION	**9,281**	**9,711**	**9,825**	**9,825**	**9,825**	**9,825**
TRINITY BASIN						
COUNTY-OTHER	70	73	74	74	74	74
TRINITY BASIN TOTAL POPULATION	**70**	**73**	**74**	**74**	**74**	**74**
ARCHER COUNTY TOTAL POPULATION	**9,409**	**9,845**	**9,960**	**9,960**	**9,960**	**9,960**
BAYLOR COUNTY						
BRAZOS BASIN						
SEYMOUR	2,740	2,740	2,740	2,740	2,740	2,740
COUNTY-OTHER	707	707	707	707	707	707
BRAZOS BASIN TOTAL POPULATION	**3,447**	**3,447**	**3,447**	**3,447**	**3,447**	**3,447**
RED BASIN						
COUNTY-OTHER	279	279	279	279	279	279
RED BASIN TOTAL POPULATION	**279**	**279**	**279**	**279**	**279**	**279**
BAYLOR COUNTY TOTAL POPULATION	**3,726**	**3,726**	**3,726**	**3,726**	**3,726**	**3,726**
CLAY COUNTY						
RED BASIN						
DEAN DALE SUD	2,262	2,333	2,333	2,333	2,333	2,333
HENRIETTA	3,259	3,361	3,361	3,361	3,361	3,361
PETROLIA	712	734	734	734	734	734
WINDTHORST WSC	233	240	240	240	240	240
COUNTY-OTHER	4,200	4,332	4,332	4,332	4,332	4,332
RED BASIN TOTAL POPULATION	**10,666**	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**
TRINITY BASIN						
COUNTY-OTHER	488	503	503	503	503	503
TRINITY BASIN TOTAL POPULATION	**488**	**503**	**503**	**503**	**503**	**503**
CLAY COUNTY TOTAL POPULATION	**11,154**	**11,503**	**11,503**	**11,503**	**11,503**	**11,503**
COTTLE COUNTY						
RED BASIN						
PADUCAH	1,224	1,224	1,224	1,224	1,224	1,224

Water User Group (WUG) Population

REGION B	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
COTTLE COUNTY						
RED BASIN						
COUNTY-OTHER	328	328	328	328	328	328
RED BASIN TOTAL POPULATION	**1,552**	**1,552**	**1,552**	**1,552**	**1,552**	**1,552**
COTTLE COUNTY TOTAL POPULATION	**1,552**	**1,552**	**1,552**	**1,552**	**1,552**	**1,552**
FOARD COUNTY						
RED BASIN						
CROWELL	986	995	995	995	995	995
COUNTY-OTHER	403	406	406	406	406	406
RED BASIN TOTAL POPULATION	**1,389**	**1,401**	**1,401**	**1,401**	**1,401**	**1,401**
FOARD COUNTY TOTAL POPULATION	**1,389**	**1,401**	**1,401**	**1,401**	**1,401**	**1,401**
HARDEMAN COUNTY						
RED BASIN						
CHILLICOTHE	731	749	755	770	778	784
QUANAH	2,728	2,797	2,821	2,876	2,905	2,927
COUNTY-OTHER	815	837	844	861	869	876
RED BASIN TOTAL POPULATION	**4,274**	**4,383**	**4,420**	**4,507**	**4,552**	**4,587**
HARDEMAN COUNTY TOTAL POPULATION	**4,274**	**4,383**	**4,420**	**4,507**	**4,552**	**4,587**
KING COUNTY						
BRAZOS BASIN						
COUNTY-OTHER	29	30	30	30	30	30
BRAZOS BASIN TOTAL POPULATION	**29**	**30**	**30**	**30**	**30**	**30**
RED BASIN						
COUNTY-OTHER	271	286	286	286	286	286
RED BASIN TOTAL POPULATION	**271**	**286**	**286**	**286**	**286**	**286**
KING COUNTY TOTAL POPULATION	**300**	**316**	**316**	**316**	**316**	**316**
MONTAGUE COUNTY						
RED BASIN						
NOCONA	3,155	3,271	3,323	3,381	3,419	3,446
COUNTY-OTHER	4,628	4,798	4,875	4,961	5,015	5,056
RED BASIN TOTAL POPULATION	**7,783**	**8,069**	**8,198**	**8,342**	**8,434**	**8,502**
TRINITY BASIN						
BOWIE	5,427	5,626	5,716	5,817	5,881	5,928
ST. JO	1,085	1,125	1,143	1,163	1,176	1,185
COUNTY-OTHER	6,212	6,440	6,543	6,657	6,732	6,786
TRINITY BASIN TOTAL POPULATION	**12,724**	**13,191**	**13,402**	**13,637**	**13,789**	**13,899**
MONTAGUE COUNTY TOTAL POPULATION	**20,507**	**21,260**	**21,600**	**21,979**	**22,223**	**22,401**
WICHITA COUNTY						
RED BASIN						
BURKBURNETT	11,151	11,557	11,876	12,100	12,314	12,495

Water User Group (WUG) Population

REGION B	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
WICHITA COUNTY						
RED BASIN						
DEAN DALE SUD	1,121	1,161	1,193	1,216	1,237	1,256
ELECTRA	2,879	2,984	3,066	3,124	3,179	3,226
IOWA PARK	6,555	6,794	6,981	7,113	7,238	7,345
WICHITA FALLS	107,835	111,767	114,848	117,013	119,080	120,838
WICHITA VALLEY WSC	3,395	3,519	3,616	3,684	3,749	3,804
COUNTY-OTHER	2,691	2,791	2,868	2,921	2,974	3,018
RED BASIN TOTAL POPULATION	**135,627**	**140,573**	**144,448**	**147,171**	**149,771**	**151,982**
WICHITA COUNTY TOTAL POPULATION	**135,627**	**140,573**	**144,448**	**147,171**	**149,771**	**151,982**
WILBARGER COUNTY						
RED BASIN						
VERNON	11,758	12,398	12,785	13,175	13,447	13,653
COUNTY-OTHER	2,707	2,854	2,943	3,033	3,095	3,143
RED BASIN TOTAL POPULATION	**14,465**	**15,252**	**15,728**	**16,208**	**16,542**	**16,796**
WILBARGER COUNTY TOTAL POPULATION	**14,465**	**15,252**	**15,728**	**16,208**	**16,542**	**16,796**
YOUNG COUNTY						
BRAZOS BASIN						
OLNEY	3,370	3,485	3,568	3,655	3,740	3,822
COUNTY-OTHER	531	631	702	778	852	923
BRAZOS BASIN TOTAL POPULATION	**3,901**	**4,116**	**4,270**	**4,433**	**4,592**	**4,745**
TRINITY BASIN						
COUNTY-OTHER	3	3	4	4	4	4
TRINITY BASIN TOTAL POPULATION	**3**	**3**	**4**	**4**	**4**	**4**
YOUNG COUNTY TOTAL POPULATION	**3,904**	**4,119**	**4,274**	**4,437**	**4,596**	**4,749**
REGION B TOTAL POPULATION	**206,307**	**213,930**	**218,928**	**222,760**	**226,142**	**228,973**

Water User Group (WUG) Demand

REGION B	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ARCHER COUNTY						
BRAZOS BASIN						
COUNTY-OTHER	10	10	10	10	10	10
MINING	8	10	7	6	4	4
LIVESTOCK	10	10	10	10	10	10
IRRIGATION	48	47	45	44	44	44
BRAZOS BASIN TOTAL DEMAND	**76**	**77**	**72**	**70**	**68**	**68**
RED BASIN						
ARCHER CITY	280	271	264	260	259	259
HOLLIDAY	285	314	318	315	314	314
LAKESIDE CITY	136	135	133	131	130	130
SCOTLAND	216	261	271	271	270	270
WICHITA VALLEY WSC	291	293	288	284	283	283
WINDTHORST WSC	317	327	327	325	324	324
COUNTY-OTHER	51	21	13	13	13	13
MANUFACTURING	1	1	1	1	1	1
MINING	348	415	296	240	183	183
LIVESTOCK	2,035	2,035	2,035	2,035	2,035	2,035
IRRIGATION	1,067	1,035	1,004	972	972	972
RED BASIN TOTAL DEMAND	**5,027**	**5,108**	**4,950**	**4,847**	**4,784**	**4,784**
TRINITY BASIN						
COUNTY-OTHER	13	13	13	13	13	13
MINING	49	58	41	33	26	26
LIVESTOCK	51	51	51	51	51	51
IRRIGATION	99	96	93	90	90	90
TRINITY BASIN TOTAL DEMAND	**212**	**218**	**198**	**187**	**180**	**180**
ARCHER COUNTY TOTAL DEMAND	**5,315**	**5,403**	**5,220**	**5,104**	**5,032**	**5,032**
BAYLOR COUNTY						
BRAZOS BASIN						
SEYMOUR	496	481	471	470	469	469
COUNTY-OTHER	93	90	87	87	86	86
MINING	6	6	6	6	6	6
LIVESTOCK	1,054	1,054	1,054	1,054	1,054	1,054
IRRIGATION	2,421	2,349	2,276	2,208	2,208	2,208
BRAZOS BASIN TOTAL DEMAND	**4,070**	**3,980**	**3,894**	**3,825**	**3,823**	**3,823**
RED BASIN						
COUNTY-OTHER	38	36	35	35	35	35
MINING	8	8	7	7	7	7
LIVESTOCK	130	130	130	130	130	130
IRRIGATION	889	862	836	810	810	810
RED BASIN TOTAL DEMAND	**1,065**	**1,036**	**1,008**	**982**	**982**	**982**
BAYLOR COUNTY TOTAL DEMAND	**5,135**	**5,016**	**4,902**	**4,807**	**4,805**	**4,805**
CLAY COUNTY						
RED BASIN						
DEAN DALE SUD	172	167	160	157	157	157
HENRIETTA	652	657	645	638	637	637
PETROLIA	68	67	64	64	63	63
WINDTHORST WSC	70	71	70	70	70	70
COUNTY-OTHER	517	514	499	490	490	490

Water User Group (WUG) Demand

REGION B	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
CLAY COUNTY						
RED BASIN						
MINING	539	692	514	414	314	314
LIVESTOCK	1,847	1,847	1,847	1,847	1,847	1,847
IRRIGATION	1,221	1,189	1,156	1,124	1,124	1,124
RED BASIN TOTAL DEMAND	**5,086**	**5,204**	**4,955**	**4,804**	**4,702**	**4,702**
TRINITY BASIN						
COUNTY-OTHER	60	60	58	58	57	57
MINING	74	94	70	57	43	43
LIVESTOCK	245	245	245	245	245	245
IRRIGATION	217	211	206	200	200	200
TRINITY BASIN TOTAL DEMAND	**596**	**610**	**579**	**560**	**545**	**545**
CLAY COUNTY TOTAL DEMAND	**5,682**	**5,814**	**5,534**	**5,364**	**5,247**	**5,247**
COTTLE COUNTY						
RED BASIN						
PADUCAH	297	290	289	289	288	288
COUNTY-OTHER	46	44	43	43	43	43
MINING	41	41	38	34	31	31
LIVESTOCK	544	544	544	544	544	544
IRRIGATION	4,004	3,884	3,767	3,655	3,655	3,655
RED BASIN TOTAL DEMAND	**4,932**	**4,803**	**4,681**	**4,565**	**4,561**	**4,561**
COTTLE COUNTY TOTAL DEMAND	**4,932**	**4,803**	**4,681**	**4,565**	**4,561**	**4,561**
FOARD COUNTY						
RED BASIN						
CROWELL	138	134	132	131	131	131
COUNTY-OTHER	75	73	72	72	72	72
MINING	12	12	12	12	11	11
LIVESTOCK	399	399	399	399	399	399
IRRIGATION	3,939	3,820	3,706	3,595	3,595	3,595
RED BASIN TOTAL DEMAND	**4,563**	**4,438**	**4,321**	**4,209**	**4,208**	**4,208**
FOARD COUNTY TOTAL DEMAND	**4,563**	**4,438**	**4,321**	**4,209**	**4,208**	**4,208**
HARDEMAN COUNTY						
RED BASIN						
CHILLICOTHE	65	63	60	61	62	62
QUANAH	397	391	388	394	397	400
COUNTY-OTHER	130	129	127	129	130	131
MANUFACTURING	276	294	313	332	332	332
MINING	17	17	18	18	18	18
LIVESTOCK	631	631	631	631	631	631
IRRIGATION	7,939	7,701	7,470	7,246	7,246	7,246
RED BASIN TOTAL DEMAND	**9,455**	**9,226**	**9,007**	**8,811**	**8,816**	**8,820**
HARDEMAN COUNTY TOTAL DEMAND	**9,455**	**9,226**	**9,007**	**8,811**	**8,816**	**8,820**
KING COUNTY						
BRAZOS BASIN						
COUNTY-OTHER	8	8	8	8	8	8
MINING	141	122	107	93	81	81
LIVESTOCK	146	146	146	146	146	146
IRRIGATION	10	10	10	10	10	10
BRAZOS BASIN TOTAL DEMAND	**305**	**286**	**271**	**257**	**245**	**245**

Water User Group (WUG) Demand

REGION B	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
KING COUNTY						
RED BASIN						
COUNTY-OTHER	71	73	73	73	72	72
MINING	239	209	182	158	138	138
LIVESTOCK	248	248	248	248	248	248
IRRIGATION	18	18	18	18	18	18
RED BASIN TOTAL DEMAND	**576**	**548**	**521**	**497**	**476**	**476**
KING COUNTY TOTAL DEMAND	**881**	**834**	**792**	**754**	**721**	**721**
MONTAGUE COUNTY						
RED BASIN						
NOCONA	740	751	751	758	766	772
COUNTY-OTHER	560	561	554	555	559	564
MANUFACTURING	5	6	8	10	10	10
MINING	1,747	1,237	771	332	373	373
LIVESTOCK	1,193	1,193	1,193	1,193	1,193	1,193
IRRIGATION	436	436	436	436	436	436
RED BASIN TOTAL DEMAND	**4,681**	**4,184**	**3,713**	**3,284**	**3,337**	**3,348**
TRINITY BASIN						
BOWIE	927	935	929	934	942	949
ST. JO	161	162	160	161	162	163
COUNTY-OTHER	752	751	743	744	750	756
MINING	1,892	1,340	835	359	404	404
LIVESTOCK	398	398	398	398	398	398
IRRIGATION	436	436	436	436	436	436
TRINITY BASIN TOTAL DEMAND	**4,566**	**4,022**	**3,501**	**3,032**	**3,092**	**3,106**
MONTAGUE COUNTY TOTAL DEMAND	**9,247**	**8,206**	**7,214**	**6,316**	**6,429**	**6,454**
WICHITA COUNTY						
RED BASIN						
BURKBURNETT	1,481	1,480	1,477	1,482	1,503	1,525
DEAN DALE SUD	86	84	82	82	84	85
ELECTRA	946	965	979	996	1,013	1,028
IOWA PARK	893	893	891	894	907	921
WICHITA FALLS	17,357	17,474	17,544	17,652	17,922	18,184
WICHITA VALLEY WSC	400	399	398	399	405	411
COUNTY-OTHER	333	342	351	356	361	367
MANUFACTURING	2,743	2,874	3,036	3,162	3,162	3,162
MINING	62	61	55	49	44	44
STEAM ELECTRIC POWER	360	360	360	360	360	360
LIVESTOCK	917	917	917	917	917	917
IRRIGATION	45,267	44,487	43,707	42,927	42,927	42,927
RED BASIN TOTAL DEMAND	**70,845**	**70,336**	**69,797**	**69,276**	**69,605**	**69,931**
WICHITA COUNTY TOTAL DEMAND	**70,845**	**70,336**	**69,797**	**69,276**	**69,605**	**69,931**
WILBARGER COUNTY						
RED BASIN						
VERNON	1,883	1,923	1,934	1,982	2,018	2,049
COUNTY-OTHER	430	438	443	455	464	471
MANUFACTURING	1,133	1,217	1,362	1,511	1,511	1,511
MINING	20	20	19	19	18	18

Water User Group (WUG) Demand

REGION B	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
WILBARGER COUNTY						
RED BASIN						
STEAM ELECTRIC POWER	10,000	10,000	10,000	10,000	10,000	10,000
LIVESTOCK	913	913	913	913	913	913
IRRIGATION	31,603	30,655	29,736	28,843	28,843	28,843
RED BASIN TOTAL DEMAND	**45,982**	**45,166**	**44,407**	**43,723**	**43,767**	**43,805**
WILBARGER COUNTY TOTAL DEMAND	**45,982**	**45,166**	**44,407**	**43,723**	**43,767**	**43,805**
YOUNG COUNTY						
BRAZOS BASIN						
OLNEY	557	559	558	566	578	590
COUNTY-OTHER	64	73	80	88	96	104
BRAZOS BASIN TOTAL DEMAND	**621**	**632**	**638**	**654**	**674**	**694**
TRINITY BASIN						
COUNTY-OTHER	1	1	1	1	1	1
TRINITY BASIN TOTAL DEMAND	**1**	**1**	**1**	**1**	**1**	**1**
YOUNG COUNTY TOTAL DEMAND	**622**	**633**	**639**	**655**	**675**	**695**
REGION B TOTAL DEMAND	**162,659**	**159,875**	**156,514**	**153,584**	**153,866**	**154,279**

Water User Group (WUG) Existing Water Supply

REGION B	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
		2020	2030	2040	2050	2060	2070
ARCHER COUNTY							
BRAZOS BASIN							
COUNTY-OTHER	B | OTHER AQUIFER | ARCHER COUNTY	10	10	10	10	10	10
MINING	B | OTHER AQUIFER | ARCHER COUNTY	8	8	7	6	4	4
LIVESTOCK	B | BRAZOS LIVESTOCK LOCAL SUPPLY	90	90	90	90	90	90
LIVESTOCK	B | OTHER AQUIFER | ARCHER COUNTY	15	15	15	15	15	15
IRRIGATION		0	0	0	0	0	0
BRAZOS BASIN TOTAL EXISTING SUPPLY		**123**	**123**	**122**	**121**	**119**	**119**
RED BASIN							
ARCHER CITY	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	152	147	142	138	133	128
HOLLIDAY	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	175	187	183	176	169	163
LAKESIDE CITY	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	92	89	86	83	80	77
WICHITA VALLEY WSC	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	410	400	383	368	352	335
WINDTHORST WSC	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	176	171	166	161	155	149
SCOTLAND	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	104	100	97	94	91	87
COUNTY-OTHER	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	43	42	40	39	38	36
COUNTY-OTHER	B | OTHER AQUIFER | ARCHER COUNTY	113	113	113	113	113	113
MANUFACTURING	B | OTHER AQUIFER | ARCHER COUNTY	1	1	1	1	1	1
MINING	B | OTHER AQUIFER | ARCHER COUNTY	126	126	126	126	126	126
LIVESTOCK	B | KEMP-DIVERSION LAKE/RESERVOIR SYSTEM	489	442	396	349	303	256
LIVESTOCK	B | OTHER AQUIFER | ARCHER COUNTY	252	252	252	252	252	267
LIVESTOCK	B | RED LIVESTOCK LOCAL SUPPLY	1,512	1,512	1,512	1,512	1,512	1,512
IRRIGATION	B | KEMP-DIVERSION LAKE/RESERVOIR SYSTEM	719	643	568	495	429	363
IRRIGATION	B | RED RUN-OF-RIVER	7	7	7	7	7	7
RED BASIN TOTAL EXISTING SUPPLY		**4,371**	**4,232**	**4,072**	**3,914**	**3,761**	**3,620**
TRINITY BASIN							
COUNTY-OTHER	B | OTHER AQUIFER | ARCHER COUNTY	13	13	13	13	13	13
MINING	B | OTHER AQUIFER | ARCHER COUNTY	16	16	16	16	16	16
LIVESTOCK	B | OTHER AQUIFER | ARCHER COUNTY	33	33	33	33	33	18
LIVESTOCK	B | TRINITY LIVESTOCK LOCAL SUPPLY	198	198	198	198	198	198
IRRIGATION		0	0	0	0	0	0
TRINITY BASIN TOTAL EXISTING SUPPLY		**260**	**260**	**260**	**260**	**260**	**245**
ARCHER COUNTY TOTAL EXISTING SUPPLY		**4,754**	**4,615**	**4,454**	**4,295**	**4,140**	**3,984**
BAYLOR COUNTY							
BRAZOS BASIN							
SEYMOUR	B | SEYMOUR AQUIFER | BAYLOR COUNTY	600	600	600	600	600	600
COUNTY-OTHER	B | OTHER AQUIFER | BAYLOR COUNTY	17	17	17	17	17	17
COUNTY-OTHER	B | SEYMOUR AQUIFER | BAYLOR COUNTY	108	109	109	109	109	109
COUNTY-OTHER	G | MILLERS CREEK LAKE/RESERVOIR	147	147	119	89	60	28
MINING	B | SEYMOUR AQUIFER | BAYLOR COUNTY	7	7	8	8	8	8
LIVESTOCK	B | BRAZOS LIVESTOCK LOCAL SUPPLY	800	799	799	799	799	799

Water User Group (WUG) Existing Water Supply

REGION B	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
BAYLOR COUNTY							
BRAZOS BASIN							
LIVESTOCK	B | OTHER AQUIFER | BAYLOR COUNTY	8	8	8	8	8	8
LIVESTOCK	B | SEYMOUR AQUIFER | BAYLOR COUNTY	116	117	117	117	117	117
IRRIGATION	B | BRAZOS RUN-OF-RIVER	17	17	17	17	17	17
IRRIGATION	B | SEYMOUR AQUIFER | BAYLOR COUNTY	2,404	2,332	2,259	2,191	2,191	2,191
BRAZOS BASIN TOTAL EXISTING SUPPLY		**4,224**	**4,153**	**4,053**	**3,955**	**3,926**	**3,894**
RED BASIN							
COUNTY-OTHER	B | OTHER AQUIFER | BAYLOR COUNTY	28	28	28	28	28	28
COUNTY-OTHER	B | SEYMOUR AQUIFER | BAYLOR COUNTY	42	41	41	41	41	41
MINING	B | SEYMOUR AQUIFER | BAYLOR COUNTY	8	8	7	7	7	7
LIVESTOCK	B | OTHER AQUIFER | BAYLOR COUNTY	7	7	7	7	7	7
LIVESTOCK	B | RED LIVESTOCK LOCAL SUPPLY	99	100	100	100	100	100
LIVESTOCK	B | SEYMOUR AQUIFER | BAYLOR COUNTY	24	23	23	23	23	23
IRRIGATION	B | SEYMOUR AQUIFER | BAYLOR COUNTY	501	550	623	691	691	691
RED BASIN TOTAL EXISTING SUPPLY		**709**	**757**	**829**	**897**	**897**	**897**
BAYLOR COUNTY TOTAL EXISTING SUPPLY		**4,933**	**4,910**	**4,882**	**4,852**	**4,823**	**4,791**
CLAY COUNTY							
RED BASIN							
HENRIETTA	B | RED RUN-OF-RIVER	1,090	1,090	1,090	1,090	1,090	1,090
PETROLIA	B | RED RUN-OF-RIVER	67	67	67	67	67	67
PETROLIA	B | SEYMOUR AQUIFER | CLAY COUNTY	30	30	30	30	30	30
WINDTHORST WSC	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	39	37	36	34	33	33
DEAN DALE SUD	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	158	152	147	141	135	130
COUNTY-OTHER	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	213	206	199	193	186	179
COUNTY-OTHER	B | OTHER AQUIFER | CLAY COUNTY	315	315	315	315	315	315
COUNTY-OTHER	B | SEYMOUR AQUIFER | CLAY COUNTY	55	55	55	55	55	55
MINING	B | OTHER AQUIFER | CLAY COUNTY	707	691	530	443	357	357
MINING	B | RED RUN-OF-RIVER	1	1	1	1	1	1
LIVESTOCK	B | OTHER AQUIFER | CLAY COUNTY	142	142	142	142	142	142
LIVESTOCK	B | RED LIVESTOCK LOCAL SUPPLY	1,685	1,685	1,685	1,685	1,685	1,685
LIVESTOCK	B | SEYMOUR AQUIFER | CLAY COUNTY	20	20	20	20	20	20
IRRIGATION	B | KEMP-DIVERSION LAKE/RESERVOIR SYSTEM	59	55	50	45	39	33
IRRIGATION	B | OTHER AQUIFER | CLAY COUNTY	383	389	394	400	400	400
IRRIGATION	B | RED RUN-OF-RIVER	300	300	300	300	300	300
IRRIGATION	B | SEYMOUR AQUIFER | CLAY COUNTY	500	500	500	500	500	500
RED BASIN TOTAL EXISTING SUPPLY		**5,764**	**5,735**	**5,561**	**5,461**	**5,355**	**5,337**
TRINITY BASIN							
COUNTY-OTHER	B | OTHER AQUIFER | CLAY COUNTY	60	60	60	60	60	60
MINING	B | OTHER AQUIFER | CLAY COUNTY	78	94	70	57	43	43
LIVESTOCK	B | OTHER AQUIFER | CLAY COUNTY	58	58	58	58	58	58
LIVESTOCK	B | TRINITY LIVESTOCK LOCAL SUPPLY	187	187	187	187	187	187

Water User Group (WUG) Existing Water Supply

REGION B	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
CLAY COUNTY							
TRINITY BASIN							
IRRIGATION	B | OTHER AQUIFER | CLAY COUNTY	217	211	206	200	200	200
TRINITY BASIN TOTAL EXISTING SUPPLY		**600**	**610**	**581**	**562**	**548**	**548**
CLAY COUNTY TOTAL EXISTING SUPPLY		**6,364**	**6,345**	**6,142**	**6,023**	**5,903**	**5,885**
COTTLE COUNTY							
RED BASIN							
PADUCAH	B | BLAINE AQUIFER | COTTLE COUNTY	494	494	494	494	494	494
COUNTY-OTHER	B | OTHER AQUIFER | COTTLE COUNTY	200	200	200	200	200	200
MINING	B | BLAINE AQUIFER | COTTLE COUNTY	41	41	38	34	31	31
LIVESTOCK	B | BLAINE AQUIFER | COTTLE COUNTY	250	250	250	250	250	250
LIVESTOCK	B | RED LIVESTOCK LOCAL SUPPLY	294	294	294	294	294	294
IRRIGATION	B | BLAINE AQUIFER | COTTLE COUNTY	2,400	2,400	2,400	2,400	2,400	2,400
IRRIGATION	B | OTHER AQUIFER | COTTLE COUNTY	1,600	1,500	1,400	1,300	1,300	1,300
IRRIGATION	B | RED RUN-OF-RIVER	13	13	13	13	13	13
RED BASIN TOTAL EXISTING SUPPLY		**5,292**	**5,192**	**5,089**	**4,985**	**4,982**	**4,982**
COTTLE COUNTY TOTAL EXISTING SUPPLY		**5,292**	**5,192**	**5,089**	**4,985**	**4,982**	**4,982**
FOARD COUNTY							
RED BASIN							
CROWELL	A | GREENBELT LAKE/RESERVOIR	92	94	96	99	102	105
CROWELL	A | OGALLALA AQUIFER | DONLEY COUNTY	46	40	36	32	29	26
COUNTY-OTHER	A | GREENBELT LAKE/RESERVOIR	33	35	36	38	39	40
COUNTY-OTHER	A | OGALLALA AQUIFER | DONLEY COUNTY	17	15	14	12	11	10
COUNTY-OTHER	B | SEYMOUR AQUIFER | FOARD COUNTY	35	35	35	35	35	35
MINING	B | OTHER AQUIFER | FOARD COUNTY	12	12	12	12	11	11
LIVESTOCK	B | BLAINE AQUIFER | FOARD COUNTY	23	23	23	23	23	23
LIVESTOCK	B | RED LIVESTOCK LOCAL SUPPLY	368	368	368	368	368	368
LIVESTOCK	B | SEYMOUR AQUIFER | FOARD COUNTY	8	8	8	8	8	8
IRRIGATION	B | SEYMOUR AQUIFER | FOARD COUNTY	4,511	4,511	4,511	4,511	4,511	4,511
RED BASIN TOTAL EXISTING SUPPLY		**5,145**	**5,141**	**5,139**	**5,138**	**5,137**	**5,137**
FOARD COUNTY TOTAL EXISTING SUPPLY		**5,145**	**5,141**	**5,139**	**5,138**	**5,137**	**5,137**
HARDEMAN COUNTY							
RED BASIN							
CHILLICOTHE	A | GREENBELT LAKE/RESERVOIR	44	44	44	46	48	50
CHILLICOTHE	A | OGALLALA AQUIFER | DONLEY COUNTY	21	19	16	15	14	12
CHILLICOTHE	B | SEYMOUR AQUIFER | HARDEMAN COUNTY	45	45	45	45	45	45
QUANAH	A | GREENBELT LAKE/RESERVOIR	266	274	283	298	310	321
QUANAH	A | OGALLALA AQUIFER | DONLEY COUNTY	131	117	105	96	87	79
COUNTY-OTHER	A | GREENBELT LAKE/RESERVOIR	40	42	44	45	47	48
COUNTY-OTHER	A | OGALLALA AQUIFER | DONLEY COUNTY	20	18	16	15	13	12
COUNTY-OTHER	B | SEYMOUR AQUIFER | HARDEMAN COUNTY	80	80	80	80	80	80
MANUFACTURING	A | GREENBELT LAKE/RESERVOIR	185	206	228	251	259	267
MANUFACTURING	A | OGALLALA AQUIFER | DONLEY COUNTY	91	88	85	81	73	65
MINING	B | BLAINE AQUIFER | HARDEMAN COUNTY	12	12	12	12	12	12

Water User Group (WUG) Existing Water Supply

REGION B	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
HARDEMAN COUNTY							
RED BASIN							
MINING	B | OTHER AQUIFER | HARDEMAN COUNTY	7	7	7	7	7	7
LIVESTOCK	B | BLAINE AQUIFER | HARDEMAN COUNTY	136	136	136	136	136	136
LIVESTOCK	B | OTHER AQUIFER | HARDEMAN COUNTY	40	40	40	40	40	40
LIVESTOCK	B | RED LIVESTOCK LOCAL SUPPLY	400	400	400	400	400	400
LIVESTOCK	B | SEYMOUR AQUIFER | HARDEMAN COUNTY	55	55	55	55	55	55
IRRIGATION	B | BLAINE AQUIFER | HARDEMAN COUNTY	5,050	5,050	5,050	5,050	5,050	5,050
IRRIGATION	B | RED RUN-OF-RIVER	148	148	148	148	148	148
IRRIGATION	B | SEYMOUR AQUIFER | HARDEMAN COUNTY	250	250	250	250	250	250
RED BASIN TOTAL EXISTING SUPPLY		**7,021**	**7,031**	**7,044**	**7,070**	**7,074**	**7,077**
HARDEMAN COUNTY TOTAL EXISTING SUPPLY		**7,021**	**7,031**	**7,044**	**7,070**	**7,074**	**7,077**
KING COUNTY							
BRAZOS BASIN							
COUNTY-OTHER	B | BLAINE AQUIFER | KING COUNTY	190	190	190	190	190	190
MINING	B | OTHER AQUIFER | KING COUNTY	141	122	107	93	81	81
LIVESTOCK	B | BLAINE AQUIFER | KING COUNTY	37	37	37	37	37	37
LIVESTOCK	B | BRAZOS LIVESTOCK LOCAL SUPPLY	61	61	61	61	61	61
LIVESTOCK	B | OTHER AQUIFER | KING COUNTY	48	48	48	48	48	48
IRRIGATION	B | BLAINE AQUIFER | KING COUNTY	10	10	10	10	10	10
BRAZOS BASIN TOTAL EXISTING SUPPLY		**487**	**468**	**453**	**439**	**427**	**427**
RED BASIN							
COUNTY-OTHER	B | OTHER AQUIFER | KING COUNTY	5	5	5	5	5	5
COUNTY-OTHER	O | OTHER AQUIFER BRACKISH | DICKENS COUNTY	86	86	86	86	86	86
MINING	B | OTHER AQUIFER | KING COUNTY	239	209	182	158	138	138
LIVESTOCK	B | BLAINE AQUIFER | KING COUNTY	63	63	63	63	63	63
LIVESTOCK	B | OTHER AQUIFER | KING COUNTY	82	82	82	82	82	82
LIVESTOCK	B | RED LIVESTOCK LOCAL SUPPLY	103	103	103	103	103	103
IRRIGATION	B | BLAINE AQUIFER | KING COUNTY	18	18	18	18	18	18
RED BASIN TOTAL EXISTING SUPPLY		**596**	**566**	**539**	**515**	**495**	**495**
KING COUNTY TOTAL EXISTING SUPPLY		**1,083**	**1,034**	**992**	**954**	**922**	**922**
MONTAGUE COUNTY							
RED BASIN							
NOCONA	B | FARMERS CREEK/NOCONA LAKE/RESERVOIR	1,102	1,101	1,098	1,096	1,096	1,095
COUNTY-OTHER	B | FARMERS CREEK/NOCONA LAKE/RESERVOIR	52	52	52	52	52	53
COUNTY-OTHER	B | OTHER AQUIFER | MONTAGUE COUNTY	298	300	299	299	299	299
COUNTY-OTHER	B | TRINITY AQUIFER | MONTAGUE COUNTY	213	214	214	214	214	214
MANUFACTURING	B | FARMERS CREEK/NOCONA LAKE/RESERVOIR	6	7	10	12	12	12
MINING	B | DIRECT REUSE	156	157	156	0	0	0
MINING	B | OTHER AQUIFER | MONTAGUE COUNTY	960	960	480	337	384	384
LIVESTOCK	B | OTHER AQUIFER | MONTAGUE COUNTY	28	28	28	28	28	28
LIVESTOCK	B | RED LIVESTOCK LOCAL SUPPLY	1,165	1,165	1,165	1,165	1,165	1,165
IRRIGATION	B | FARMERS CREEK/NOCONA LAKE/RESERVOIR	100	100	100	100	100	100

Water User Group (WUG) Existing Water Supply

REGION B	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
MONTAGUE COUNTY							
RED BASIN							
IRRIGATION	B | OTHER AQUIFER | MONTAGUE COUNTY	72	72	72	72	72	72
IRRIGATION	B | RED RUN-OF-RIVER	108	108	108	108	108	108
IRRIGATION	B | TRINITY AQUIFER | MONTAGUE COUNTY	157	157	157	157	157	157
RED BASIN TOTAL EXISTING SUPPLY		**4,417**	**4,421**	**3,939**	**3,640**	**3,687**	**3,687**
TRINITY BASIN							
BOWIE	B | AMON G. CARTER LAKE/RESERVOIR	1,235	1,168	1,102	1,035	969	968
ST. JO	B | TRINITY AQUIFER | MONTAGUE COUNTY	211	211	211	211	211	211
COUNTY-OTHER	B | AMON G. CARTER LAKE/RESERVOIR	131	131	130	130	131	132
COUNTY-OTHER	B | OTHER AQUIFER | MONTAGUE COUNTY	402	400	401	401	401	401
COUNTY-OTHER	B | TRINITY AQUIFER | MONTAGUE COUNTY	287	286	286	286	286	286
MINING	B | DIRECT REUSE	168	170	169	0	0	0
MINING	B | OTHER AQUIFER | MONTAGUE COUNTY	1,040	1,040	520	363	416	416
LIVESTOCK	B | OTHER AQUIFER | MONTAGUE COUNTY	22	22	22	22	22	22
LIVESTOCK	B | TRINITY LIVESTOCK LOCAL SUPPLY	500	500	500	500	500	500
IRRIGATION	B | OTHER AQUIFER | MONTAGUE COUNTY	278	278	278	278	278	278
IRRIGATION	B | TRINITY AQUIFER | MONTAGUE COUNTY	158	158	158	158	158	158
TRINITY BASIN TOTAL EXISTING SUPPLY		**4,432**	**4,364**	**3,777**	**3,384**	**3,372**	**3,372**
MONTAGUE COUNTY TOTAL EXISTING SUPPLY		**8,849**	**8,785**	**7,716**	**7,024**	**7,059**	**7,059**
WICHITA COUNTY							
RED BASIN							
WICHITA FALLS	B | KEMP-DIVERSION LAKE/RESERVOIR SYSTEM	4,248	3,845	3,440	3,037	2,633	2,229
WICHITA FALLS	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	6,426	6,555	6,677	6,818	7,014	7,209
BURKBURNETT	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	823	784	748	713	682	651
BURKBURNETT	B | SEYMOUR AQUIFER | WICHITA COUNTY	989	989	989	989	989	989
ELECTRA	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	411	397	384	371	357	344
ELECTRA	B | SEYMOUR AQUIFER | WICHITA COUNTY	220	220	220	220	220	220
IOWA PARK	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	469	444	419	396	382	368
WICHITA VALLEY WSC	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	536	516	504	491	477	463
DEAN DALE SUD	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	79	77	75	74	72	70
COUNTY-OTHER	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	182	176	171	165	159	153
COUNTY-OTHER	B | SEYMOUR AQUIFER | WICHITA COUNTY	100	100	100	100	100	100
MANUFACTURING	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	1,360	1,384	1,421	1,438	1,393	1,347
MANUFACTURING	B | SEYMOUR AQUIFER | WICHITA COUNTY	129	129	129	129	129	129
MINING	B | SEYMOUR AQUIFER | WICHITA COUNTY	62	61	55	49	44	44
STEAM ELECTRIC POWER	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	185	179	173	167	161	156
LIVESTOCK	B | OTHER AQUIFER | WICHITA COUNTY	40	40	40	40	40	40
LIVESTOCK	B | RED LIVESTOCK LOCAL SUPPLY	916	916	916	916	916	916
IRRIGATION	B | KEMP-DIVERSION LAKE/RESERVOIR SYSTEM	26,247	23,759	21,271	18,780	16,282	13,788

Water User Group (WUG) Existing Water Supply

REGION B	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
		2020	2030	2040	2050	2060	2070
WICHITA COUNTY							
RED BASIN							
IRRIGATION	B | OTHER AQUIFER | WICHITA COUNTY	600	600	600	600	600	600
IRRIGATION	B | RED RUN-OF-RIVER	351	351	351	351	351	351
RED BASIN TOTAL EXISTING SUPPLY		**44,373**	**41,522**	**38,683**	**35,844**	**33,001**	**30,167**
WICHITA COUNTY TOTAL EXISTING SUPPLY		**44,373**	**41,522**	**38,683**	**35,844**	**33,001**	**30,167**
WILBARGER COUNTY							
RED BASIN							
VERNON	B | SEYMOUR AQUIFER | WILBARGER COUNTY	2,087	1,998	1,889	1,831	1,844	1,855
COUNTY-OTHER	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	20	20	20	20	20	20
COUNTY-OTHER	B | RED RUN-OF-RIVER	115	115	115	115	115	115
COUNTY-OTHER	B | SEYMOUR AQUIFER | WILBARGER COUNTY	380	385	381	373	376	377
MANUFACTURING	B | SEYMOUR AQUIFER | WILBARGER COUNTY	1,133	1,217	1,330	1,396	1,380	1,368
MINING	B | OTHER AQUIFER | WILBARGER COUNTY	10	10	10	10	10	10
MINING	B | RED RUN-OF-RIVER	30	30	30	30	30	30
STEAM ELECTRIC POWER	B | KEMP-DIVERSION LAKE/RESERVOIR SYSTEM	8,886	8,041	7,197	6,352	5,508	4,663
LIVESTOCK	B | RED LIVESTOCK LOCAL SUPPLY	738	738	738	738	738	738
LIVESTOCK	B | SANTA ROSA LAKE/RESERVOIR	50	50	50	50	50	50
LIVESTOCK	B | SEYMOUR AQUIFER | WILBARGER COUNTY	125	125	125	125	125	125
IRRIGATION	B | OTHER AQUIFER | WILBARGER COUNTY	4,000	3,800	3,600	3,400	3,200	3,000
IRRIGATION	B | RED RUN-OF-RIVER	825	825	825	825	825	825
IRRIGATION	B | SEYMOUR AQUIFER | WILBARGER COUNTY	25,696	25,686	25,686	25,562	25,190	25,190
RED BASIN TOTAL EXISTING SUPPLY		**44,095**	**43,040**	**41,996**	**40,827**	**39,411**	**38,366**
WILBARGER COUNTY TOTAL EXISTING SUPPLY		**44,095**	**43,040**	**41,996**	**40,827**	**39,411**	**38,366**
YOUNG COUNTY							
BRAZOS BASIN							
OLNEY	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	288	278	270	261	252	243
OLNEY	B | OLNEY-COOPER LAKE/RESERVOIR SYSTEM	620	620	620	620	620	620
COUNTY-OTHER	G | OTHER AQUIFER | YOUNG COUNTY	89	89	99	99	99	99
BRAZOS BASIN TOTAL EXISTING SUPPLY		**997**	**987**	**989**	**980**	**971**	**962**
TRINITY BASIN							
COUNTY-OTHER	G | OTHER AQUIFER | YOUNG COUNTY	1	1	1	1	1	1
TRINITY BASIN TOTAL EXISTING SUPPLY		**1**	**1**	**1**	**1**	**1**	**1**
YOUNG COUNTY TOTAL EXISTING SUPPLY		**998**	**988**	**990**	**981**	**972**	**963**
	REGION B TOTAL EXISTING SUPPLY	**132,907**	**128,603**	**123,127**	**117,993**	**113,424**	**109,333**

Water User Group (WUG) Needs/Surplus

REGION B	WUG (NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ARCHER COUNTY						
BRAZOS BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	(2)	0	0	0	0
LIVESTOCK	95	95	95	95	95	95
IRRIGATION	(48)	(47)	(45)	(44)	(44)	(44)
RED BASIN						
ARCHER CITY	(128)	(124)	(122)	(122)	(126)	(131)
HOLLIDAY	(110)	(127)	(135)	(139)	(145)	(151)
LAKESIDE CITY	(44)	(46)	(47)	(48)	(50)	(53)
SCOTLAND	(112)	(161)	(174)	(177)	(179)	(183)
WICHITA VALLEY WSC	119	107	95	84	69	52
WINDTHORST WSC	(141)	(156)	(161)	(164)	(169)	(175)
COUNTY-OTHER	105	134	140	139	138	136
MANUFACTURING	0	0	0	0	0	0
MINING	(222)	(289)	(170)	(114)	(57)	(57)
LIVESTOCK	218	171	125	78	32	0
IRRIGATION	(341)	(385)	(429)	(470)	(536)	(602)
TRINITY BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	(33)	(42)	(25)	(17)	(10)	(10)
LIVESTOCK	180	180	180	180	180	165
IRRIGATION	(99)	(96)	(93)	(90)	(90)	(90)
BAYLOR COUNTY						
BRAZOS BASIN						
SEYMOUR	104	119	129	130	131	131
COUNTY-OTHER	179	183	158	128	100	68
MINING	1	1	2	2	2	2
LIVESTOCK	(130)	(130)	(130)	(130)	(130)	(130)
IRRIGATION	0	0	0	0	0	0
RED BASIN						
COUNTY-OTHER	32	33	34	34	34	34
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(388)	(312)	(213)	(119)	(119)	(119)
CLAY COUNTY						
RED BASIN						
DEAN DALE SUD	(14)	(15)	(13)	(16)	(22)	(27)
HENRIETTA	438	433	445	452	453	453
PETROLIA	29	30	33	33	34	34
WINDTHORST WSC	(31)	(34)	(34)	(36)	(37)	(37)
COUNTY-OTHER	66	62	70	73	66	59
MINING	169	0	17	30	44	44
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	21	55	88	121	115	109
TRINITY BASIN						
COUNTY-OTHER	0	0	2	2	3	3
MINING	4	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0

Water User Group (WUG) Needs/Surplus

REGION B	WUG (NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
CLAY COUNTY						
TRINITY BASIN						
IRRIGATION	0	0	0	0	0	0
COTTLE COUNTY						
RED BASIN						
PADUCAH	197	204	205	205	206	206
COUNTY-OTHER	154	156	157	157	157	157
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	9	29	46	58	58	58
FOARD COUNTY						
RED BASIN						
CROWELL	0	0	0	0	0	0
COUNTY-OTHER	10	12	13	13	13	13
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	572	691	805	916	916	916
HARDEMAN COUNTY						
RED BASIN						
CHILLICOTHE	45	45	45	45	45	45
QUANAH	0	0	0	0	0	0
COUNTY-OTHER	10	11	13	11	10	9
MANUFACTURING	0	0	0	0	0	0
MINING	2	2	1	1	1	1
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(2,491)	(2,253)	(2,022)	(1,798)	(1,798)	(1,798)
KING COUNTY						
BRAZOS BASIN						
COUNTY-OTHER	182	182	182	182	182	182
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
RED BASIN						
COUNTY-OTHER	20	18	18	18	19	19
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
MONTAGUE COUNTY						
RED BASIN						
NOCONA	362	350	347	338	330	323
COUNTY-OTHER	3	5	11	10	6	2
MANUFACTURING	1	1	2	2	2	2
MINING	(631)	(120)	(135)	5	11	11
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	1	1	1	1	1	1
TRINITY BASIN						
BOWIE	308	233	173	101	27	19
ST. JO	50	49	51	50	49	48
COUNTY-OTHER	68	66	74	73	68	63

Water User Group (WUG) Needs/Surplus

REGION B	WUG (NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MONTAGUE COUNTY						
TRINITY BASIN						
MINING	(684)	(130)	(146)	4	12	12
LIVESTOCK	124	124	124	124	124	124
IRRIGATION	0	0	0	0	0	0
WICHITA COUNTY						
RED BASIN						
BURKBURNETT	331	293	260	220	168	115
DEAN DALE SUD	(7)	(7)	(7)	(8)	(12)	(15)
ELECTRA	(315)	(348)	(375)	(405)	(436)	(464)
IOWA PARK	(424)	(449)	(472)	(498)	(525)	(553)
WICHITA FALLS	(6,683)	(7,074)	(7,427)	(7,797)	(8,275)	(8,746)
WICHITA VALLEY WSC	136	117	106	92	72	52
COUNTY-OTHER	(51)	(66)	(80)	(91)	(102)	(114)
MANUFACTURING	(1,254)	(1,361)	(1,486)	(1,595)	(1,640)	(1,686)
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	(175)	(181)	(187)	(193)	(199)	(204)
LIVESTOCK	39	39	39	39	39	39
IRRIGATION	(18,069)	(19,777)	(21,485)	(23,196)	(25,694)	(28,188)
WILBARGER COUNTY						
RED BASIN						
VERNON	204	75	(45)	(151)	(174)	(194)
COUNTY-OTHER	85	82	73	53	47	41
MANUFACTURING	0	0	(32)	(115)	(131)	(143)
MINING	20	20	21	21	22	22
STEAM ELECTRIC POWER	(1,114)	(1,959)	(2,803)	(3,648)	(4,492)	(5,337)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(1,082)	(344)	375	944	372	172
YOUNG COUNTY						
BRAZOS BASIN						
OLNEY	351	339	332	315	294	273
COUNTY-OTHER	25	16	19	11	3	(5)
TRINITY BASIN						
COUNTY-OTHER	0	0	0	0	0	0

Water User Group (WUG) Category Summary

REGION B	2020	2030	2040	2050	2060	2070
MUNICIPAL						
POPULATION	181,591	188,450	193,070	196,466	199,522	202,088
DEMANDS (acre-feet per year)	29,311	29,547	29,583	29,766	30,154	30,534
EXISTING SUPPLIES (acre-feet per year)	23,976	23,400	22,792	22,270	21,882	21,556
NEEDS (acre-feet per year)*	(8,009)	(8,541)	(9,012)	(9,561)	(10,150)	(10,729)
COUNTY-OTHER						
POPULATION	24,716	25,480	25,858	26,294	26,620	26,885
DEMANDS (acre-feet per year)	3,252	3,237	3,210	3,230	3,260	3,293
EXISTING SUPPLIES (acre-feet per year)	4,140	4,131	4,094	4,043	4,004	3,960
NEEDS (acre-feet per year)*	(51)	(66)	(80)	(91)	(102)	(119)
MANUFACTURING						
DEMANDS (acre-feet per year)	4,158	4,392	4,720	5,016	5,016	5,016
EXISTING SUPPLIES (acre-feet per year)	2,905	3,032	3,204	3,308	3,247	3,189
NEEDS (acre-feet per year)*	(1,254)	(1,361)	(1,518)	(1,710)	(1,771)	(1,829)
MINING						
DEMANDS (acre-feet per year)	5,203	4,342	2,978	1,837	1,701	1,701
EXISTING SUPPLIES (acre-feet per year)	3,829	3,782	2,543	1,769	1,726	1,726
NEEDS (acre-feet per year)*	(1,570)	(583)	(476)	(131)	(67)	(67)
STEAM ELECTRIC POWER						
DEMANDS (acre-feet per year)	10,360	10,360	10,360	10,360	10,360	10,360
EXISTING SUPPLIES (acre-feet per year)	9,071	8,220	7,370	6,519	5,669	4,819
NEEDS (acre-feet per year)*	(1,289)	(2,140)	(2,990)	(3,841)	(4,691)	(5,541)
LIVESTOCK						
DEMANDS (acre-feet per year)	10,761	10,761	10,761	10,761	10,761	10,761
EXISTING SUPPLIES (acre-feet per year)	11,287	11,240	11,194	11,147	11,101	11,054
NEEDS (acre-feet per year)*	(130)	(130)	(130)	(130)	(130)	(130)
IRRIGATION						
DEMANDS (acre-feet per year)	99,614	97,236	94,902	92,614	92,614	92,614
EXISTING SUPPLIES (acre-feet per year)	77,699	74,798	71,930	68,937	65,795	63,029
NEEDS (acre-feet per year)*	(22,518)	(23,214)	(24,287)	(25,717)	(28,281)	(30,841)
REGION TOTALS						
POPULATION	206,307	213,930	218,928	222,760	226,142	228,973
DEMANDS (acre-feet per year)	162,659	159,875	156,514	153,584	153,866	154,279
EXISTING SUPPLIES (acre-feet per year)	132,907	128,603	123,127	117,993	113,424	109,333
NEEDS (acre-feet per year)*	(34,821)	(36,035)	(38,493)	(41,181)	(45,192)	(49,256)

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Category Summary report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

Water User Group (WUG) Second-Tier Identified Water Need

REGION B	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ARCHER COUNTY						
BRAZOS BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	36	37	36	36	37	37
RED BASIN						
ARCHER CITY	128	124	116	107	100	99
HOLLIDAY	110	127	128	120	113	112
LAKESIDE CITY	44	46	45	42	39	38
SCOTLAND	112	158	166	161	157	155
WICHITA VALLEY WSC	0	0	0	0	0	0
WINDTHORST WSC	141	153	153	150	148	147
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	133	185	94	52	10	10
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
TRINITY BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	21	27	15	9	4	4
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	75	74	74	74	75	77
BAYLOR COUNTY						
BRAZOS BASIN						
SEYMOUR	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	130	130	130	130	130	130
IRRIGATION	0	0	0	0	0	0
RED BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	57	0	0	0	0	0
CLAY COUNTY						
RED BASIN						
DEAN DALE SUD	14	15	13	16	22	22
HENRIETTA	0	0	0	0	0	0
PETROLIA	0	0	0	0	0	0
WINDTHORST WSC	31	33	32	33	33	31
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
TRINITY BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

Water User Group (WUG) Second-Tier Identified Water Need

REGION B	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
COTTLE COUNTY						
RED BASIN						
PADUCAH	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
FOARD COUNTY						
RED BASIN						
CROWELL	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
HARDEMAN COUNTY						
RED BASIN						
CHILLICOTHE	0	0	0	0	0	0
QUANAH	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	1,697	1,483	1,275	1,073	1,073	1,073
KING COUNTY						
BRAZOS BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
RED BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
MONTAGUE COUNTY						
RED BASIN						
NOCONA	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	194	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
TRINITY BASIN						
BOWIE	0	0	0	0	0	0
ST. JO	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	211	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

Water User Group (WUG) Second-Tier Identified Water Need

REGION B	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
WICHITA COUNTY						
RED BASIN						
BURKBURNETT	0	0	0	0	0	0
DEAN DALE SUD	7	7	7	8	12	13
ELECTRA	315	340	350	352	354	359
IOWA PARK	424	449	467	462	449	462
WICHITA FALLS	2,199	2,590	2,943	3,313	3,791	4,262
WICHITA VALLEY WSC	0	0	0	0	0	0
COUNTY-OTHER	51	66	78	76	75	78
MANUFACTURING	1,254	1,361	1,486	1,595	1,640	1,686
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	175	181	187	193	199	204
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	280	2,607	5,671	8,729
WILBARGER COUNTY						
RED BASIN						
VERNON	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
YOUNG COUNTY						
BRAZOS BASIN						
OLNEY	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
TRINITY BASIN						
COUNTY-OTHER	0	0	0	0	0	0

***Second-tier needs are WUG split needs adjusted to include the implementation of recommended demand reduction and direct reuse water management strategies.**

Water User Group (WUG) Second-Tier Identified Water Need Summary

REGION B

	2020	2030	2040	2050	2060	2070
MUNICIPAL	3,525	4,042	4,420	4,764	5,218	5,700
COUNTY-OTHER	51	66	78	76	75	78
MANUFACTURING	1,254	1,361	1,486	1,595	1,640	1,686
MINING	559	212	109	61	14	14
STEAM ELECTRIC POWER	175	181	187	193	199	204
LIVESTOCK	130	130	130	130	130	130
IRRIGATION	1,865	1,594	1,665	3,790	6,856	9,916

*Second-tier needs are WUG split needs adjusted to include the implementation of recommended demand reduction and direct reuse water management strategies.

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Primary Region: B

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
ARCHER CITY	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	152	146	115	114	113	112	$632	$360
ARCHER CITY	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	190	189	187	185	N/A	$482
ARCHER CITY	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	8	8	8	8	8	8	$1601	$865
ARCHER CITY	B	MUNICIPAL CONSERVATION - ARCHER CITY	DEMAND REDUCTION	0	0	6	15	26	32	N/A	$681
ARCHER CITY	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	23	23	23	23	23	22	$816	$397
BOWIE	B	MUNICIPAL CONSERVATION - BOWIE	DEMAND REDUCTION	27	43	40	48	64	81	$600	$600
BURKBURNETT	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	648	643	639	635	629	623	$632	$360
BURKBURNETT	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	1,060	1,053	1,043	1,033	N/A	$482
BURKBURNETT	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	46	46	45	46	45	45	$1601	$865
BURKBURNETT	B	MUNICIPAL CONSERVATION - BURKBURNETT	DEMAND REDUCTION	148	305	269	251	251	254	$770	$770
BURKBURNETT	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	130	129	128	127	126	125	$816	$397
COUNTY-OTHER, ARCHER	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	29	29	29	28	28	28	$632	$360
COUNTY-OTHER, ARCHER	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	48	47	47	46	N/A	$482
COUNTY-OTHER, ARCHER	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	2	2	2	2	2	2	$1601	$865
COUNTY-OTHER, ARCHER	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	6	6	6	6	6	6	$816	$397
COUNTY-OTHER, BAYLOR	B	MUNICIPAL CONSERVATION - BAYLOR COUNTY OTHER	DEMAND REDUCTION	0	0	0	6	10	14	N/A	$770
COUNTY-OTHER, CLAY	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	144	143	142	141	139	138	$632	$360
COUNTY-OTHER, CLAY	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	235	234	231	229	N/A	$482
COUNTY-OTHER, CLAY	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	10	10	10	10	10	10	$1601	$865
COUNTY-OTHER, CLAY	B	MUNICIPAL CONSERVATION - CLAY COUNTY OTHER	DEMAND REDUCTION	0	0	0	18	43	60	N/A	$770
COUNTY-OTHER, CLAY	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	29	29	28	28	28	28	$816	$397
COUNTY-OTHER, FOARD	A	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	A | OGALLALA AQUIFER | DONLEY COUNTY	5	3	0	0	0	0	$629	N/A
COUNTY-OTHER, FOARD	B	MUNICIPAL CONSERVATION - FOARD COUNTY OTHER	DEMAND REDUCTION	0	0	1	4	7	8	N/A	$770
COUNTY-OTHER, HARDEMAN	A	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	A | OGALLALA AQUIFER | DONLEY COUNTY	16	15	12	11	8	4	$629	$101
COUNTY-OTHER, HARDEMAN	B	MUNICIPAL CONSERVATION - HARDEMAN COUNTY OTHER	DEMAND REDUCTION	0	0	0	4	8	13	N/A	$770
COUNTY-OTHER, MONTAGUE	B	MUNICIPAL CONSERVATION - MONTAGUE COUNTY OTHER	DEMAND REDUCTION	0	0	3	47	105	144	N/A	$770
COUNTY-OTHER, WICHITA	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	97	96	95	95	94	93	$632	$360
COUNTY-OTHER, WICHITA	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	159	158	156	155	N/A	$482
COUNTY-OTHER, WICHITA	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	7	7	7	7	7	7	$1601	$865
COUNTY-OTHER, WICHITA	B	MUNICIPAL CONSERVATION - WICHITA COUNTY OTHER	DEMAND REDUCTION	0	0	2	15	27	36	N/A	$770
COUNTY-OTHER, WICHITA	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	20	20	19	19	19	18	$816	$397

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
COUNTY-OTHER, WILBARGER	B	ADDITIONAL SEYMOUR AQUIFER - VERNON	B | SEYMOUR AQUIFER | WILBARGER COUNTY	1	6	16	38	46	53	$1793	$425
COUNTY-OTHER, WILBARGER	B	MUNICIPAL CONSERVATION - WILBARGER COUNTY OTHER	DEMAND REDUCTION	0	0	0	13	31	45	N/A	$770
CROWELL	A	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	A | OGALLALA AQUIFER | DONLEY COUNTY	28	27	24	19	13	10	$629	$101
CROWELL	B	MUNICIPAL CONSERVATION - CROWELL	DEMAND REDUCTION	0	0	2	7	13	16	N/A	$770
DEAN DALE SUD	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	160	159	158	157	155	154	$632	$360
DEAN DALE SUD	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	262	260	257	255	N/A	$482
DEAN DALE SUD	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	12	11	11	11	11	11	$1601	$865
DEAN DALE SUD	B	MUNICIPAL CONSERVATION - DEAN DALE SUD	DEMAND REDUCTION	0	0	0	0	0	7	N/A	$770
DEAN DALE SUD	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	32	32	32	32	31	31	$816	$397
ELECTRA	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	425	463	287	285	285	280	$632	$360
ELECTRA	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	476	473	469	464	N/A	$482
ELECTRA	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	21	21	20	20	20	20	$1601	$865
ELECTRA	B	MUNICIPAL CONSERVATION - ELECTRA	DEMAND REDUCTION	0	8	25	53	82	105	N/A	$600
ELECTRA	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	58	58	57	57	56	56	$816	$397
HOLLIDAY	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	136	154	132	128	124	123	$632	$360
HOLLIDAY	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	216	213	210	208	N/A	$482
HOLLIDAY	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	8	9	9	9	9	9	$1601	$865
HOLLIDAY	B	MUNICIPAL CONSERVATION - HOLLIDAY	DEMAND REDUCTION	0	0	7	19	32	39	N/A	$600
HOLLIDAY	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	24	26	26	26	25	25	$816	$397
IOWA PARK	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	485	481	478	475	470	466	$632	$360
IOWA PARK	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	793	788	781	773	N/A	$482
IOWA PARK	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	34	34	34	34	34	34	$1601	$865
IOWA PARK	B	MUNICIPAL CONSERVATION - IOWA PARK	DEMAND REDUCTION	0	0	5	36	76	91	N/A	$600
IOWA PARK	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	97	96	96	95	94	93	$816	$397
IRRIGATION, ARCHER	B	CHLORIDE CONTROL PROJECT - RRA - IRRIGATION	DEMAND REDUCTION	144	129	114	99	86	73	$987	$227
IRRIGATION, ARCHER	B	IRRIGATION CONSERVATION - ARCHER	DEMAND REDUCTION	121	118	114	111	111	111	$8	$8
IRRIGATION, ARCHER	B	IRRIGATION CONSERVATION - WCWID NO. 2 ARCHER	DEMAND REDUCTION	368	411	454	494	560	626	$49	$49
IRRIGATION, BAYLOR	B	IRRIGATION CONSERVATION - BAYLOR	DEMAND REDUCTION	331	321	311	302	302	302	$8	$8
IRRIGATION, CLAY	B	CHLORIDE CONTROL PROJECT - RRA - IRRIGATION	DEMAND REDUCTION	12	11	10	9	8	7	$987	$227
IRRIGATION, CLAY	B	IRRIGATION CONSERVATION - CLAY	DEMAND REDUCTION	144	140	136	132	132	132	$8	$8
IRRIGATION, COTTLE	B	IRRIGATION CONSERVATION - COTTLE	DEMAND REDUCTION	400	388	377	366	366	366	$8	$8
IRRIGATION, FOARD	B	IRRIGATION CONSERVATION - FOARD	DEMAND REDUCTION	394	382	371	360	360	360	$8	$8
IRRIGATION, HARDEMAN	B	IRRIGATION CONSERVATION - HARDEMAN	DEMAND REDUCTION	794	770	747	725	725	725	$8	$8

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
IRRIGATION, KING	B	IRRIGATION CONSERVATION - KING	DEMAND REDUCTION	3	3	3	3	3	3	$8	$8
IRRIGATION, MONTAGUE	B	IRRIGATION CONSERVATION - MONTAGUE	DEMAND REDUCTION	87	87	87	87	87	87	$8	$8
IRRIGATION, WICHITA	B	CHLORIDE CONTROL PROJECT - RRA - IRRIGATION	DEMAND REDUCTION	5,249	4,752	4,254	3,756	3,256	2,758	$987	$227
IRRIGATION, WICHITA	B	IRRIGATION CONSERVATION - WCWID NO. 2 WICHITA	DEMAND REDUCTION	12,666	12,623	12,580	12,540	12,474	12,408	$49	$49
IRRIGATION, WICHITA	B	IRRIGATION CONSERVATION - WICHITA	DEMAND REDUCTION	4,527	4,449	4,371	4,293	4,293	4,293	$8	$8
IRRIGATION, WILBARGER	B	IRRIGATION CONSERVATION - WILBARGER	DEMAND REDUCTION	3,160	3,066	2,974	2,884	2,884	2,884	$8	$8
LAKESIDE CITY	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	62	61	61	61	60	60	$632	$360
LAKESIDE CITY	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	101	101	100	99	N/A	$482
LAKESIDE CITY	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	3	4	4	4	4	3	$1601	$865
LAKESIDE CITY	B	MUNICIPAL CONSERVATION - LAKESIDE CITY	DEMAND REDUCTION	0	0	2	6	11	15	N/A	$600
LAKESIDE CITY	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	12	12	12	12	12	12	$816	$397
MANUFACTURING, HARDEMAN	A	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	A | OGALLALA AQUIFER | DONLEY COUNTY	55	59	63	66	66	66	$629	$101
MANUFACTURING, WICHITA	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	1,068	1,169	746	772	765	757	$632	$360
MANUFACTURING, WICHITA	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	1,238	1,281	1,269	1,257	N/A	$482
MANUFACTURING, WICHITA	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	49	50	53	55	55	55	$1601	$865
MANUFACTURING, WICHITA	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	137	142	149	154	153	151	$816	$397
MANUFACTURING, WILBARGER	B	ADDITIONAL SEYMOUR AQUIFER - VERNON	B | SEYMOUR AQUIFER | WILBARGER COUNTY	227	243	4	17	33	45	$1793	$425
MANUFACTURING, WILBARGER	B	VERNON DIRECT REUSE TO WILBARGER COUNTY MANUFACTURING	B | DIRECT REUSE	0	0	300	400	400	400	N/A	$950
MINING, ARCHER	B	MINING CONSERVATION - ARCHER	DEMAND REDUCTION	101	121	86	70	53	53	$2500	$2500
MINING, BAYLOR	B	MINING CONSERVATION - BAYLOR	DEMAND REDUCTION	4	4	3	3	3	3	$2500	$2500
MINING, CLAY	B	MINING CONSERVATION - CLAY	DEMAND REDUCTION	153	197	146	118	89	89	$2500	$2500
MINING, COTTLE	B	MINING CONSERVATION - COTTLE	DEMAND REDUCTION	10	10	10	9	8	8	$2500	$2500
MINING, FOARD	B	MINING CONSERVATION - FOARD	DEMAND REDUCTION	3	3	3	3	3	3	$2500	$2500
MINING, HARDEMAN	B	MINING CONSERVATION - HARDEMAN	DEMAND REDUCTION	4	4	5	5	5	5	$2500	$2500
MINING, KING	B	MINING CONSERVATION - KING	DEMAND REDUCTION	95	83	72	63	55	55	$2500	$2500
MINING, MONTAGUE	B	MINING CONSERVATION - MONTAGUE	DEMAND REDUCTION	910	644	402	173	194	194	$2500	$2500
MINING, WICHITA	B	MINING CONSERVATION - WICHITA	DEMAND REDUCTION	16	15	14	12	11	11	$2500	$2500
MINING, WILBARGER	B	MINING CONSERVATION - WILBARGER	DEMAND REDUCTION	5	5	5	5	5	5	$2500	$2500
OLNEY	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	194	193	191	190	188	187	$632	$360
OLNEY	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	319	314	311	309	N/A	$482
OLNEY	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	14	14	14	14	14	14	$1601	$865
OLNEY	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	39	39	38	38	38	37	$816	$397

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
QUANAH	A	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	A | OGALLALA AQUIFER | DONLEY COUNTY	79	78	73	56	38	32	$629	$101
QUANAH	B	MUNICIPAL CONSERVATION - QUANNAH	DEMAND REDUCTION	0	0	5	23	41	48	N/A	$600
SCOTLAND	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	137	194	95	99	102	107	$632	$360
SCOTLAND	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	114	114	113	112	N/A	$482
SCOTLAND	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	5	5	5	5	5	5	$1601	$865
SCOTLAND	B	MUNICIPAL CONSERVATION - SCOTLAND	DEMAND REDUCTION	0	3	8	16	22	28	N/A	$600
SCOTLAND	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	14	14	14	14	14	13	$816	$397
STEAM ELECTRIC POWER, WICHITA	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	142	148	123	122	121	120	$632	$360
STEAM ELECTRIC POWER, WICHITA	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	204	203	201	199	N/A	$482
STEAM ELECTRIC POWER, WICHITA	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	9	9	9	9	9	9	$1601	$865
STEAM ELECTRIC POWER, WICHITA	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	25	25	25	24	24	24	$816	$397
STEAM ELECTRIC POWER, WILBARGER	B	ALTERNATIVE COOLING TECHNOLOGY - STEAM ELECTRIC POWER WILBARGER COUNTY	DEMAND REDUCTION	1,114	1,959	2,803	3,648	4,492	5,337	$420	$420
VERNON	B	ADDITIONAL SEYMOUR AQUIFER - VERNON	B | SEYMOUR AQUIFER | WILBARGER COUNTY	372	351	580	545	521	502	$1793	$425
VERNON	B	MUNICIPAL CONSERVATION - VERNON	DEMAND REDUCTION	0	0	0	51	124	202	N/A	$681
VERNON	B	WATER CONSERVATION (REPLACE TRANSMISSION PIPELINE) - VERNON	DEMAND REDUCTION	313	313	313	313	313	313	$2271	$185
WICHITA FALLS	B	CHLORIDE CONTROL PROJECT - RRA - WICHITA FALLS	B | KEMP-DIVERSION LAKE/RESERVOIR SYSTEM	1,133	1,025	917	810	702	594	$987	$227
WICHITA FALLS	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	6,515	6,298	7,160	7,153	7,189	7,220	$632	$360
WICHITA FALLS	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	11,924	11,919	11,984	12,046	N/A	$482
WICHITA FALLS	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	512	511	510	515	521	524	$1601	$865
WICHITA FALLS	B	MUNICIPAL CONSERVATION - WICHITA FALLS	DEMAND REDUCTION	4,484	4,484	4,484	4,484	4,484	4,484	$815	$131
WICHITA FALLS	B	PRECIPITATION ENHANCEMENT - WICHITA FALLS	B | LITTLE WICHITA RIVER LAKE/RESERVOIR SYSTEM	1,000	1,000	1,000	1,000	1,000	1,000	$280	$280
WICHITA FALLS	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	1,443	1,441	1,437	1,437	1,445	1,452	$816	$397
WICHITA VALLEY WSC	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	234	232	230	229	227	225	$632	$360
WICHITA VALLEY WSC	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	392	389	386	384	380	377	$632	$360
WICHITA VALLEY WSC	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	382	380	376	373	N/A	$482
WICHITA VALLEY WSC	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	641	637	631	625	N/A	$482
WICHITA VALLEY WSC	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	17	16	16	16	16	16	$1601	$865
WICHITA VALLEY WSC	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	28	28	27	28	27	27	$1601	$865
WICHITA VALLEY WSC	B	MUNICIPAL CONSERVATION - WICHITA VALLEY WSC	DEMAND REDUCTION	0	0	0	0	12	24	N/A	$681
WICHITA VALLEY WSC	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	47	46	46	46	45	45	$816	$397

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
WICHITA VALLEY WSC	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	78	78	77	77	76	75	$816	$397
WINDTHORST WSC	B	INDIRECT REUSE TO LAKE ARROWHEAD	B | RED INDIRECT REUSE	190	212	143	142	141	140	$632	$360
WINDTHORST WSC	B	LAKE RINGGOLD	B | RINGGOLD LAKE/RESERVOIR	0	0	238	236	234	232	N/A	$482
WINDTHORST WSC	B	LOCAL SEYMOUR AQUIFER	B | SEYMOUR AQUIFER | WICHITA COUNTY	10	10	10	10	10	10	$1601	$865
WINDTHORST WSC	B	MUNICIPAL CONSERVATION - WINDHORST WSC	DEMAND REDUCTION	0	4	10	17	25	34	N/A	$600
WINDTHORST WSC	B	WICHITA RIVER DIVERSION	B | RED RUN-OF-RIVER	29	29	29	28	28	28	$816	$397
Region B Total RecommendedWMS Supplies				52,951	52,912	71,469	71,534	72,059	72,557		

Recommended Projects Associated with Water Management Strategies

Project Sponosr Region: B

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade
COUNTY-OTHER, BAYLOR	N	CHLORIDE CONTROL PROJECT	CONVEYANCE/TRANSMISSION PIPELINE; DIVERSION AND CONTROL STRUCTURE; PUMP STATION	$59,371,000	2020
MINING, ARCHER	N	MINING CONSERVATION - ARCHER	MINING CONSERVATION CAPITAL COST	$1,004,000	2020
MINING, BAYLOR	N	MINING CONSERVATION - BAYLOR	MINING CONSERVATION CAPITAL COST	$33,000	2020
MINING, CLAY	N	MINING CONSERVATION - CLAY	MINING CONSERVATION CAPITAL COST	$1,635,000	2020
MINING, COTTLE	N	MINING CONSERVATION - COTTLE	MINING CONSERVATION CAPITAL COST	$83,000	2020
MINING, FOARD	N	MINING CONSERVATION - FOARD	MINING CONSERVATION CAPITAL COST	$25,000	2020
MINING, HARDEMAN	N	MINING CONSERVATION - HARDEMAN	MINING CONSERVATION CAPITAL COST	$42,000	2020
MINING, KING	N	MINING CONSERVATION - KING	MINING CONSERVATION CAPITAL COST	$789,000	2020
MINING, MONTAGUE	N	MINING CONSERVATION - MONTAGUE	MINING CONSERVATION CAPITAL COST	$7,553,000	2020
MINING, WICHITA	N	MINING CONSERVATION - WICHITA	MINING CONSERVATION CAPITAL COST	$133,000	2020
MINING, WILBARGER	N	MINING CONSERVATION - WILBARGER	MINING CONSERVATION CAPITAL COST	$42,000	2020
STEAM ELECTRIC POWER, WILBARGER	N	ALTERNATIVE COOLING TECHNOLOGY - STEAM ELECTRIC POWER WILBARGER COUNTY	INDUSTRIAL CONSERVATION	$89,740,000	2020
VERNON	N	ADDITIONAL SEYMOUR AQUIFER - VERNON	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$9,810,000	2020
VERNON	N	DIRECT REUSE - VERNON	CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT	$8,500,000	2040
VERNON	N	WATER CONSERVATION (REPLACE TRANSMISSION PIPELINE) - VERNON	WATER LOSS CONTROL	$7,807,000	2020
WICHITA FALLS	Y	INDIRECT REUSE TO LAKE ARROWHEAD	CONVEYANCE/TRANSMISSION PIPELINE	$36,400,000	2020
WICHITA FALLS	Y	LAKE RINGGOLD	CONVEYANCE/TRANSMISSION PIPELINE; RESERVOIR CONSTRUCTION	$330,510,000	2040
WICHITA FALLS	Y	LOCAL SEYMOUR AQUIFER	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT	$19,674,000	2020
WICHITA FALLS	Y	WATER CONSERVATION - WICHITA FALLS	WATER LOSS CONTROL	$36,656,000	2020
WICHITA FALLS	Y	WICHITA RIVER DIVERSION	CONVEYANCE/TRANSMISSION PIPELINE; DIVERSION AND CONTROL STRUCTURE	$11,230,000	2020
WICHITA WCID #2	Y	WCWID NO. 2 CANAL CONVERSION TO PIPELINE	CONVEYANCE/TRANSMISSION PIPELINE	$8,538,000	2020

Region B Total Recommended Capital Cost	**$629,575,000**

***Projects with a capital cost of zero are excluded from the report list.**

Water User Group (WUG) Management Supply Factor

REGION B	WUG MANAGEMENT SUPPLY FACTOR					
	2020	2030	2040	2050	2060	2070
ARCHER CITY	1.2	1.2	1.8	1.9	1.9	1.9
BOWIE	1.4	1.3	1.2	1.2	1.1	1.1
BURKBURNETT	1.9	2.0	2.6	2.6	2.5	2.4
CHILLICOTHE	1.7	1.7	1.8	1.7	1.7	1.7
COUNTY-OTHER, ARCHER	2.9	4.9	7.3	7.2	7.1	7.1
COUNTY-OTHER, BAYLOR	2.6	2.7	2.6	2.4	2.2	2.0
COUNTY-OTHER, CLAY	1.4	1.4	1.9	1.9	2.0	2.0
COUNTY-OTHER, COTTLE	4.3	4.5	4.7	4.7	4.7	4.7
COUNTY-OTHER, FOARD	1.2	1.2	1.2	1.2	1.3	1.3
COUNTY-OTHER, HARDEMAN	1.2	1.2	1.2	1.2	1.2	1.2
COUNTY-OTHER, KING	3.6	3.5	3.5	3.5	3.5	3.5
COUNTY-OTHER, MONTAGUE	1.1	1.1	1.1	1.1	1.1	1.2
COUNTY-OTHER, WICHITA	1.2	1.2	1.6	1.6	1.6	1.5
COUNTY-OTHER, WILBARGER	1.2	1.2	1.2	1.2	1.3	1.3
CROWELL	1.2	1.2	1.2	1.2	1.2	1.2
DEAN DALE SUD	1.7	1.7	2.8	2.8	2.7	2.7
ELECTRA	1.2	1.2	1.5	1.5	1.5	1.4
HENRIETTA	1.7	1.7	1.7	1.7	1.7	1.7
HOLLIDAY	1.2	1.2	1.8	1.8	1.8	1.8
IOWA PARK	1.2	1.2	2.0	2.0	2.0	2.0
IRRIGATION, ARCHER	1.1	1.1	1.1	1.1	1.1	1.1
IRRIGATION, BAYLOR	1.0	1.0	1.0	1.1	1.1	1.1
IRRIGATION, CLAY	1.1	1.1	1.2	1.2	1.2	1.2
IRRIGATION, COTTLE	1.1	1.1	1.1	1.1	1.1	1.1
IRRIGATION, FOARD	1.2	1.3	1.3	1.4	1.4	1.4
IRRIGATION, HARDEMAN	0.8	0.8	0.8	0.9	0.9	0.9
IRRIGATION, KING	1.1	1.1	1.1	1.1	1.1	1.1
IRRIGATION, MONTAGUE	1.1	1.1	1.1	1.1	1.1	1.1
IRRIGATION, WICHITA	1.1	1.0	1.0	0.9	0.9	0.8
IRRIGATION, WILBARGER	1.0	1.1	1.1	1.1	1.1	1.1
LAKESIDE CITY	1.2	1.2	2.0	2.0	2.1	2.0
LIVESTOCK, ARCHER	1.2	1.2	1.2	1.2	1.1	1.1
LIVESTOCK, BAYLOR	0.9	0.9	0.9	0.9	0.9	0.9
LIVESTOCK, CLAY	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, COTTLE	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, FOARD	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, HARDEMAN	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, KING	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, MONTAGUE	1.1	1.1	1.1	1.1	1.1	1.1
LIVESTOCK, WICHITA	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, WILBARGER	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, ARCHER	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, HARDEMAN	1.2	1.2	1.2	1.2	1.2	1.2
MANUFACTURING, MONTAGUE	1.2	1.2	1.3	1.2	1.2	1.2
MANUFACTURING, WICHITA	1.0	1.0	1.2	1.2	1.2	1.2
MANUFACTURING, WILBARGER	1.2	1.2	1.2	1.2	1.2	1.2
MINING, ARCHER	0.6	0.6	0.7	0.8	0.9	0.9
MINING, BAYLOR	1.4	1.4	1.4	1.4	1.4	1.4
MINING, CLAY	1.5	1.3	1.3	1.3	1.4	1.4
MINING, COTTLE	1.2	1.2	1.3	1.3	1.3	1.3

Water User Group (WUG) Management Supply Factor

REGION B	WUG MANAGEMENT SUPPLY FACTOR					
	2020	2030	2040	2050	2060	2070
MINING, FOARD	1.3	1.3	1.3	1.3	1.3	1.3
MINING, HARDEMAN	1.4	1.4	1.3	1.3	1.3	1.3
MINING, KING	1.3	1.3	1.2	1.3	1.3	1.3
MINING, MONTAGUE	0.9	1.2	1.1	1.3	1.3	1.3
MINING, WICHITA	1.3	1.2	1.3	1.2	1.3	1.3
MINING, WILBARGER	2.3	2.3	2.4	2.4	2.5	2.5
NOCONA	1.5	1.5	1.5	1.4	1.4	1.4
OLNEY	2.1	2.0	2.6	2.5	2.5	2.4
PADUCAH	1.7	1.7	1.7	1.7	1.7	1.7
PETROLIA	1.4	1.4	1.5	1.5	1.5	1.5
QUANAH	1.2	1.2	1.2	1.2	1.2	1.2
SCOTLAND	1.2	1.2	1.2	1.3	1.3	1.3
SEYMOUR	1.2	1.2	1.3	1.3	1.3	1.3
ST. JO	1.3	1.3	1.3	1.3	1.3	1.3
STEAM ELECTRIC POWER, WICHITA	1.0	1.0	1.5	1.5	1.4	1.4
STEAM ELECTRIC POWER, WILBARGER	1.0	1.0	1.0	1.0	1.0	1.0
VERNON	1.5	1.4	1.4	1.4	1.4	1.4
WICHITA FALLS	1.5	1.4	2.1	2.1	2.1	2.0
WICHITA VALLEY WSC	2.5	2.5	3.9	3.9	3.8	3.7
WINDTHORST WSC	1.1	1.2	1.6	1.6	1.6	1.6

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. To calculate the Management Supply Factor for each WUG as a whole, not split by region-county-basin the combined total of existing and future supply is divided by the total projected demand.

Water User Group (WUG) Unmet Needs

REGION B	WUG UNMET NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ARCHER COUNTY						
BRAZOS BASIN						
IRRIGATION	36	37	36	36	37	37
RED BASIN						
MINING	133	185	94	52	10	10
TRINITY BASIN						
MINING	21	27	15	9	4	4
IRRIGATION	75	74	74	74	75	77
BAYLOR COUNTY						
BRAZOS BASIN						
LIVESTOCK	130	130	130	130	130	130
RED BASIN						
IRRIGATION	57	0	0	0	0	0
HARDEMAN COUNTY						
RED BASIN						
IRRIGATION	1,697	1,483	1,275	1,073	1,073	1,073
MONTAGUE COUNTY						
RED BASIN						
MINING	194	0	0	0	0	0
TRINITY BASIN						
MINING	211	0	0	0	0	0
WICHITA COUNTY						
RED BASIN						
IRRIGATION	0	0	280	2,607	5,671	8,729

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. In order to display only unmet needs associated with the WUG split, these surplus volumes are updated to a zero and the unmet needs water volumes are shown as absolute values.

Water User Group (WUG) Unmet Needs Summary

REGION B

	2020	2030	2040	2050	2060	2070
MUNICIPAL	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	559	212	109	61	14	14
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	130	130	130	130	130	130
IRRIGATION	1,865	1,594	1,665	3,790	6,856	9,916

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs Summary report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG category level, calculated surpluses are updated to zero so that only the WUGs with unmet needs in the decade are included with the Needs totals. Unmet needs water volumes are shown as absolute values.

Alternative Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Primary Region: B

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
			Region B Total Alternative WMS Supplies								

Alternative Projects Associated with Water Management Strategies

Project Sponsor Region: B

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade

Region B Total Alternative Capital Cost	

***Projects with a capital cost of zero are excluded from the report list.**

WWP DEMAND

WICHITA FALLS										
					WWP DEMAND (ACRE-FEET PER YEAR)					
CUSTOMER	**WUG**	**COUNTY**	**BASIN**	**USE TYPE**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ARCHER CITY	ARCHER CITY	ARCHER	RED	MUNICIPAL	336	336	336	336	336	336
ARCHER CO. MUD #1	COUNTY-OTHER	ARCHER	RED	MUNICIPAL	84	84	84	84	84	84
HOLLIDAY	HOLLIDAY	ARCHER	RED	MUNICIPAL	285	314	318	315	314	314
LAKESIDE CITY	LAKESIDE CITY	ARCHER	RED	MUNICIPAL	179	179	179	179	179	179
SCOTLAND	SCOTLAND	ARCHER	RED	MUNICIPAL	202	202	202	202	202	202
WICHITA VALLEY W.S.C.	WICHITA VALLEY W.S.C.	ARCHER	RED	MUNICIPAL	761	765	759	751	743	737
RED RIVER AUTH.	COUNTY - OTHER	CLAY	RED	MUNICIPAL	415	415	415	415	415	415
DEAN DALE WSC	DEAN DALE WSC	CLAY	RED	MUNICIPAL	308	307	305	303	301	300
WINDTHORST WSC	WINDTHORST WSC	CLAY	RED	MUNICIPAL	420	420	420	420	420	420
BURKBURNETT	BURKBURNETT	WICHITA	RED	MUNICIPAL	1,872	1,872	1,872	1,872	1,872	1,872
DEAN DALE WSC	DEAN DALE WSC	WICHITA	RED	MUNICIPAL	154	155	157	159	161	162
ELECTRA	ELECTRA	WICHITA	RED	MUNICIPAL	841	841	841	841	841	841
IOWA PARK	IOWA PARK	WICHITA	RED	MUNICIPAL	1,401	1,401	1,401	1,401	1,401	1,401
FRIBERG COOPER W.S.C.	COUNTY - OTHER	WICHITA	RED	MUNICIPAL	168	168	168	168	168	168
PLEASANT VALLEY	COUNTY - OTHER	WICHITA	RED	MUNICIPAL	112	112	112	112	112	112
MANUFACTURING	MANUFACTURING	WICHITA	RED	MANUFACTURING	1,646	1,724	1,822	1,897	1,897	1,897
STEAM ELECTRIC POWER	STEAM ELECTRIC POWER	WICHITA	RED	STEAM ELECTRIC	360	360	360	360	360	360
WICHITA FALLS	WICHITA FALLS	WICHITA	RED	MUNICIPAL	17,357	17,474	17,544	17,652	17,922	18,184
WICHITA VALLEY W.S.C.	WICHITA VALLEY W.S.C.	WICHITA	RED	MUNICIPAL	1,046	1,042	1,048	1,056	1,064	1,070
OLNEY	OLNEY	YOUNG	BRAZOS	MUNICIPAL	561	561	561	561	561	561
WICHITA FALLS TOTAL DEMAND					**28,508**	**28,732**	**28,904**	**29,084**	**29,353**	**29,615**

WCWID #2										
					WWP DEMAND (ACRE-FEET PER YEAR)					
CUSTOMER	**WUG**	**County**	**Basin**	**USE TYPE**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
IRRIGATION	IRRIGATION	ARCHER	RED	IRRIGATION	1,214	1,178	1,142	1,106	1,106	1,106
IRRIGATION	IRRIGATION	CLAY	RED	IRRIGATION	100	100	100	100	100	100
IRRIGATION	IRRIGATION	WICHITA	RED	IRRIGATION	44,316	43,536	42,756	41,976	41,976	41,976
OKLAUNION	STEAM ELECTRIC POWER	WILBARGER	RED	STEAM ELECTRIC	10,000	10,000	10,000	10,000	10,000	10,000
TPWD FISH HATCHERY	LIVESTOCK	ARCHER	RED	LIVESTOCK	2,200	2,201	2,202	2,203	2,204	2,205
WCWID #2 TOTAL DEMAND					**57,830**	**57,015**	**56,200**	**55,385**	**55,386**	**55,387**

WWP EXISTING SUPPLY

WICHITA FALLS									
				WWP EXISTING SUPPLY (ACRE-FEET PER YEAR)					
SURFACE WATER	**COUNTY**	**BASIN**	**SALINITY**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
LAKE ARROWHEAD	RESERVOIR	RED	FRESH	8,754	8,754	8,754	8,754	8,754	8,754
LAKE KICKAPOO	RESERVOIR	RED	FRESH	3,587	3,587	3,587	3,587	3,587	3,587
LITTLE WICHITA SYSTEM	*RESERVOIR*	*RED*	*FRESH*	*12,341*	*12,341*	*12,341*	*12,341*	*12,341*	*12,341*
KEMP MUNICIPAL	RESERVOIR	RED	FRESH	4,248	3,845	3,440	3,037	2,633	2,229
WICHITA FALLS TOTAL EXISTING SUPPLY				**16,589**	**16,186**	**15,781**	**15,378**	**14,974**	**14,570**

WCWID #2									
				WWP EXISTING SUPPLY (ACRE-FEET PER YEAR)					
SURFACE WATER	**COUNTY**	**BASIN**	**SALINITY**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
KEMP IRRIGATION	RESERVOIR	RED	FRESH	27,025	24,456	21,889	19,320	16,750	14,183
KEMP INDUSTRIAL	RESERVOIR	RED	FRESH	8,886	8,041	7,197	6,352	5,508	4,663
KEMP LIVESTOCK	RESERVOIR	RED	FRESH	489	442	396	349	303	256
WCWID #2 TOTAL EXISTING SUPPLY				**36,400**	**32,939**	**29,482**	**26,021**	**22,561**	**19,102**

WWP (NEEDS)/SURPLUS

WICHITA FALLS

CUSTOMER	WUG	COUNTY	BASIN	USE TYPE	WWP (NEEDS)/SURPLUS (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
ARCHER CITY	ARCHER CITY	ARCHER	RED	MUNICIPAL	(164)	(169)	(175)	(180)	(185)	(191)
ARCHER CO. MUD #1	COUNTY-OTHER	ARCHER	RED	MUNICIPAL	(41)	(42)	(44)	(45)	(46)	(48)
HOLLIDAY	HOLLIDAY	ARCHER	RED	MUNICIPAL	(110)	(127)	(135)	(139)	(145)	(151)
LAKESIDE CITY	LAKESIDE CITY	ARCHER	RED	MUNICIPAL	(87)	(90)	(93)	(96)	(99)	(102)
SCOTLAND	SCOTLAND	ARCHER	RED	MUNICIPAL	(98)	(102)	(105)	(108)	(111)	(115)
WICHITA VALLEY W.S.C.	WICHITA VALLEY W.S.C.	ARCHER	RED	MUNICIPAL	(371)	(386)	(394)	(402)	(410)	(418)
RED RIVER AUTH.	COUNTY - OTHER	CLAY	RED	MUNICIPAL	(202)	(209)	(216)	(222)	(229)	(236)
DEAN DALE WSC	DEAN DALE WSC	CLAY	RED	MUNICIPAL	(150)	(155)	(158)	(162)	(166)	(170)
WINDTHORST WSC	WINDTHORST WSC	CLAY	RED	MUNICIPAL	(205)	(212)	(218)	(225)	(232)	(238)
BURKBURNETT	BURKBURNETT	WICHITA	RED	MUNICIPAL	(912)	(944)	(972)	(1,001)	(1,032)	(1,063)
DEAN DALE WSC	DEAN DALE WSC	WICHITA	RED	MUNICIPAL	(75)	(78)	(82)	(85)	(89)	(92)
ELECTRA	ELECTRA	WICHITA	RED	MUNICIPAL	(410)	(424)	(437)	(450)	(464)	(477)
IOWA PARK	IOWA PARK	WICHITA	RED	MUNICIPAL	(683)	(706)	(728)	(749)	(773)	(795)
FRIBERG COOPER W.S.C.	COUNTY - OTHER	WICHITA	RED	MUNICIPAL	(82)	(85)	(87)	(90)	(93)	(95)
PLEASANT VALLEY	COUNTY - OTHER	WICHITA	RED	MUNICIPAL	(55)	(56)	(58)	(60)	(62)	(64)
MANUFACTURING	MANUFACTURING	WICHITA	RED	MANUFACTURING	(634)	(698)	(772)	(838)	(876)	(913)
STEAM ELECTRIC POWER	STEAM ELECTRIC POWER	WICHITA	RED	STEAM ELECTRIC	(175)	(181)	(187)	(193)	(199)	(204)
WICHITA FALLS	WICHITA FALLS	WICHITA	RED	MUNICIPAL	(6,681)	(7,074)	(7,427)	(7,798)	(8,274)	(8,748)
WICHITA VALLEY W.S.C.	WICHITA VALLEY W.S.C.	WICHITA	RED	MUNICIPAL	(510)	(525)	(545)	(565)	(587)	(607)
OLNEY	OLNEY	YOUNG	BRAZOS	MUNICIPAL	(273)	(283)	(291)	(300)	(309)	(318)
WICHITA FALLS TOTAL NEEDS/SURPLUS					**(11,919)**	**(12,546)**	**(13,123)**	**(13,706)**	**(14,379)**	**(15,045)**

WCWID #2

CUSTOMER	WUG	County	Basin	USE TYPE	WWP (NEEDS)/SURPLUS (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
IRRIGATION	IRRIGATION	ARCHER	RED	IRRIGATION	(495)	(535)	(574)	(611)	(677)	(743)
IRRIGATION	IRRIGATION	CLAY	RED	IRRIGATION	(41)	(45)	(50)	(55)	(61)	(67)
IRRIGATION	IRRIGATION	WICHITA	RED	IRRIGATION	(18,069)	(19,778)	(21,485)	(23,196)	(25,694)	(28,189)
OKLAUNION	STEAM ELECTRIC POWER	WILBARGER	RED	STEAM ELECTRIC	(1,114)	(1,959)	(2,803)	(3,648)	(4,492)	(5,337)
TPWD FISH HATCHERY	LIVESTOCK	ARCHER	RED	LIVESTOCK	(1,711)	(1,759)	(1,806)	(1,854)	(1,901)	(1,949)
WCWID #2 TOTAL NEEDS/SURPLUS					**(21,430)**	**(24,076)**	**(26,718)**	**(29,364)**	**(32,825)**	**(36,285)**

APPENDIX H

IMPLEMENTATION SURVEY FOR 2011 REGIONAL PLAN

2016 FINAL PLAN

REGION B

DECEMBER 2015

Region B 2016 Final Plan
Implementation Survey for 2011 Regional Plan

Sponsor Region	wmsSponsorEntityId	Sponsor	Recommended Water Management Strategy	DBProjectId	CapitalCost	SS2010	SS2020	SS2030	SS2040	SS2050	SS2060	Y denotes strategies with supply volumes included in other
B	275	BOWIE	Municipal conservation	90	$0	8	34	34	61	69	72	N
B	275	BOWIE	Wastewater reuse	99	$1,206,500	0	0	0	171	171	171	N
B	416	COUNTY-OTHER, ARCHER	Municipal conservation	90	$0	7	11	14	16	17	18	N
B	416	COUNTY-OTHER, ARCHER	Purchase water from local provider	92	$364,000	296	296	296	296	296	296	N
B	423	COUNTY-OTHER, BAYLOR	Emergency interconnect Millers Creek Reservoir	100	$714,000	250	250	250	250	250	250	Y
B	450	COUNTY-OTHER, CLAY	Municipal conservation	90	$0	16	42	45	45	41	39	N
B	450	COUNTY-OTHER, CLAY	Nitrate removal plant	98	$200,500	10	10	10	10	10	10	N
B	450	COUNTY-OTHER, CLAY	Purchase water from local provider	92	$364,000	223	223	223	223	223	223	N
B	580	COUNTY-OTHER, MONTAGUE	Develop other aquifer supplies	136	$957,975	245	245	245	245	245	245	N
B	580	COUNTY-OTHER, MONTAGUE	Develop Trinity Aquifer supplies	93	$1,059,638	271	271	271	271	271	271	N
B	580	COUNTY-OTHER, MONTAGUE	Develop Trinity Aquifer supplies (includes overdrafting)	221	$265,887	68	68	68	68	68	68	N
B	580	COUNTY-OTHER, MONTAGUE	Municipal conservation	90	$0	18	78	80	80	81	81	N
B	655	COUNTY-OTHER, WILBARGER	Nitrate removal plant	98	$446,500	40	40	40	40	40	40	N
B	655	COUNTY-OTHER, WILBARGER	Purchase water from local provider	92	$1,658,700	109	109	109	109	109	109	N
B	978	IOWA PARK	Municipal conservation	90	$0	21	57	68	72	76	80	N
B	978	IOWA PARK	Purchase water from local provider	91	$0	229	229	229	229	229	229	N
B	983	IRRIGATION, ARCHER	Increase water conservation pool at Lake Kemp	95	$26,000	0	1,344	1,386	1,426	1,465	1,584	N
B	1016	IRRIGATION, CLAY	Increase water conservation pool at Lake Kemp	95	$26,000	0	331	309	284	253	274	N
B	1207	IRRIGATION, WICHITA	Enclose canal laterals in pipe	97	$7,658,469	13,034	13,034	13,034	13,034	13,034	13,034	N
B	1207	IRRIGATION, WICHITA	Increase water conservation pool at Lake Kemp	95	$26,000	0	15,995	11,186	10,392	9,605	8,687	N
B	1207	IRRIGATION, WICHITA	Wichita River diversion	817	$5,380,000	0	0	0	8,850	8,850	8,850	N
B	1301	LAKESIDE CITY	Municipal conservation	90	$0	3	9	10	11	11	11	N
B	1301	LAKESIDE CITY	Purchase water from local provider	91	$0	12	12	12	12	12	12	N
B	1787	MANUFACTURING, WICHITA	Purchase water from local provider	91	$0	462	0	0	0	0	0	N
B	1787	MANUFACTURING, WICHITA	Purchase water from local provider	91	$0	0	462	462	462	462	462	Y
B	1992	MINING, MONTAGUE	Purchase water from local provider	92	$379,411	163	163	163	163	163	163	N
B	1992	MINING, MONTAGUE	Purchase water from local provider	275	$32,589	14	14	14	14	14	14	N
B	120	REGIONAL WATER PROVIDER-WICHITA BASIN CHLORIDE CONTROL PR	Wichita Basin chloride control project	102	$95,450,000	26,500	26,500	26,500	26,500	26,500	26,500	Y
B	2480	STEAM ELECTRIC POWER, WILBARGER	Increase water conservation pool at Lake Kemp	95	$26,000	0	3,800	8,529	9,258	9,987	10,715	N
B	160	WICHITA FALLS	Construct Lake Ringgold	101	$382,900,000	0	0	0	0	27,000	27,000	N
B	160	WICHITA FALLS	Increase water conservation pool at Lake Kemp	95	$26,000	0	3,364	3,366	3,358	3,350	3,340	N
B	160	WICHITA FALLS	Municipal conservation	90	$0	124	533	548	556	562	1,367	N

Project Description	Infrastructure Type*	At what level of Implementation is the project?*	If not implemented, why?*	Initial Volume of Water Provided (acft/yr)	Funds Expended to Date ($)	Project Cost ($) (should include development and construction costs)	Year the Project is Online?*	Is this a phased project?*	(Phased) Ultimate Volume (acft/yr)	(Phased) Ultimate Project Cost ($)	Year project reaches maximum capacity?*	What is the project funding source(s)?*	Included in the 2016 Plan?*	Comments
Muncipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
Wastewater Reuse	Pipeline	Not Implemented	Too soon										No	
Muncipal Conservation	No Infrastructure	Feasibility Study Ongoing	Other										No	
By Contract	No Infrastructure	Not Implemented	Too soon										No	
Emergency Interconnect	Pipeline	Not Implemented	Financing										No	
Municipal Conservation	No Infrastructure	Feasibility Study Ongoing	Other										Yes	
Nitrate Removal	Water Treatment Plant	Not Implemented	Financing										No	
Voluntary Transfer	Pipeline	Feasibility Study Ongoing	Too soon										Yes	
Additional Groundwater	Wells	Not Implemented	Too soon										No	
Additional Groundwater	Wells	Not Implemented	Too soon										No	
Additional Groundwater	Wells	Not Implemented	Too soon										No	
Municipal Conservation	No Infrastructure	Not Implemented	Other										Yes	
Nitrate Removal	Water Treatment Plant	Not Implemented	Financing										No	
Voluntarty Transfer	No Infrastructure	Currently Operating											No	
Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
By Contract	No Infrastructure	Not Implemented	Too soon										Yes	
Irrigation	No Infrastructure	Not Implemented	Permit contraints										No	
Irrigation	No Infrastructure	Not Implemented	Permit contraints										No	
Irrigation	Pipeline	Not Implemented	Financing										Yes	
Irrigation	No Infrastructure	Not Implemented	Permit contraints										No	
Irrigation	Pipeline	Not Implemented	Too soon										No	
Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
By Contract	No Infrastructure	Not Implemented	Too soon										Yes	
Manufacturing	No Infrastructure	Not Implemented	Too soon										Yes	
Manufacturing	No Infrastructure	Not Implemented	Too soon										Yes	
Mining Project	Pipeline	Not Implemented	Financing										No	
Mining Project	Pipeline	Not Implemented	Financing										No	
Chloride Control Poject	Impoundment	Not Implemented	Financing										Yes	
Steam Elec. Pwr.	No Infrastructure	Not Implemented	Permit contraints										No	
Lake Ringgold	Impoundment	Not Implemented	Permit contraints										Yes	
Kemp Conv. Increase	No Infrastructure	Not Implemented	Permit contraints										No	
Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	

APPENDIX I

COMMENTS RECEIVED ON THE IPP AND RESPONSES

2016 FINAL PLAN

REGION B

DECEMBER 2015

Texas Water Development Board
P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

August 6, 2015

Mr. Curtis Campbell, Chair
c/o Red River Authority of Texas
P.O. Box 240
Wichita Falls, Texas 76307

Re: Texas Water Development Board Comments on the Region B Initially Prepared Plan, Contract No. 1148301313

Dear Mr. Campbell:

Texas Water Development Board (TWDB) staff completed a review of the Initially Prepared Plan (IPP) submitted by May 1, 2015 on behalf of the Region B Regional Water Planning Group. The attached comments follow this format:

- **Level 1:** Comments, questions, and online regional water planning database revisions that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements; and,

- **Level 2:** Comments and suggestions for consideration that may improve the readability and overall understanding of the regional water plan.

The TWDB's statutory requirement for review of potential interregional conflicts under Title 31 Texas Administrative Code (TAC) §357.62 will not be completed until submittal and review of adopted regional water plans. However, as previously requested by our Executive Administrator, please inform TWDB in advance of your final plan if your planning group believes that an interregional conflict exists. Additionally, subsequent review will be performed as the planning group completes its data entry into the regional water planning database (DB17). If issues arise during our ongoing data review, they will be communicated promptly to the planning group to resolve.

Title 31 TAC§357.50(d) requires the regional water planning group to consider timely agency and public comment. Section 357.50(e) requires the final adopted plan include summaries of all timely written and oral comments received, along with a response explaining any resulting revisions or why changes are not warranted. Copies of TWDB's Level 1 and 2 written comments and the region's responses must be included in the final, adopted regional water plan. While the comments included in this letter represent TWDB's review to date, please anticipate the need to respond to additional comments regarding data integrity, including any water source overallocations, in the regional water planning database (DB17) once data entry is completed by the region.

Standard to all planning groups is the need to include certain content in the final regional water plans that was not yet available at the time that IPPs were prepared and submitted. In your final regional water plan, however please be sure to also incorporate the following:

a) Completed results from the regional planning group's infrastructure financing survey (IFR) for sponsors of recommended projects with capital costs *[31 TAC §357.44]*;
b) Completed results from the implementation survey *[31 TAC §357.45(a)]*;
c) The socioeconomic impact evaluation provided by TWDB at the request of the planning group *[31 TAC §357.33(c)]*;
d) Documentation that comments received on the IPP were considered in the development of the final plan *[31 TAC §357.50(d)]*;
e) Evidence, such as a certification, that the final, adopted regional water plan is complete and adopted by the planning group *[31 TAC §357.50(j)(1)]*; and,
f) The required DB17 reports, as made available by TWDB, in the executive summary or elsewhere in the plan as specified in the Contract *[31 TAC §357.50(e)(2)(B), Contract Scope of Work Task 4D(p), Contract Exhibit 'C', Table 2]*. Please ensure that the numerical values presented in the tables throughout the final, adopted regional water plan are consistent with the data provided in DB17. For the purpose of development of the 2017 State Water Plan, water management strategy and other data entered by the regional water group in DB17 (and as presented in the regional plan) shall take precedence over any conflicting data presented in the final regional water plan. *[Contract Exhibit 'C', Sections 12.1.3. and 12.2.2]*

The following items must accompany, separately, the submission of the final, adopted regional water plan:

- The prioritized list of all recommended projects in the regional water plan *[Texas Water Code 15.436(a), Contract Scope of Work Task 13]*; and,
- Any remaining hydrologic modeling files or GIS files that may not have been provided at the time of the submission of the IPP but that were used in developing the final plan. *[31 TAC §357.50(e)(2)(C), Contract Exhibit 'C', Section 12.2.1; Contract Scope of Work Task 3-III-13]*

Note that provision of certain content in an electronic-only form is permissible as follows: Internet links are permissible as a method for including model conservation and drought contingency plans within the final regional water plan; hydrologic modeling files may be submitted as electronic appendices, however all other regional water plan appendices should be incorporated in hard copy format within each plan. *[31 TAC §357.50(e)(2)(C), Contract Scope of Work Task 5e, Contract Exhibit 'C', Section 12.2.1]*

The following general requirements that apply to recommended water management strategies must be adhered to in all final regional water plans including:

- Regional water plans must not include any strategies or costs that are associated with simply maintaining existing water supplies or replacing existing infrastructure. Plans may include only infrastructure costs that are associated with volumetric increases of treated water supplies delivered to water user groups or that result in more efficient use of existing supplies *[31 TAC §357.10(28), §357.34(d)(3)(A), Contract Exhibit 'C", Section 5.1.2.2, Section 5.1.2.3]*; and,

- Regional water plans must not include any retail distribution-level infrastructure costs (other than those costs related to conservation strategies such as water loss reduction). *[31 TAC §357.10(28), §357.34(d)(3)(A), Contract Exhibit 'C", Section 5.1.2.3]*

To facilitate efficient and timely completion, and Board approval, of your final regional water plan, please provide your TWDB project manager with early drafts of your responses to these IPP comments for preliminary review and feedback.

If you have any questions regarding these comments or would like to discuss your approach to addressing any of these comments, please do not hesitate to contact Tom Barnett at (512) 463-4209. TWDB staff will be available to assist you in any way possible to ensure successful completion of your final regional water plan.

Sincerely,

Jeff Walker
Deputy Executive Administrator
Water Supply and Infrastructure

Attachments

cc w/att: Mr. Kerry Maroney, Biggs & Mathews

TWDB Comments on the Initially Prepared 2016 Region B Regional Water Plan

Level 1:	Comments and questions must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements.

1. Pages 2-10 and 2-11, Appendix G: The plan does not appear to include demand splits by river basin. Additionally, page 2-11 states that "Wholesale water provider (WWP) demands by county and river basin are provided in Appendix G." However, Appendix G appears to only have this information for Water User Groups (WUGs). Please include WWP demands by river basin in the final, adopted regional water plan. *[31 Texas Administrative Code (TAC) §357.31(b)]*

2. The plan does not appear to include a listing of the water rights that are the basis for the surface water availability in the plan. Please include in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 3.1]*

3. The plan does not appear to include an explanation of the basis of the associated local supply water volumes. Please include the required information on local supplies in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 3.3]*

4. Please clarify how the run-of-river availabilities were calculated for municipal water users to ensure that all monthly demands are fully met for the entire simulation of the unmodified TCEQ WAM Run 3 in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 3.4]*

5. Please provide a statement regarding any water availability requirements promulgated by a county commissioners court pursuant to TWC §35.019, which in Region B applies to the Montague County Priority Groundwater Management Areas. *[31 TAC §357.22(a)(6)]*

6. Tables 4-11 and 4-12: The plan does not appear to include projected needs for the two WWPs in Region B by water use category or by county. Please include WWP needs by water use category and county in the final, adopted regional water plan. *[31 TAC §357.33(b),(d)]*

7. Page 5-15, Subchapter 5.3.1: The plan does not appear to to include a copy of the model water conservation plans and the referenced online link to the model plan does not appear to be a link to the referenced document at the time of plan review. Please ensure an operational link to the model conservation plan if the model plan is to be included only by online reference. *[31 TAC §357.34(g)]*

8. Pages 5-18 and 5-19, Subchapter 5.3.2: The plan states for both manufacturing and mining demands sections there are "...opportunities for advanced conservation, which is addressed in section 5.3.2." However, it appears that discussion was not provided in section 5.3.2, therefore the plan does not appear to consider conservation to meet mining and manufacturing needs. Please include documentation that potentially feasible water management strategy types, as required by statute and rule, were considered to meet identified needs and, if not recommended, please document the reason in the final,

adopted regional water plan. *[Texas Water Code §16.053(e)(5), 31 TAC §357.34(c)(3), §357.34(f)(2)]*

9. Page 5-21 and Chapter 7: It is not clear whether the plan considered water loss information compiled by TWDB during the development of the plan. For example, in discussing the review of information compiled from TWDB water loss audits, text on page 5-21 states "the data will be discussed in more detail in Chapter 7 of this plan." However, there does not appear to be further discussion of water loss audit data in Chapter 7. Please document this consideration in the final, adopted regional water plan. *[31 TAC §357.22(a)(3)]*

10. Please indicate how the planning group considered the Texas Clean Rivers program in the final, adopted regional water plan. *[31 TAC §357.22(a)(7)]*

11. Please indicate how the planning group considered the U.S. Clean Water Act in the final, adopted regional water plan. *[31 TAC §357.22(a)(8)]*

12. Pages 5-38 through 5-43: It is not clear whether the "Wichita River Supply" and "Lake Ringgold" water management strategies were evaluated with an unmodifed Texas Commission on Environmental Quality (TCEQ) WAM Run 3. Please clarify whether analyses were based upon TCEQ WAM Run 3 in the final, adopted regional water plan. If not based upon TCEQ WAM Run 3, please present results using the most current TCEQ WAM Run 3 in the final, adopted regional water plan. *[31 TAC §357.34(d)(1)]*

13. The plan, in some instances, does not appear to include a quantitative reporting of environmental factors. For example, page 5-39 of the "Wichita River Supply" strategy indicates that construction of the channel dam and reduced flows "could impact waters of the U.S.", but the plan does not appear to include quantification of the non-zero impacts. Please include quantitative reporting in the final, adopted regional water plan. *[31 TAC §357.34(d)(3)(b)]*

14. Pages 5-40 through 5-43: It is not clear whether the "Lake Ringgold" water management strategy was evaluated with environmental flow requirements. Please clarify whether analyses considered environmental flow requirements in the final, adopted regional water plan. If environmental flow requirements were not considered, please present results with environmental flow requirement considerations in the final, adopted regional water plan. *[31 TAC §357.34(d)(3)(B)]*

15. The plan in some instances, does not appear to include a quantitative reporting of impacts to agricultural resources. For example, page 5-40 of the "Wichita River Supply" strategy indicates that WCWID No. 2 would potentially be precluded from use of the supply but does not appear to include quantification of the non-zero impact. Please include quantitative reporting of impacts to agricultural resources in the final, adopted regional water plan. *[31 TAC §357.34(d)(3)(C)]*

16. Page 6-13: The description of impacts to other water resources of the state does not appear to include information on potential impacts to groundwater and surface water interrelationships. Please include this information in the final, adopted regional water plan. *[31 TAC §357.40(b)(2)]*

17. Please indicate how the planning group considered relevant recommendations from the Drought Preparedness Council (a letter was provided to planning groups with relevant recommendations in November 2014) in the final, adopted regional water plan. *[31 TAC §357.42(h)]*

18. The model drought contingency plan for irrigation districts provided online does not appear to include specific triggers and responses for 'severe' and 'critical/emergency' drought stages. Please include this information in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 7.7]*

19. Please clarify in the final, adopted regional water plan whether plan development was guided by the principal that the designated water quality and related water uses as shown in the state water quality management plan shall be improved or maintained. *[31 TAC §358.3(19)]*

20. The technical evaluations of the water management strategies do not appear to estimate water losses from the associated strategies. Please include an estimate of water losses in the final, adopted regional water plan, for example as an estimated percent loss. *[31 TAC §357.34(d)(3)(A); Contract Exhibit 'C', Section 5.1.1]*

Level 2: Comments and suggestions for consideration that may improve the readability and overall understanding of the regional water plan.

1. Page ES-16: For the county summaries included in the Executive Summary, it says "this subchapter discusses the water issues of each county..." However, county summaries are not included for Cottle and King Counties. Please consider including in the final, adopted regional water plan.

2. Page 3-19: Please consider providing a complete description of the groundwater availability methodology employed for other aquifer groundwater sources tabulated in Table 3-5 in the plan.

3. Page 6-13: The plan uses the term "managed available groundwater" in certain instances where "modeled available groundwater" should be used. For example, in the "Partial List of Acronyms". Please consider revising to "modeled available groundwater" in the final, adopted regional water plan.

4. Chapter 7: For surface water sources, please consider clarifying, if appropriate, that the recommendation is to retain triggers and stages currently in place in local Drought Contingency Plans. Additionally, please consider including a table organized by source manager and entities reliant on sources for drought response recommendations in the final, adopted regional water plan.

5. Section 7.3, page 7-9: Please consider describing the groundwater triggers included in local drought contingency plans in more detail.

6. Page 7-27: The plan includes a link to a model drought contingency plan developed for Region B however, the link is to the river authority's main webpage and it is unclear how to navigate to the model plan docoument. Please consider clarifying in the final, adopted regional water plan.

TEXAS PARKS & WILDLIFE

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August 7, 2015

Mr. Curtis W. Campbell, RWPG-B Chair
Red River Authority of Texas
P.O. Box 240
Wichita Falls, TX 76307

Re: 2016 Region B Initially Prepared Plan

Dear Mr. Campbell,

Thank you for seeking review and comment from the Texas Parks and Wildlife Department ("TPWD") on the 2016 Initially Prepared Regional Water Plan for Region B (IPP). As you know, water impacts every aspect of TPWD's mission to manage and conserve the natural and cultural resources of Texas. As the agency charged with primary responsibility for protecting the state's fish and wildlife resources, TPWD is positioned to provide technical assistance during the water planning process. Although TPWD has limited regulatory authority over the use of state waters, TPWD is committed to working with stakeholders and others to provide science-based information during the water planning process intended to avoid or minimize impacts to state fish and wildlife resources.

TPWD understands that regional water planning groups are guided by 31 TAC §357 when preparing regional water plans. These water planning rules spell out requirements related to natural resource and environmental protection. Accordingly, TPWD staff reviewed the IPP with a focus on the following questions:

- Does the IPP include a quantitative reporting of environmental factors including the effects on environmental water needs and habitat?
- Does the IPP include a description of natural resources and threats to natural resources due to water quantity or quality problems?
- Does the IPP discuss how these threats will be addressed?
- Does the IPP describe how it is consistent with long-term protection of natural resources?
- Does the IPP include water conservation as a water management strategy?
- Does the IPP include Drought Contingency Plans?
- Does the IPP recommend any stream segments be nominated as ecologically unique?
- If the IPP includes strategies identified in the 2010 regional water plan, does it address concerns raised by TPWD in connection with the 2010 Water Plan.

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512.389.4800
www.tpwd.texas.gov

The population of the 11 counties that comprise the Region B Regional Water Planning Area was 199,298 in 2010 and is expected to be 229,000 by 2070. Water demand was 171,164 acre-feet in 2010 and is expected to decrease over time to 154,270 acre-feet by 2070. The region's largest water demand is for irrigated agriculture (61 percent). Relative to the 2011 Regional Water Plan, the 2016 IPP proposes significant changes. A new drought of record combined with increased water demands have led to an IPP that includes 28 new water management strategies. Water conservation is expected to meet 38 percent of future water needs in the region. Per capita municipal water use is predicted to gradually decline from 149 gallons per capita per day (gpcd) in 2020 to 141 gpcd in 2070. Other strategies include wastewater reuse projects, and construction of Lake Ringgold. In addition, the continued operation and funding of Red River Chloride Control Project is recommended.

Chapter 1 includes a description of natural resources in the region. The Region B IPP recognizes the importance of natural resources and discusses the importance of this region to migrating and wintering waterfowl. Ten major waterbodies in the region include Lake Kemp/Diversion, Lake Kickapoo/Arrowhead, Amon Carter Lake, Lake Electra, Lake Nocona, Olney Lake, Santa Rosa Lake, and North Fork Buffalo Creek. Lake Wichita is discussed on page 3-8 and described as being used for recreational purposes. TPWD, along with the City of Wichita Falls, the City of Lakeside City, Wichita Falls Area Community Foundation, and Lake Wichita Chapter of Friends of Reservoirs are partnering to develop and implement a revitalization project of Lake Wichita that is expected to increase storage capacity, water quality, and recreational use. Additional information can be found at www.LakeWichita.org. TPWD requests that this information be added to the description of Lake Wichita.

According to the IPP major rivers in the region include the Pease, Little Wichita, Wichita, and Beaver Rivers. Major aquifers in the region include the Seymour and Trinity aquifers. The IPP identifies the following major springs in the region: Buffalo Springs, Barrel Springs, China Springs, Doans Springs and Condon Springs. None of these springs are currently used for water supply and at least one (Barrel Springs) no longer flows. Table 1-13 lists 20 species identified as threatened or endangered that are known to, or may potentially occur in Region B. Chapter 1 also includes a brief description of Copper Breaks State Park.

The IPP includes a discussion of water-related threats to natural resources. According to the IPP excessive concentrations of total dissolved solids, sulfate, and chloride are a general problem in most streams of the Red River Basin under low flow conditions. The high salt concentrations are caused, in large part, by the presence of salt water springs, seeps, and gypsum outcrops. Salt water springs are generally located in the western portion of the (Red River) basin in the upper reaches of the Wichita River, the North and South Forks of the Pease River, and the Little Red, which is a tributary to the Prairie Dog Town Fork of the Red River. The plan also mentions that Diversion and Kemp lakes have high chloride levels. The IPP proposes to address these water quality issues through continued support of the Red River Chloride Control Project (RRCCP). TPWD staff has concerns regarding the impact of chloride control projects on fish and wildlife resources and will remain engaged in regulatory, monitoring, and environmental response programs.

Some areas in Region B have highly erodible soils that contribute to an accumulation of sediment in lakes and reservoirs. Over time this sediment can significantly reduce storage capacity and reliable water supplies. In addition, spring flows in Region B have greatly diminished or disappeared due to groundwater development. According to the IPP, at one time there were roughly 150 natural springs in the region but many have ceased to flow due to over-pumping of groundwater. The few small springs that continue to flow feed ponds and creeks that provide habitat for a number of plant and animal species. The IPP recognizes that any future development of groundwater, as well as the overuse of existing surface water supplies, may cause a further reduction of flow from existing springs.

Chapter 1 also includes a discussion of freshwater mussels and minnows, noting their usefulness as water quality indicators. Chapter 1 also discusses declines in mussel populations. In addition, since 1950, prairie stream fishes native to the Red River Basin (including the Wichita and Pease rivers) have also shown serious declines in abundance and reductions in distribution. These native minnows include Plains Minnow, Silver Chub, Prairie Chub, Chub Shiner, Silverband Shiner, and Red River Shiner. Aside from the Plains Minnow, all of these fishes are on TPWDs current list of Species of Greatest Conservation Need. Some of these species no longer occur in the Wichita River. The decline of prairie stream fishes has been linked to several factors including hydrologic alteration, fragmentation of stream habitats, and changes in water quality. Projects that further fragment and alter hydrology and water quality could lead to further extirpations and imperilment. Currently the Prairie Chub is being considered for listing by the US Fish and Wildlife Service.

Each of the water management strategies discussed in Chapter 5 has a short description of associated environmental issues. Potential impacts to sensitive environmental factors including wetlands, threatened and endangered species, unique wildlife habitats, and cultural resources are considered. In most cases, a detailed evaluation could not be completed because previous studies have not been conducted or the specific location of the new source (such as a groundwater well field) was not identified. Therefore, it is reported that a more detailed environmental assessment will be required before a strategy is implemented. Appendix D includes a Strategy Evaluation Matrix and Quantified Environmental Impact Matrix. Environmental categories including number of habitat acres impacted, environmental water needs, threatened and endangered species, water quality and cultural resources are quantitatively assessed and assigned a ranking from 1 to 5, with 1 being most impact and 5 being least or positive impact. Lake Ringgold, proposed to be built on the Little Wichita River received an environmental score of 3. According to the IPP, Lake Ringgold will impact approximately 120 acres of existing ponds and stock tanks and approximately 165 miles of streams. At the conservation elevation of 844 feet, approximately 910 acres of wetlands will be impacted. TPWD has concerns related to the lack of information regarding potential impacts to instream flows, habitat fragmentation, and dependent aquatic ecosystems.

Approximately 50 percent of the water used in Region B is projected to be supplied by groundwater. TWDB planning rules now require that groundwater supplies not exceed the Modeled Available Groundwater (MAG) values that were determined to meet the desired future conditions (DFCs) of the groundwater source. Most of the counties in Region B are in GMA 6, with Montague County included in GMA 8. The Region B IPP does not recommend strategies that exceed the MAG. However no DFCs address maintenance of spring flows or groundwater surface interactions. Ultimately TPWD would like to see DFCs adopted to protect these features.

Chapter Five covers water conservation and Wichita Falls Indirect Reuse plan. Currently, the majority of water reuse in Region B is limited to municipal irrigation and/or use at the wastewater treatment facilities; however, the City of Bowie sells nearly all of its wastewater effluent for mining purposes. The City of Wichita Falls has recently implemented an emergency direct potable water reuse project and is using up to 5 million gallons per day (MGD) of treated wastewater effluent. Since this project is temporary, it is not considered "available supply" in 2020.

The plan does not recommend nomination of any stream segments as ecologically unique. As in the 2011 plan, the IPP states that the planning group is "committed to the protection and conservation of unique and sensitive areas within the region" and a "more comprehensive study with supporting data is necessary to accurately characterize and evaluate … stream segments." At this time, no studies have been defined or proposed. TPWD is available to assist with this effort.

Thank you for your consideration of these comments. TPWD looks forward to continuing to work with the planning group to develop water supply strategies that not only meet the future water supply needs of the region but also preserve the ecological health of the region's aquatic resources. Please contact Cindy Loeffler at (512) 389-8715 if you have any questions or comments.

Sincerely,

Ross Melinchuk,
Deputy Executive Director, Natural Resources

RM:CL:ms

cc: Craig Bonds, Division Director, Inland Fisheries Division, TPWD
Tom Lang, Inland Fisheries Division, TPWD
Robert Mauk, Inland Fisheries Division, TPWD

TWDB Comments on the Initially Prepared 2016 Region B Regional Water Plan

Level 1: Comments and questions must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements.

1. Pages 2-10 and 2-11, Appendix G: The plan does not appear to include demand splits by river basin. Additionally, page 2-11 states that "Wholesale water provider (WWP) demands by county and river basin are provided in Appendix G." However, Appendix G appears to only have this information for Water User Groups (WUGs). Please include WWP demands by river basin in the final, adopted regional water plan. *[31 Texas Administrative Code (TAC) §357.31(b)]*

   The details of the WUG demand splits and WWP Splits are provided in the final data reports in Appendix G. River basin splits will not be shown in Table 2-5 or Table 2-6 on pages 2-10 and 2-11.

2. The plan does not appear to include a listing of the water rights that are the basis for the surface water availability in the plan. Please include in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 3.1]*

   A table showing the water rights in Region B was added in Appendix A

3. The plan does not appear to include an explanation of the basis of the associated local supply water volumes. Please include the required information on local supplies in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 3.3]*

   A footnote was added to Table 3-3 referring to Appendix A regarding the methodology for local run-of-river supplies. Another footnote was added to Table 3-3 describing how livestock local supplies were calculated.

4. Please clarify how the run-of-river availabilities were calculated for municipal water users to ensure that all monthly demands are fully met for the entire simulation of the unmodified TCEQ WAM Run 3 in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 3.4]*

   Appendix A includes methodology for how local run-of-river supplies were calculated based on TCEQ WAM Run 3.

5. Please provide a statement regarding any water availability requirements promulgated by a county commissioners court pursuant to TWC §35.019, which in Region B applies to the Montague County Priority Groundwater Management Areas. *[31 TAC §357.22(a)(6)]*

   A discussion on Priority Groundwater Management Areas was added to Section 3.2, Groundwater Supplies.

6. Tables 4-11 and 4-12: The plan does not appear to include projected needs for the two WWPs in Region B by water use category or by county. Please include WWP needs by

water use category and county in the final, adopted regional water plan. *[31 TAC §357.33(b),(d)]*

The details of the wholesale water provider needs are included in the data reports in Appendix G of the plan.

7. Page 5-15, Subchapter 5.3.1: The plan does not appear to to include a copy of the model water conservation plans and the referenced online link to the model plan does not appear to be a link to the referenced document at the time of plan review. Please ensure an operational link to the model conservation plan if the model plan is to be included only by online reference. *[31 TAC §357.34(g)*

   Model Drought Contingency Plans are included at the following link under http://www.rra.texas.gov/; Publications; Region B Water Planning. Model water conservation plans are provided online at the same link.

8. Pages 5-18 and 5-19, Subchapter 5.3.2: The plan states for both manufacturing and mining demands sections there are "...opportunities for advanced conservation, which is addressed in section 5.3.2." However, it appears that discussion was not provided in section 5.3.2, therefore the plan does not appear to consider conservation to meet mining and manufacturing needs. Please include documentation that potentially feasible water management strategy types, as required by statute and rule, were considered to meet identified needs and, if not recommended, please document the reason in the final, adopted regional water plan. *[Texas Water Code §16.053(e)(5), 31 TAC §357.34(c)(3), §357.34(f)(2)]*

   The discussion for Mining Conservation was included as Section 5.3.3.3, page 5-26. This section has been updated to address costs for mining conservation. The discussion on manuafcturing was modified to reflect that no manufacturing conservation strategies were identified for Region B.

9. Page 5-21 and Chapter 7: It is not clear whether the plan considered water loss information compiled by TWDB during the development of the plan. For example, in discussing the review of information compiled from TWDB water loss audits, text on page 5-21 states "the data will be discussed in more detail in Chapter 7 of this plan." However, there does not appear to be further discussion of water loss audit data in Chapter 7. Please document this consideration in the final, adopted regional water plan. *[31 TAC §357.22(a)(3)]*

   Further discussion of the water loss audit data provided from TWDB was added to Section 5.3.3.1, Municipal Conservation.

10. Please indicate how the planning group considered the Texas Clean Rivers program in the final, adopted regional water plan. *[31 TAC §357.22(a)(7)]*

    Discussion on the consideration of the Texas Clean Rivers program was added to Section 6.7 "Major Impacts of Recommended WMSs on Key Parameters of Water Quality."

11. Please indicate how the planning group considered the U.S. Clean Water Act in the final, adopted regional water plan. *[31 TAC §357.22(a)(8)]*

    Discussion on the consideration of the U.S. Clean Water Act was added to Section 6.7 "Major Impacts of Recommended WMSs on Key Parameters of Water Quality."

12. Pages 5-38 through 5-43: It is not clear whether the "Wichita River Supply" and "Lake Ringgold" water management strategies were evaluated with an unmodifed Texas Commission on Environmental Quality (TCEQ) WAM Run 3. Please clarify whether analyses were based upon TCEQ WAM Run 3 in the final, adopted regional water plan. If not based upon TCEQ WAM Run 3, please present results using the most current TCEQ WAM Run 3 in the final, adopted regional water plan. *[31 TAC §357.34(d)(1)]*

    The Lake Ringgold strategy was evaluated using another method that is more conservative than TCEQ WAM Run 3 since it accounts for the recent drought. Additional description of this method was added to the strategy description. Yields based on the unmodified TCEQ WAM Run 3 were included in the final plan for comparison purposes.

    For the Wichita River Supply, this strategy is simply an addition of a new downstream diversion point for an existing water right. It is not a new appropriation. This supply was analyzed as part of the run of river supplies under current supply (Chapter 3). This will be clarified in the strategy description.

13. The plan, in some instances, does not appear to include a quantitative reporting of environmental factors. For example, page 5-39 of the "Wichita River Supply" strategy indicates that construction of the channel dam and reduced flows "could impact waters of the U.S.", but the plan does not appear to include quantification of the non-zero impacts. Please include quantitative reporting in the final, adopted regional water plan. *[31 TAC §357.34(d)(3)(b)]*

    The strategy evaluation matrix is included as Appendix D in the final Region B plan. This evaluation matrix documents impacts and quantifies those impacts with available data. For the Wichita River strategy, no specific site has been selected or environmental studies conducted on the potential impacts to Waters of the U.S. For conceptual strategies, quantified impacts may not be available.

14. Pages 5-40 through 5-43: It is not clear whether the "Lake Ringgold" water management strategy was evaluated with environmental flow requirements. Please clarify whether analyses considered environmental flow requirements in the final, adopted regional water plan. If environmental flow requirements were not considered, please present results with environmental flow requirement considerations in the final, adopted regional water plan. *[31 TAC §357.34(d)(3)(B)]*

    Environmental flows were considered for the Lake Ringgold project. Lake Ringgold was evaluated with Lyons instream flow criteria. Yields based on the unmodified TCEQ WAM Run 3 with the consensus criteria were included for comparison purposes.

15. The plan in some instances, does not appear to include a quantitative reporting of impacts to agricultural resources. For example, page 5-40 of the "Wichita River Supply" strategy indicates that WCWID No. 2 would potentially be precluded from use of the supply but does not appear to include quantification of the non-zero impact. Please include quantitative reporting of impacts to agricultural resources in the final, adopted regional water plan. *[31 TAC §357.34(d)(3)(C)]*

    Impacts to agricultural resources were added to the evaluation matrix included in Appendix D. These impacts are based on temporary and permanent impacts to irrigated agriculture.

    Regarding the specific example provided, WCWID No. 2 has never used this diversion right and has not taken steps to implement use of this diversion right.Therefore, since they would be precluded from using something they have never used and have not planned to use, there is no impact to irrigated agriculture from implementing the Wichita River Supply.

16. Page 6-13: The description of impacts to other water resources of the state does not appear to include information on potential impacts to groundwater and surface water interrelationships. Please include this information in the final, adopted regional water plan. *[31 TAC §357.40(b)(2)]*

    Discussion of the impacts on other water resources due to the interrelationships between surface water and groundwater was added to Section 6.10.

17. Please indicate how the planning group considered relevant recommendations from the Drought Preparedness Council (a letter was provided to planning groups with relevant recommendations in November 2014) in the final, adopted regional water plan. *[31 TAC §357.42(h)]*

    Information addressing the recommendations from the Drought Preparedness Council and how they were considered was added to Section 7.1 on page 7-1.

18. The model drought contingency plan for irrigation districts provided online does not appear to include specific triggers and responses for 'severe' and 'critical/emergency' drought stages. Please include this information in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 7.7]*

    Specific triggers for severe and critical drought stages were added to the model drought contingency plan for irrigation districts.

19. Please clarify in the final, adopted regional water plan whether plan development was guided by the principal that the designated water quality and related water uses as shown in the state water quality management plan shall be improved or maintained. *[31 TAC §358.3(19)]*

    Discussion was added to Chapter 6, addressing how strategies maintained or improved the water quality of sources based on the state water quality management plan.

20. The technical evaluations of the water management strategies do not appear to estimate water losses from the associated strategies. Please include an estimate of water losses in the final, adopted regional water plan, for example as an estimated percent loss. *[31 TAC §357.34(d)(3)(A); Contract Exhibit 'C', Section 5.1.1]*

    A summary of the water loss audit data provided from TWDB was added to Section 5.3.3.1. Water loss estimates were assessed for each of the water management strategies on the basis of percent loss. This information is integrated in Chapter 5.

Level 2:	Comments and suggestions for consideration that may improve the readability and overall understanding of the regional water plan.

1. Page ES-16: For the county summaries included in the Executive Summary, it says "this subchapter discusses the water issues of each county…" However, county summaries are not included for Cottle and King Counties. Please consider including in the final, adopted regional water plan.

   The sentence was revised to say "This subchapter discusses the water issues of each county *with needs* …" Cottle and King Counties do not have needs in the Region B Plan.

2. Page 3-19: Please consider providing a complete description of the groundwater availability methodology employed for other aquifer groundwater sources tabulated in Table 3-5 in the plan.

   The methodology employed is based on reported data provided by the TWDB regarding historical use from these formations. This is stated in Section 3.2.2.

3. Page 6-13: The plan uses the term "managed available groundwater" in certain instances where "modeled available groundwater" should be used. For example, in the "Partial List of Acronyms". Please consider revising to "modeled available groundwater" in the final, adopted regional water plan.

   All references were changed to "modeled available groundwater".

4. Chapter 7: For surface water sources, please consider clarifying, if appropriate, that the recommendation is to retain triggers and stages currently in place in local Drought Contingency Plans. Additionally, please consider including a table organized by source manager and entities reliant on sources for drought response recommendations in the final, adopted regional water plan.

   Chapter 7 was modfied to indicate that, if appropriate, triggers and stages currently in place in Drought Contingency Plans would be retained. Table 7-7 essentially provides the infromation indicating the source manager and entities reliant on the source for drought response recommendations. The table was modified to more specifically address this issue.

5. Section 7.3, page 7-9: Please consider describing the groundwater triggers included in local drought contingency plans in more detail.

Section 7.3 was modified to more specifically address groundwater drought triggers. Table 7-3 was also modified to include more specific information on drought triggers.

6. Page 7-27: The plan includes a link to a model drought contingency plan developed for Region B however, the link is to the river authority's main webpage and it is unclear how to navigate to the model plan docoument. Please consider clarifying in the final, adopted regional water plan.

   Model Drought Contingency Plans are included at the following link under http://www.rra.texas.gov/; Publications; Region B Water Planning. This additional description has been added to page 7-27.

APPENDIX J

INFRASTRUCTURE FINANCING REPORT SURVEY RESULTS

2016 FINAL PLAN

REGION B

DECEMBER 2015

APPENDIX J
INFRASTRUCTURE FINANCING REPORT
CONTACT INFORMATION

Entity Name	Entity Planning Region	Respondent Contact Name	Area Code	Phone	Extension	Email	Comment	Entity RWP ID
STEAM ELECTRIC POWER, WILBARGER	B	MONTE MACMAHON	940	886-2725		mamcmahon@aep.com		2327
VERNON	B	DARELL KENNON	940	552-9961		dkennon@vernontx.gov		2408
WICHITA FALLS	B	RUSSELL SCHREIBER	940	761-7477		deana.farquharson@wichitafallstx.gov		151
WICHITA WCID #2	B	KYLE MILLER	940	767-6721		wcwid2@sbcglobal.net		2976

APPENDIX J
INFRASTRUCTURE FINANCING REPORT
SURVEY RESULTS

Project Name	WMS Project Sponsor Region	IFR Element Name	IFR Element Value	Year Of Need	IFR Project Data ID	Entity RWP ID	WMS Project ID	IFR Project Elements ID
ALTERNATIVE COOLING TECHNOLOGY - STEAM ELECTRIC POWER WILBARGER COUNTY	B	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$13,461,000.00	2020		2327	1179	1
ALTERNATIVE COOLING TECHNOLOGY - STEAM ELECTRIC POWER WILBARGER COUNTY	B	CONSTRUCTION FUNDING	$76,279,000.00	2020		2327	1179	2
ALTERNATIVE COOLING TECHNOLOGY - STEAM ELECTRIC POWER WILBARGER COUNTY	B	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	$0.00	2020		2327	1179	3
ADDITIONAL SERMOUR AQUIFER - VERNON	B	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$1,429,500.00	2020		2408	1177	1
ADDITIONAL SERMOUR AQUIFER - VERNON	B	CONSTRUCTION FUNDING	$6,910,500.00	2020		2408	1177	2
ADDITIONAL SERMOUR AQUIFER - VERNON	B	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	$0.00	2020		2408	1177	3
DIRECT REUSE - VERNON	B	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$1,245,500.00	2040		2408	1178	1
DIRECT REUSE - VERNON	B	CONSTRUCTION FUNDING	$7,254,500.00	2040		2408	1178	2
DIRECT REUSE - VERNON	B	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	$0.00	2040		2408	1178	3
WATER CONSERVATION (REPLACE TRANSMISSION PIPELINE) - VERNON	B	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$1,978,000.00	2020		2408	3861	1
WATER CONSERVATION (REPLACE TRANSMISSION PIPELINE) - VERNON	B	CONSTRUCTION FUNDING	$5,829,000.00	2020		2408	3861	2
WATER CONSERVATION (REPLACE TRANSMISSION PIPELINE) - VERNON	B	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	$0.00	2020		2408	3861	3
INDIRECT REUSE TO LAKE ARROWHEAD	B	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$4,800,000.00	2020		151	1173	1
INDIRECT REUSE TO LAKE ARROWHEAD	B	CONSTRUCTION FUNDING	$29,000,000.00	2020		151	1173	2
INDIRECT REUSE TO LAKE ARROWHEAD	B	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	$0.00	2020		151	1173	3
LAKE RINGGOLD	B	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$140,495,000.00	2035		151	1174	1
LAKE RINGGOLD	B	CONSTRUCTION FUNDING	$169,565,000.00	2035		151	1174	2
LAKE RINGGOLD	B	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	$0.00	2035		151	1174	3
LOCAL SEYMOUR AQUIFER	B	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$2,414,000.00	2020		151	1175	1
LOCAL SEYMOUR AQUIFER	B	CONSTRUCTION FUNDING	$17,260,000.00	2020		151	1175	2
LOCAL SEYMOUR AQUIFER	B	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	$0.00	2020		151	1175	3
WATER CONSERVATION (WATER LINE REPLACMENT) - WICHITA FALLS	B	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$8,459,000.00	2020		151	1172	1
WATER CONSERVATION (WATER LINE REPLACMENT) - WICHITA FALLS	B	CONSTRUCTION FUNDING	$28,197,000.00	2020		151	1172	2
WATER CONSERVATION (WATER LINE REPLACMENT) - WICHITA FALLS	B	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	$0.00	2020		151	1172	3
WICHITA RIVER DIVERSION	B	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$1,455,000.00	2020		151	1176	1
WICHITA RIVER DIVERSION	B	CONSTRUCTION FUNDING	$9,775,000.00	2020		151	1176	2
WICHITA RIVER DIVERSION	B	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	$0.00	2020		151	1176	3
WCWID NO. 2 CANAL CONVERSION TO PIPELINE	B	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$1,539,000.00	2020		2976	2187	1
WCWID NO. 2 CANAL CONVERSION TO PIPELINE	B	CONSTRUCTION FUNDING	$6,999,000.00	2020		2976	2187	2
WCWID NO. 2 CANAL CONVERSION TO PIPELINE	B	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	$0.00	2020		2976	2187	3

Section 7.3 was modified to more specifically address groundwater drought triggers. Table 7-3 was also modified to include more specific information on drought triggers.

6. Page 7-27: The plan includes a link to a model drought contingency plan developed for Region B however, the link is to the river authority's main webpage and it is unclear how to navigate to the model plan docoument. Please consider clarifying in the final, adopted regional water plan.

   Model Drought Contingency Plans are included at the following link under http://www.rra.texas.gov/; Publications; Region B Water Planning. This additional description has been added to page 7-27.